IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation Session End Snapshot Format & Version	Documentation Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots Draft Predicted Initial	WG Letter Ballots Date Predicted Recirc	WG Letter Ballots Result	Form Standards Association (SA) Ballot Pool / Reform	MEC / MDR Done	IEEE SA Ballots Draft Predicted Initial	IEEE SA Ballots Date Predicted Recirc	IEEE SA Ballots Result	Final 802.11 WG Approval	Final or Conditional 802 LMSC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	Sup Wit Sta E
					2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be	Predicted	C	C	C		C	C	C	C		C	C	Sep 2025	N/A	
IEEE Std P802.11bi	A	Enhanced Data Privacy	TGbi	PDF D1.10	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be 802.11bk 802.11bf	Actual	2021-02-10 [2025-12-31]	D1.0	2025-02-27	89%										
						Predicted	C	C	Jul 2025		Sep 2025	Jul 2025	Jan 2026	Mar 2026		May 2026	May 2026	Jul 2026	N/A	
IEEE Std P802.11me	A	802.11 Accumulated Maintenance Changes	TGme	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024	Actual	2021-02-10 [2025-12-31]	D1.0 D2.0 D3.0 D4.0	2022-01-10 2022-11-11 2023-05-07 2023-08-30	84% 87% 93% 96%	2023-05-01	2023-07-01	D4.0 D5.0 D6.0 D7.0	2023-10-10 2024-03-05 2024-07-02 2024-08-08	85% 84% 93% 98%	2024-07-01	2024-07-01			
						Predicted	C	C	C		C	C	C	C		C	C	Sep 2024	N/A	
IEEE Std P802.11bh	A	Randomized and Changing MAC Addresses	TGbh	PDF D6.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me	Actual	2021-02-10 [2025-12-31]	D1.0 D2.0 D3.0 D4.0	2023-07-01 2024-01-05 2024-02-24 2024-04-06	92% 94% 98% 99%	2024-02-01	2024-03-01	D4.0 D5.0 D6.0	2024-05-09 2024-07-13 2024-08-15	91% 92% 98%	2024-07-01	2024-07-01			
						Predicted	C	C	C		C	C	C	C		C	C	Sep 2024	N/A	
IEEE Std P802.11bf	A	WLAN Sensing	TGbf	PDF D8.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be 802.11bk	Actual	2020-09-25 [2026-12-31]	D1.0 D2.0 D3.0 D4.0	2023-03-02 2023-08-20 2024-01-04 2024-04-26	78% 86% 93% 96%	2024-04-01	2024-03-01	D4.0 D5.0 D6.0 D7.0 D8.0	2024-06-12 2024-10-23 2024-12-11 2025-01-16 2025-04-04	90% 96% 97% 98% 98%	2025-03-12	2025-03-14			
						Predicted	C	C	C		C	C	C	C		C	C	Jun 2025	N/A	
IEEE Std P802.11be	A	Extremely High Throughput	TGbe	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh	Actual	2019-03-21 [2025-12-31]	D2.0 D3.0 D4.0 D5.0	2022-07-04 2023-03-02 2023-08-13 2023-12-16	64% 80% 90% 95%	2023-10-01	2023-09-01	D5.0 D6.0 D7.0	2024-02-02 2024-05-31 2024-08-10	82% 93% 97%	2024-07-01	2024-07-01			
						Predicted	C	C	C		C	C	C	C		C	C	Sep 2024	N/A	

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IEEE Std P802.11-2020/Cor2-2024	COR	Correct 802.11bc identifer of EBCS ANQP element	WG Tech Ed	PDF D1.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023	Actual	2023-07-20 [2024-07-20]	D1.0	2023-10-25	100%	2023-10-01	2023-11-01	D1.0	2023-12-28	100%	2023-11-17	2024-01-09	2024-01-01		20
IEEE Std P802.11bc-2023	A	Enhanced Broadcast Service	TGbc	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023	Actual	2018-12-05 [2022-12-31]	D1.0 D2.0 D3.0 D4.0	2020-12-20 2021-10-28 2022-04-28 2022-08-25	83% 90% 92% 95%	2022-09-01	2022-07-01	D4.0 D5.0 D6.0 D7.0	2022-11-04 2023-01-13 2023-02-21 2023-03-13	92% 97% 100% 100%	2023-03-01	2023-03-01	2023-06-01		20
IEEE Std P802.11bb-2023	A	Light Communications	TGbb	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022	Actual	2018-03-09 [2022-12-31]	D1.0 D2.0 D3.0 D4.0	2022-01-12 2022-04-22 2022-08-31 2022-10-01	87% 94% 95% 99%	2022-03-01	2022-03-01	D4.1 D5.0 D6.0 D7.0	2022-11-07 2023-01-14 2023-02-21 2023-03-14	91% 92% 96% 100%	2023-03-01	2023-03-01	2023-06-01		20
IEEE Std P802.11bd-2022	A	Enhancements for Next Generation V2X	TGbd	PDF D8.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022	Actual	2018-12-05 [2022-12-31]	D1.0 D2.0 D3.0 D4.0	2020-11-18 2021-08-01 2021-12-16 2022-03-30	82% 88% 94% 99%	2021-12-02	2022-03-01	D4.0 D5.0 D6.0 D7.0 D8.0	2022-05-09 2022-07-05 2022-08-30 2022-09-30 2022-10-14	92% 93% 95% 97% 97%	2022-09-16	2022-10-04	2022-12-01		20
IEEE Std P802.11az-2022	A	Next Generation Positioning	TGaz	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022	Actual	2015-09-03 [2023-12-31]	D1.0 D2.0 D3.0 D4.0 D4.0	2019-03-09 2020-01-03 2021-02-10 2021-09-07 2021-10-01	79% 87% 88% 95% 98%	2021-08-01	2021-07-01	D4.0 D5.0 D6.0 D7.0	2021-11-05 2022-06-09 2022-09-07 2022-09-29	93% 94% 99% 100%	2022-09-16	2022-10-04	2022-12-01		20
IEEE Std P802.11-2020/Cor1-2022	COR	Correct 802.11ay Assignment of Protected Announce Support Bit	WG Tech Ed	PDF D2.10	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021	Actual	2022-02-23 [2026-12-31]	D1.0 D2.1	2022-04-14 2022-06-01	99% 100%	2022-05-01	2022-06-01	D2.1	2022-07-08	100%	2022-07-01	2022-07-01	2022-09-21		20
IEEE Std P802.11ba-2021	A	Wake Up Radio	TGba	PDF D8.00	802.11-2020 802.11ax-2021 802.11ay-2021	Actual	2016-12-07 [2020-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2018-10-24 2019-03-03 2019-06-18 2019-10-15 2019-12-17 2020-02-01	72% 82% 84% 90% 96% 99%	2019-08-01	2019-11-01	D6.0 D7.0 D8.0	2020-03-18 2020-10-01 2020-12-21	91% 95% 98%	2020-11-01	2020-11-01	2021-03-01		20
IEEE Std P802.11ay-2021	A	Next Generation 60GHz	TGay	PDF D7.00	802.11-2020 802.11ax-2021	Actual	2015-03-26 [2021-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0	2018-01-07 2018-08-31 2019-02-28 2019-07-08 2019-11-08	74% 93% 93% 98% 99%	2019-06-01	2019-07-16	D5.0 D6.0 D7.0	2020-01-09 2020-09-29 2020-12-20	89% 92% 98%	2020-11-01	2020-11-01	2021-03-01		20
IEEE Std P802.11ax-2021	A	High Efficiency WLAN	TGax	PDF D8.00	802.11-2020	Actual	2014-03-27 [2020-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2017-01-08 2017-11-04 2018-07-01 2019-02-25 2019-10-24 2019-12-11	58% 63% 87% 92% 94% 97%	2019-09-01	2019-05-01	D6.0 D7.0 D8.0	2020-01-24 2020-09-17 2020-11-27	82% 88% 95%	2020-09-01	2020-11-01	2021-02-01		20
IEEE Std P802.11-2020	STD	802.11 Accumulated Maintenance Changes	TGmd	PDF D5.00	802.11-2016	Actual	2017-03-23 [2021-12-31]	D1.0 D2.0 D3.0	2018-03-17 2019-01-10 2019-10-30	85% 93% 96%	2019-09-01	2019-05-01	D3.0 D4.0 D5.0 D7.0	2019-12-15 2020-09-04 2020-10-04 2024-08-08	83% 91% 97% 98%	2020-09-01	2020-10-01	2020-12-01		20

SUPERSEDED OR WITHDRAWN - Standards, Amendments, and Recommended Practices

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IEEE Std P802.11aq-2018	A	Pre-Association Discovery	TGaq	PDF D14.00	802.11-2016 802.11ai-2016 802.11-2020 802.11ah-2016 802.11aj-2018 802.11ak-2018	Actual	2012-12-05 [2018-12-31]	D1.0 D3.0 D4.0 D5.0 D6.0 D7.0	2015-03-04 2015-11-07 2016-04-21 2016-07-19 2016-08-19 2016-09-25	73% 93% 93% 93% 96% 97%	2016-08-01	2016-06-01	D7.0 D8.0 D9.0 D10.0 D12.0 D13.0 D14.0 D14.0	2016-11-04 2017-03-18 2017-06-23 2017-07-29 2017-10-01 2017-10-30 2018-01-04 2018-01-31	88% 91% 94% 98% 97% 97% 98% 99%	2018-03-07	2018-03-09	2018-06-14		2
IEEE Std P802.11ak-2018	A	General Link	TGak	PDF D6.00	802.11-2016 802.11ai-2016 802.11-2020 802.11ah-2016 802.11aj-2018	Actual	2012-12-05 [2018-12-31]	D1.0 D2.0 D3.0 D4.0	2015-05-06 2016-03-10 2017-01-10 2017-03-30	85% 91% 94% 95%	2016-11-01	2016-11-01	D4.0 D5.0 D6.0	2017-05-11 2017-11-09 2018-01-01	90% 93% 97%	2018-01-19	2018-01-31	2018-03-08		2
IEEE Std P802.11aj-2018	A	China Millimeter Wave	TGaj	PDF D9.00	802.11-2016 802.11ai-2016 802.11-2020 802.11ah-2016	Actual	2012-08-01 [2018-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0	2016-01-20 2016-06-30 2016-08-30 2016-12-21 2017-03-04	88% 89% 89% 92% 95%	2017-01-01	2016-11-01	D6.0 D7.0 D8.0 D9.0 D14.0	2017-06-25 2017-08-04 2017-08-24 2017-12-17 2018-01-04	98% 100% 100% 100% 98%	2017-11-10	2017-11-10	2018-01-24		2
IEEE Std P802.11-2016	STD	802.11 Accumulated Maintenance Changes	TGmc	PDF D8.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-	Actual	2012-08-30 [2016-12-31]	D1.0 D2.0 D3.0 D4.0 D4.0	2013-03-02 2013-10-23 2014-06-23 2015-02-17 2015-03-26	88% 90% 90% 94% 96%	2014-09-01	2014-07-01	D4.0 D5.0 D6.0 D7.0 D8.0	2015-04-26 2016-01-26 2016-06-30 2016-08-20 2016-09-08	88% 90% 93% 97% 99%	2016-09-01	2016-10-01	2016-12-07		2

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					2012 802.11ac-2013 802.11af-2013															
IEEE Std P802.11ah-2016	A	Sub 1 GHz	TGah	PDF D10.00	802.11-2016 802.11ai-2016 802.11-2020	Actual	2010-10-04 [2016-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2013-11-04 2014-07-05 2014-10-25 2015-02-14 2015-04-16 2015-10-03	73% 83% 90% 93% 93% 98%	2015-04-01	2016-02-01	D5.0 D6.0 D7.0 D8.0 D9.0 D10.0	2015-11-05 2016-03-02 2016-04-14 2016-05-17 2016-09-09 2016-09-30	91% 91% 92% 95% 95% 96%	2016-09-01	2016-10-01	2016-12-07		2
IEEE Std P802.11ai-2016	A	Fast Initial Link Setup	TGai	PDF D11.00	802.11-2016	Actual	2010-12-08 [2016-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2013-09-12 2014-05-07 2014-10-14 2015-02-24 2015-06-26 2015-07-31	74% 85% 88% 90% 92% 97%	2015-03-01	2014-11-01	D6.0 D7.0 D8.0 D9.0 D9.0 D11.0	2015-09-15 2016-03-30 2016-07-13 2016-08-06 2016-09-09 2016-09-30	90% 89% 93% 95% 97% 95%	2016-09-01	2016-10-01	2016-12-07		2
IEEE Std P802.11af-2013	A	TV White Spaces	TGaf	PDF D6.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012 802.11ac-2013	Actual	2009-12-09 [2013-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2011-02-24 2012-08-19 2013-02-08 2013-04-17 2013-06-14 2013-08-01	62% 79% 87% 92% 94% 99%	2013-06-01	2013-11-01	D5.0 D6.0 D6.0	2013-09-11 2013-10-19 2013-10-30	97% 99% 99%	2013-11-01	2013-11-01	2013-12-11		2
IEEE Std P802.11ac-2013	A	Very High Throughput 6GHz	TGac	PDF D7.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012	Actual	2008-09-26 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2011-06-25 2012-02-18 2012-06-25 2012-11-01 2013-02-01 2013-04-04	74% 89% 91% 94% 95% 96%	2013-01-01	2013-01-01	D5.0 D6.0 D7.0	2013-05-05 2013-08-03 2013-10-23	93% 97% 99%	2013-11-01	2013-11-01	2013-12-09		2
IEEE Std P802.11ad-2012	A	Very High Throughput 60GHz	TGad	PDF D9.00	802.11-2012 802.11ae-2012 802.11aa-2012	Actual	2008-12-10 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2010-10-24 2011-04-05 2011-06-01 2011-08-09 2011-10-06 2011-11-24	87% 88% 92% 95% 94% 95%	2011-09-01	2011-07-01	D5.0 D6.0 D7.0 D8.0 D9.0 D9.0	2012-01-05 2012-03-30 2012-05-11 2012-06-16 2012-07-28 2012-08-12	86% 90% 95% 97% 98% 98%	2012-07-01	2012-07-01	2012-10-23		2
IEEE Std P802.11aa-2012	A	Video Transport Streams	TGaa	Word / PDF D9.00	802.11-2012 802.11ae-2012	Actual	2008-03-27 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D6.0	2010-07-10 2010-12-08 2011-02-24 2011-04-09 2011-06-17 2011-08-09 2011-08-31	78% 79% 81% 85% 90% 94% 95%	2011-06-30	2011-06-16	D6.0 D7.0 D8.0 D9.0	2011-10-12 2011-11-26 2012-01-02 2012-01-27	93% 96% 99% 100%	2012-01-28	2012-02-17	2012-06-01		2
IEEE Std P802.11ae-2012	A	Prioritization of Management Frames	TGae	PDF D8.00	802.11-2012	Actual	2009-12-09 [2010-10-15]	D1.0 D2.0 D3.0 D4.0 D5.0	2010-10-27 2011-02-18 2011-04-26 2011-06-18 2011-08-04	81% 86% 89% 96% 96%	2011-07-01	2011-05-01	D5.0 D6.0 D7.0 D8.0	2011-09-09 2011-10-29 2011-12-13 2012-01-04	95% 96% 100% 100%	2012-01-20	2012-02-17	2012-03-01		2
IEEE Std P802.11-2012	STD	802.11 Accumulated Maintenance Changes	TGmb	Frame / PDF D9.01	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011 802.11u-2011 802.11s-2011	Actual	2007-03-22 [2011-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0	2009-06-27 2010-01-08 2010-04-25 2010-06-25 2010-08-19	87% 89% 89% 89% 92%	2010-09-14	2010-09-01	D6.0 D7.0 D8.0 D9.0 D10.0 D11.0 D12.0	2010-11-05 2011-02-18 2011-04-14 2011-06-22 2011-09-07 2011-10-22 2011-11-13	87% 90% 92% 93% 92% 94% 97%	2011-11-11	2011-11-11	2012-03-01		2
IEEE Std P802.11s-2011	A	Mesh Networking	TGs	PDF	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011 802.11u-2011	Actual	2004-05-13 [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0	2007-01-06 2008-05-03 2009-05-04 2010-01-08 2010-04-15 2010-06-28 2010-08-13	48% 61% 79% 85% 89% 89% 95%	2010-09-12	2010-09-29	D7.0 D8.0 D9.0 D10.0 D11.0	2010-11-01 2011-01-10 2011-03-05 2011-04-06 2011-05-07	95% 96% 95% 97% 97%	2011-07-01	2011-07-01	2011-08-01		2
IEEE Std P802.11u-2011	A	InterWorking with External Networks	TGu	Frame / PDF D13.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011	Actual	2004-12-08 (02/05/2008) [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D8.0	2007-07-08 2008-03-15 2008-07-12 2008-10-08 2009-02-20 2009-04-24 2009-06-19 2009-08-18	64% 70% 77% 78% 82% 90% 88% 93%	2009-06-01	2009-07-12	D8.0 D9.0 D10.0 D11.0 D12.0 D13.0	2009-11-07 2010-04-23 2010-07-08 2010-08-13 2010-09-12 2010-11-21	90% 92% 94% 96% 98% 99%	2010-11-01	2010-11-01	2011-02-25		2
IEEE Std P802.11v-2011	A	Wireless Network Management	TGv	Frame / PDF D16.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010	Actual	2004-12-08 [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0	2007-08-30 2008-03-15 2008-07-13 2008-12-19 2009-04-04 2009-06-12 2009-08-07	63% 67% 69% 81% 83% 90% 92%	2009-06-01	2009-07-12	D7.0 D9.0 D10.0 D11.0 D12.0 D13.0 D14.0 D15.0 D15.0 D16.0	2009-11-07 2010-02-17 2010-04-13 2010-06-10 2010-07-07 2010-07-28 2010-08-25 2010-10-18 2010-09-30 2010-11-15	81% 84% 87% 92% 94% 98% 98% 98% 98% 98%	2010-11-01	2010-11-01	2011-02-09		2
IEEE Std P802.11z-2010	A	Extensions to Direct Link Setup	TGz	Word / PDF D13.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010	Actual	2007-08-22	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2008-05-03 2008-08-20 2008-12-18 2009-03-05 2009-06-23 2009-08-26	64% 66% 84% 88% 92% 96%	2009-06-01	2009-06-18	D6.0 D7.0 D8.0 D9.0 D11.0 D13.0	2009-11-07 2010-02-27 2010-05-04 2010-06-10 2010-08-04 2010-08-29	87% 87% 94% 95% 95% 98%	C	C	2010-10-01		2
IEEE Std P802.11p-2010	A	Wireless Access for the Vehicular Environment	TGp	N/A	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009	Actual	2004-09-23	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D8.0 D9.0	2006-04-11 2007-01-05 2007-09-12 2008-05-03 2008-12-05 2009-03-31 2009-06-13 2009-08-05 2009-10-10	59% 67% 74% 79% 85% 89% 85% 89% 93%	2009-06-01	2008-06-19	D9.0 D10.0 D11.0	2009-11-22 2010-02-16 2010-04-07	93% 96% 99%	C	C	2010-07-15		2
IEEE Std P802.11w-2009	A	Protected Management Frames	TGw	N/A	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008	Actual	2005-03-20	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2006-11-19 2007-05-02 2007-10-19 2008-01-05 2008-02-20 2008-04-18	86% 89% 92% 92% 95% 97%	2007-11-13		D6.0 D7.0 D9.0 D10.0 D11.0	2008-09-24 2009-01-18 2009-05-23 2009-06-14 2009-06-28	86% 88% 92% 93% 95%	C	C	2009-09-11		2
IEEE Std P802.11n-2009	A	High Throughput	TGn		802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009	Actual	2003-09-11 [2007-09-27]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D7.0	2006-04-29 2007-03-09 2007-10-27 2008-04-12 2008-06-12 2008-08-05 2008-09-30 2008-12-02	47% 83% 85% 88% 90% 91% 94% 95%	2008-12-11	2008-12-11	D7.0 D8.0 D9.0 D10.0 D11.0 D11.0	2009-01-10 2009-03-06 2009-04-04 2009-05-30 2009-07-03 2009-06-20	78% 80% 81% 88% 91% 90%	C	C	2009-09-11		2
IEEE Std P802.11y-2008	A	3650-3700 MHz Operation in USA	TGy	N/A	802.11-2007 802.11k-2008 802.11r-2008	Actual	2006-03-16	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2007-01-07 2007-05-05 2007-06-20 2007-08-21 2007-10-13 2007-12-08	76% 84% 91% 94% 96% 99%	2007-06-20	2007-07-28	D7.0 D8.0 D9.0 D10.0 D11.0	2008-01-30 2008-03-08 2008-03-27 2008-03-18 2008-06-20	93% 93% 96% 97% 97%	C	C	2008-11-06		2
IEEE Std P802.11r-2008	A	Fast Roaming	TGr	N/A	802.11-2007 802.11k-2008	Actual	2006-05-25	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2006-01-04 2006-04-04 2006-10-14 2006-12-04 2007-04-04 2007-06-13	81% 88% 86% 92% 95% 97%		2007-04-11	D7.0 D8.0 D9.0 D9.0	2007-08-30 2007-10-07 2008-02-01 2008-01-17	86% 90% 97% 96%	C	C	2008-05-09		2
IEEE Std P802.11k-	A	Radio Resource	TGk	N/A	802.11-2007	Actual	2002-12-11		2007-09-11 2008-01-05	90% 100%		2007-04-10	D8.0 D9.0	2007-08-13 2007-10-04	90% 89%	C	C	2008-05-09		2

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result Recirc	Form SA Ballot Pool / Reform	MEC / MDR Done	IEEE SA Ballots: Draft Predicted Initial	IEEE SA Ballots: Date Predicted Recirc	IEEE SA Ballots: Result Recirc	Final 802.11 WG Approval	Final or Conditional 802 LMSC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	S W S
2008		Measurement						D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D7.0	2004-09-11 2005-03-15 2005-11-12 2006-03-31 2006-09-16 2006-11-16 2007-02-13 2007-05-05	95% 86% 80% 81% 85% 91% 92% 93%			D10.0 D11.0 D12.0 D12.0 D13.0	2007-12-08 2008-01-17 2008-02-14 2008-02-01 2008-03-18	91% 95% 95% 95% 97%					
IEEE Std P802.11-2007	STD	802.11 Standard Maintenance Revision	TGma	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004 802.11j-2004 802.11e-2005	Actual	2003-03-20 [2003-03-20]	D1.0 D2.0 D3.0 D4.0	2005-05-08 2005-07-17 2005-08-19 2005-09-19	91% 94% 95% 96%	2005-08-21	2005-08-21	D5.0 D6.0 D7.0 D8.0 D9.0	2005-11-20 2006-05-10 2006-07-11 2006-09-09 2006-11-07	86% 90% 91% 96% 96%	2006-11-08	2006-11-08	2007-03-08		2
IEEE Std P802.11.2	RP	Wireless Performance	TGt			Actual	2008-12-31	D1.0	2007-05-16	76%										2
IEEE Std P802.11e-2005	A	MAC Enhancements QoS	TGe	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004 802.11j-2004	Actual	2000-03-30	D4.0 D5.0 D6.0 D7.0 D8.0	2001-05-15 2002-01-16 2002-07-02 2003-01-08 2003-08-22 2003-12-20 2004-02-15 2004-03-10	0% 55% 49% 83% 97% 89% 93% 94%			D8.0 D9.0 D10.0 D11.0 D12.0 D13.0 D13.0	2004-05-30 2004-08-31 2004-10-08 2004-11-11 2004-12-23 2005-04-16 2005-02-18	85% 87% 92% 95% 96% 99% 96%	2005-07-22	2005-07-22	2005-09-22		2
IEEE Std P802.11j-2004	A	4.9 GHz-5 GHz Operation in Japan	TGj	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004	Actual	2002-12-11	D1.0 D1.2 D1.3 D1.4	2003-05-12 2004-01-14 2004-03-11 2004-04-20	68% 89% 94% 95%	2004-05-13		D1.5 D1.6	2004-07-02 2004-08-14	88% 96%	C	C	2004-09-23	2005-02-02	2
IEEE Std P802.11i-2004	A	MAC Security Enhancements	TGi	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003	Actual	2001-05-30	D3.0 D4.0 D5.0 D6.0 D7.0	2002-05-04 2003-01-12 2003-06-06 2003-08-19 2003-10-09 2003-11-04	77% 76% 78% 87% 92% 95%	2003-08-10		D7.0 D8.0 D9.0 D10.0	2003-12-20 2004-03-12 2004-04-10 2004-05-08	89% 92% 98% 98%	C	C	2004-06-24	2005-02-14	2
IEEE Std P802.11h-2003	A	Spectrum and Transmit Power Management Extensions in the 5 GHz Band in Europe	TGh	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003	Actual	2000-12-07	D2.2	2001-09-03 2002-05-05 2002-09-01 2002-11-01	0% 76% 90% 97%	2002-07-25		D3.0 D3.11 D3.6	2003-02-06 2003-06-26 2003-04-30	92% 98% 96%	C	C	2003-09-11	2003-12-29	2
IEEE Std P802.11g-2003	A	Further Higher Data Rate Extension in the 2.4 GHz Band	TGg	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001	Actual	2000-09-21	D5.0 D4.0 D6.1	2002-03-11 2002-09-01 2003-01-08 2002-11-01 2003-02-04	45% 83% 88% 87% 89%	2002-07-25		D6.2 D7.1 D8.2	2003-03-09 2003-04-08 2003-05-14	84% 85% 96%	C	C	2003-06-12	2003-10-20	2
IEEE Std P802.11b Cor1-2001	COR	Corrigenda to IEEE 802.11b-1999	TGb-Cor1		802.11-1999 802.11c 802.11a-1999	Actual	1999-11-27						D1.5	2001-04-13	98%	C	C	2001-10-10	2002-01-30	2
IEEE Std P802.11d-2001	A	Operation in Additional Regulatory Domains	TGd	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001	Actual	1999-06-26		2000-04-04 2000-06-26	0% 0%	2001-11-29		D2.0 D3.0	2001-03-01 2001-04-13	93% 100%	C	C	2001-06-14	2001-10-25	2
IEEE Std P802.11b-1999	A	Higher Speed PHY Extension in the 2.4 GHz Band	TGb	N/A	802.11-1999 802.11c 802.11a-1999	Actual	1997-12-09		1998-11-09	0%						C	C	1999-09-16		2
IEEE Std P802.11a-1999	A	Higher Speed PHY Extension in the 5GHz Band	TGa	N/A	802.11-1999	Actual	1997-09-16									C	C	1999-09-16	2000-02-04	2
IEEE Std P802.11f-2003	RP	Inter-Access Point Protocol Across Distribution Systems Supporting IEEE 802.11 Operation	TGf	N/A		Actual	2000-03-30		2001-05-15 2001-09-03 2002-03-10 2002-06-16	0% 0% 82% 96%	2002-07-27		D4.0 D4.1 D5.0 D6.0	2002-10-28 2002-12-19 2003-02-17 2003-04-08	88% 95% 97% 98%	C	C	2003-06-12		2
IEEE Std P802.11-1999	STD	Part II Wireless LAN Medium Access Control MAC and Physical Layer PHY Specifications	MAC/PHY	N/A		Actual	1997-12-09							2003-01-07 2003-04-09 2003-02-02	99% 99% 99%	C	C	1999-03-18	1999-07-15	2
IEEE Std P802.11-1997	STD	IEEE Standard for Wireless LAN Medium Access Control MAC and Physical Layer PHY Specifications	MAC/PHY	N/A		Actual	1991-03-21									C	C	1997-06-26		1
IEEE Std P802.11c	A	Media Access Control MAC Bridges - Supplement for Support by IEEE 802.11 [Rolled into IEEE 802.1D]	TGc	N/A	802.11-1999	Actual	1997-12-09													

Timeline Chart Notes:

C = Stage Completed or Currently In-Process
A / COR = Amendment / Corrigendum
Predicted = Current Date Estimate
Date = Actual or Start Date
LB = Letter Ballot
N/A = Not Applicable
RP = Recommended Practice
SB = SA Ballot
STD = Standard and/or Revision
TG = Task Group
MEC = IEEE-SA Mandatory Editorial Coordination
Final 802.11 WG = Approval by 802.11 WG - Current WG Calendar
Final or Conditional 802 LMSC = Approval by 802 LMSC at Plenary Session - Current 802 LMSC Plenary Calendar
RevCom/Standards Board = Approval of RevCom / IEEE-SA Standards Board in Normal Session - Current IEEE-SA Calendar
ANSI = American National Standards Institute
MDR = 802.11 WG Mandatory Draft Review

This page is maintained by Stephen McCann . Comments are welcome.

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APPENDIX S

The Wayback Machine - https://web.archive.org/web/20140702154806/http://www.ieee802.org/11/Reports/802.11_Timelines.htm

OFFICIAL IEEE 802.11 WORKING GROUP PROJECT TIMELINES - 2014-06-02

IN PROCESS - Standards, Amendments, and Recommended Practices

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result	WG Letter Ballots: Form Sponsor Ballot Pool / Reform	WG Letter Ballots: MEC / MDR Done	IEEE-SA Sponsor Ballots: Draft Predicted Initial	IEEE-SA Sponsor Ballots: Date Predicted Recirc	IEEE-SA Sponsor Ballots: Result	Final 802.11 WG Approval	Final or Conditional 802 EC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved
IEEE Std P802.11ax	A	High Efficiency WLAN	TGax	None	802.11REVmc 802.11ai 802.11ah 802.11ak 802.11aq 802.11aj	Actual	2014-03-25												
						Predicted	C	Jul 2016			Jan 2018	Jan 2018	May 2018			Jan 2019	Mar 2019	Mar 2019	N/A
IEEE Std P802.11ak	A	General Link	TGak	None	802.11REVmc 802.11ai 802.11ah	Actual	2012-12-05 [2016-12-31]												
						Predicted	C	Jul 2014	Nov 2014		May 2015	Sep 2015	Nov 2015	Jan 2016		May 2016	May 2016	May 2016	N/A
IEEE Std P802.11aq	A	Pre-association Discovery	TGaq	None	802.11REVmc 802.11ai 802.11ah 802.11ak	Actual	2012-12-05 [2016-12-31]												
						Predicted	C	Nov 2014	Mar 2015		Jul 2015	Jul 2015	Nov 2015	Mar 2016		Jul 2016	Jul 2016	Jul 2016	N/A
IEEE Std P802.11aj	A	China Millimeter Wave	TGaj	PDF D0.01	802.11REVmc 802.11ai 802.11ah 802.11ak 802.11aq	Actual	2012-08-01												
						Predicted	C	Mar 2015	Jul 2015		Jul 2015	Sep 2015	Sep 2015	Jan 2016		May 2016	May 2016	Jun 2016	N/A
IEEE Std P802.11REVmc	STD	Maintenance	TGmc	PDF D2.70	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012 802.11ac-2013 802.11af-2013	Actual	2012-07-20	D1.0 D2.0	2013-03-02 2013-10-23	88% 90%									
						Predicted	C	C	C		Aug 2014	Jul 2014	Nov 2014	Mar 2015		Jul 2015	Jul 2015	Dec 2015	Dec 2015
IEEE Std P802.11ai	A	Fast Initial Link Setup	TGai	PDF D1.30	802.11REVmc	Actual	2010-12-08 [2014-12-31]	D1.0 D2.0	2013-09-12 2014-05-07	74% 85%									
						Predicted	C	C	Sep 2014		Mar 2015	Nov 2014	Jul 2015	Sep 2015		Nov 2015	Nov 2015	Mar 2016	N/A
IEEE Std P802.11ah	A	Sub 1 GHz	TGah	PDF D1.20	802.11REVmc 802.11ai	Actual	2010-10-04 [2013-12-31]	D1.0	2013-11-04	73%									
						Predicted	C	C	Sep 2014		Nov 2014	Nov 2014	Feb 2015	Nov 2015		Jan 2016	Jan 2016	Mar 2016	N/A

PUBLISHED - Standards, Amendments, and Recommended Practices

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IEEE Std P802.11af-2013	A	TV White Spaces	TGaf	PDF D6.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012 802.11ac-2013	Actual	2009-12-09 [2013-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2011-02-24 2012-08-19 2013-02-08 2013-04-17 2013-06-14 2013-08-01	62% 79% 87% 92% 94% 99%	2013-06-01	2013-11-01	D5.0 D6.0 D6.0	2013-09-11 2013-10-19 2013-10-30	97% 99% 99%	2013-11-01	2013-11-01	2013-12-11	2013-12-11
IEEE Std P802.11ac-2013	A	Very High Throughput 6GHz	TGac	PDF D7.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012	Actual	2008-09-26 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2011-06-25 2012-02-18 2012-06-25 2012-11-01 2013-02-01 2013-04-04	74% 89% 91% 94% 95% 96%	2013-01-01	2013-01-01	D5.0 D6.0 D7.0	2013-05-05 2013-08-03 2013-10-23	93% 97% 99%	2013-11-01	2013-11-01	2013-12-09	2013-12-11
IEEE Std P802.11ad-2012	A	Very High Throughput 60GHz	TGad	PDF D9.00	802.11-2012 802.11ae-2012 802.11aa-2012	Actual	2008-12-10 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2010-10-24 2011-04-05 2011-06-01 2011-08-09 2011-10-06 2011-11-24	87% 88% 92% 95% 94% 95%	2011-09-01	2011-07-01	D5.0 D6.0 D7.0 D8.0 D9.0 D9.0	2012-01-05 2012-03-30 2012-05-11 2012-06-16 2012-07-28 2012-08-12	86% 90% 95% 97% 98% 98%	2012-07-01	2012-07-01	2012-10-23	2012-12-28
IEEE Std P802.11aa-2012	A	Video Transport Streams	TGaa	Word / PDF D9.00	802.11-2012 802.11ae-2012	Actual	2008-03-27 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D6.0	2010-07-10 2010-12-08 2011-02-24 2011-04-09 2011-06-17 2011-08-09 2011-08-31	78% 79% 81% 85% 90% 94% 95%	2011-06-30	2011-06-16	D6.0 D7.0 D8.0 D9.0	2011-10-12 2011-11-26 2012-01-02 2012-01-27	93% 96% 99% 100%	2012-01-28	2012-02-17	2012-06-01	2012-05-29
IEEE Std P802.11ae-2012	A	Prioritization of Management Frames	TGae	PDF D8.00	802.11-2012	Actual	2009-12-09 [2010-10-15]	D1.0 D2.0 D3.0 D4.0 D5.0	2010-10-27 2011-02-18 2011-04-26 2011-06-18 2011-08-04	81% 86% 89% 96% 96%	2011-07-01	2011-05-01	D5.0 D6.0 D7.0 D8.0	2011-09-09 2011-10-29 2011-12-13 2012-01-04	95% 96% 100% 100%	2012-01-20	2012-02-17	2012-03-01	2012-03-31
IEEE Std P802.11-2012	STD	802.11 Accumulated Maintenance Changes	TGmb	Frame / PDF D9.01	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011 802.11u-2011 802.11s-2011	Actual	2007-03-22 [2011-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0	2009-06-27 2010-01-08 2010-04-25 2010-06-25 2010-08-19	87% 89% 89% 89% 92%	2010-09-14	2010-09-01	D6.0 D7.0 D8.0 D9.0 D10.0 D11.0 D12.0	2010-11-05 2011-02-18 2011-04-14 2011-06-22 2011-09-07 2011-10-22 2011-11-13	87% 90% 92% 93% 92% 94% 97%	2011-11-11	2011-11-11	2012-03-01	2012-05-13

SUPERSEDED OR WITHDRAWN - Standards, Amendments, and Recommended Practices

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IEEE Std P802.11s-2011	A	Mesh Networking	TGs	PDF	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008	Actual	2004-05-13 [2010-12-31]	D1.0 D2.0 D3.0 D4.0	2007-01-06 2008-05-03 2009-05-04 2010-01-08	48% 61% 79% 85%	2010-09-12	2010-09-29	D7.0 D8.0 D9.0	2010-11-01 2011-01-10 2011-03-05	95% 96% 95%	2011-07-01	2011-07-01	2011-08-01	

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot: Format & Version	Documentation: Session End Snapshot: Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft: Predicted Initial	WG Letter Ballots: Date: Predicted Recirc	WG Letter Ballots: Result	Form Sponsor Ballot Pool / Reform	MEC / MDR Done	IEEE-SA Sponsor Ballots: Draft: Predicted Initial	IEEE-SA Sponsor Ballots: Date: Predicted Recirc	IEEE-SA Sponsor Ballots: Result	Final 802.11 WG Approval	Final or Conditional 802 EC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	S
					802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011 802.11u-2011			D5.0 D6.0 D7.0	2010-04-15 2010-06-28 2010-08-13	89% 89% 95%			D10.0 D11.0	2011-04-09 2011-05-07	97% 97%					
IEEE Std P802.11u-2011	A	InterWorking with External Networks	TGu	Frame / PDF D13.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011	Actual	2004-12-08 (02/05/2008) [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D8.0	2007-07-08 2008-03-15 2008-07-12 2008-10-08 2009-02-20 2009-04-24 2009-06-19 2009-08-18	64% 70% 77% 78% 82% 90% 88% 93%	2009-06-01	2009-07-12	D8.0 D9.0 D10.0 D11.0 D12.0 D13.0	2009-11-07 2010-04-23 2010-07-08 2010-08-13 2010-09-12 2010-11-21	90% 92% 94% 96% 98% 99%	2010-11-01	2010-11-01	2011-02-25		2
IEEE Std P802.11v-2011	A	Wireless Network Management	TGv	Frame / PDF D16.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010	Actual	2004-12-08 [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0	2007-08-30 2008-03-15 2008-07-13 2008-12-19 2009-04-04 2009-06-12 2009-08-07	63% 67% 69% 81% 83% 90% 92%	2009-06-01	2009-07-12	D7.0 D9.0 D10.0 D11.0 D12.0 D13.0 D14.0 D15.0 D15.0 D16.0	2009-11-07 2010-02-17 2010-04-13 2010-06-10 2010-07-07 2010-07-28 2010-08-25 2010-10-18 2010-09-30 2010-11-15	81% 84% 87% 92% 94% 98% 98% 98% 98% 98%	2010-11-01	2010-11-01	2011-02-09		2
IEEE Std P802.11z-2010	A	Extensions to Direct Link Setup	TGz	Word / PDF D13.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010	Actual	2007-08-22	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2008-05-03 2008-08-20 2008-12-18 2009-03-05 2009-06-23 2009-08-26	64% 66% 84% 88% 92% 96%	2009-06-01	2009-06-18	D6.0 D7.0 D8.0 D9.0 D11.0 D13.0	2009-11-07 2010-02-27 2010-05-04 2010-06-10 2010-08-04 2010-08-29	87% 87% 94% 95% 95% 98%	C	C	2010-10-01		2
IEEE Std P802.11p-2010	A	Wireless Access for the Vehicular Environment	TGp	N/A	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009	Actual	2004-09-23	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D8.0 D9.0	2006-04-11 2007-01-05 2007-09-12 2008-05-03 2008-12-05 2009-03-31 2009-06-13 2009-08-05 2009-10-10	59% 67% 74% 79% 85% 89% 85% 89% 93%	2009-06-01	2008-06-19	D9.0 D10.0 D11.0	2009-11-22 2010-02-16 2010-04-07	93% 96% 99%	C	C	2010-07-15		2
IEEE Std P802.11w-2009	A	Protected Management Frames	TGw	N/A	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008	Actual	2005-03-20	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2006-11-19 2007-05-02 2007-10-19 2008-01-05 2008-02-20 2008-04-18	86% 89% 92% 92% 95% 97%	2007-11-13		D6.0 D7.0 D9.0 D10.0 D11.0	2008-09-24 2009-01-18 2009-05-23 2009-06-14 2009-06-28	86% 88% 92% 93% 95%	C	C	2009-09-11		2
IEEE Std P802.11n-2009	A	High Throughput	TGn		802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009	Actual	2003-09-11 [2007-09-27]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D7.0	2006-04-29 2007-03-09 2007-10-27 2008-04-12 2008-06-12 2008-08-05 2008-09-30 2008-12-02	47% 83% 85% 88% 90% 91% 94% 95%	2008-12-11	2008-12-11	D7.0 D8.0 D9.0 D10.0 D11.0 D11.0	2009-01-10 2009-03-06 2009-04-04 2009-05-30 2009-07-03 2009-06-20	78% 80% 81% 88% 91% 90%	C	C	2009-09-11		2
IEEE Std P802.11y-2008	A	3650-3700 MHz Operation in USA	TGy	N/A	802.11-2007 802.11k-2008 802.11r-2008	Actual	2008-12-31	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2007-01-07 2007-05-05 2007-06-20 2007-08-21 2007-10-13 2007-12-08	76% 84% 91% 94% 96% 99%	2007-06-20	2007-07-28	D7.0 D8.0 D9.0 D10.0 D11.0	2008-01-30 2008-03-08 2008-03-27 2008-03-18 2008-06-20	93% 93% 96% 97% 97%	C	C	2008-11-06		2
IEEE Std P802.11r-2008	A	Fast Roaming	TGr	N/A	802.11-2007 802.11k-2008	Actual	2008-12-31	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2006-01-04 2006-04-04 2006-10-14 2006-12-04 2007-04-04 2007-06-13	81% 88% 86% 92% 95% 97%		2007-04-11	D7.0 D8.0 D9.0 D9.0	2007-08-30 2007-10-07 2008-02-01 2008-01-17	86% 90% 97% 96%	C	C	2008-05-09		2
IEEE Std P802.11k-2008	A	Radio Resource Measurement	TGk	N/A	802.11-2007	Actual	2002-12-11	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D7.0	2007-09-11 2008-01-05 2004-09-11 2005-03-15 2005-11-12 2006-03-31 2006-09-16 2006-11-16 2007-02-13 2007-05-05	90% 100% 95% 86% 80% 81% 85% 91% 92% 93%		2007-04-10	D8.0 D9.0 D10.0 D11.0 D12.0 D12.0 D13.0	2007-08-13 2007-10-04 2007-12-08 2008-01-17 2008-02-14 2008-02-01 2008-03-18	90% 89% 91% 95% 95% 95% 97%	C	C	2008-05-09		2
IEEE Std P802.11-2007	STD	802.11 Standard Maintenance Revision	TGma	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004 802.11j-2004 802.11e-2005	Actual	2003-03-20 [2003-03-20]	D1.0 D2.0 D3.0 D4.0	2005-05-08 2005-07-17 2005-08-19 2005-09-19	91% 94% 95% 96%	2005-08-21	2005-08-21	D5.0 D6.0 D7.0 D8.0 D9.0	2005-11-20 2006-05-10 2006-07-11 2006-09-09 2006-11-07	86% 90% 91% 96% 96%	2006-11-08	2006-11-08	2007-03-08		2
IEEE Std P802.11.2	RP	Wireless Performance	TGt			Actual	2008-12-31	D1.0	2007-05-16	76%										2
IEEE Std P802.11e-2005	A	MAC Enhancements QoS	TGe	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004 802.11j-2004	Actual	2000-03-30	D4.0 D5.0 D6.0 D7.0 D8.0	2001-05-15 2002-01-16 2002-07-02 2003-01-08 2003-08-22 2003-12-20 2004-02-15 2004-03-10	0% 55% 49% 83% 97% 89% 93% 94%			D8.0 D9.0 D10.0 D11.0 D12.0 D13.0 D13.0	2004-05-30 2004-08-31 2004-10-08 2004-11-11 2004-12-23 2005-04-16 2005-02-18	85% 87% 92% 95% 96% 99% 96%	2005-07-22	2005-07-22	2005-09-22		2
IEEE Std P802.11j-2004	A	4.9 GHz-5 GHz Operation in Japan	TGj	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004	Actual	2002-12-11	D1.0 D1.2 D1.3 D1.4	2003-05-12 2004-01-14 2004-03-11 2004-04-20	68% 89% 94% 95%	2004-05-13		D1.5 D1.6	2004-07-02 2004-08-14	88% 96%	C	C	2004-09-23	2005-02-02	2
IEEE Std P802.11i-2004	A	MAC Security Enhancements	TGi	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003	Actual	2001-05-30	D3.0 D4.0 D5.0 D6.0 D7.0	2002-05-04 2003-01-12 2003-06-06 2003-08-19 2003-10-09 2003-11-04	77% 76% 78% 87% 92% 95%	2003-08-10		D7.0 D8.0 D9.0 D10.0	2003-12-20 2004-03-12 2004-04-10 2004-05-08	89% 92% 98% 98%	C	C	2004-06-24	2005-02-14	2
IEEE Std P802.11h-2003	A	Spectrum and Transmit Power Management Extensions in the 5 GHz Band in Europe	TGh	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003	Actual	2000-12-07	D2.2	2001-09-03 2002-05-05 2002-09-01 2002-11-01	0% 76% 90% 97%	2002-07-25		D3.0 D3.11 D3.6	2003-02-06 2003-06-26 2003-04-30	92% 98% 96%	C	C	2003-09-11	2003-12-29	2
IEEE Std P802.11g-2003	A	Further Higher Data Rate Extension in	TGg	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999	Actual	2000-09-21	D5.0	2002-03-11 2002-09-01 2003-01-08	45% 83% 88%	2002-07-25		D6.2 D7.1 D8.2	2003-03-09 2003-04-08 2003-05-14	84% 85% 96%	C	C	2003-06-12	2003-10-20	2

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft / Predicted Initial	WG Letter Ballots: Date / Predicted Initial	WG Letter Ballots: Result / Predicted Recirc	Form Sponsor Ballot Pool / Reform	MEC / MDR Done	IEEE-SA Sponsor Ballots: Draft / Predicted Initial	IEEE-SA Sponsor Ballots: Date / Predicted Recirc	IEEE-SA Sponsor Ballots: Result / Predicted Recirc	Final 802.11 WG Approval	Final or Conditional 802 EC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	Su W S
		the 2.4 GHz Band			802.11b Cor1-2001 802.11d-2001			D4.0 D6.1	2002-11-01 2003-02-04	87% 89%										
IEEE Std P802.11b Cor1-2001	COR	Corrigenda to IEEE 802.11b-1999	TGb-Cor1		802.11-1999 802.11c 802.11a-1999	Actual	1999-11-27						D1.5	2001-04-13	98%	C	C	2001-10-10	2002-01-30	2
IEEE Std P802.11d-2001	A	Operation in Additional Regulatory Domains	TGd	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001	Actual	1999-06-26		2000-04-04 2000-06-26	0% 0%	2001-11-29		D2.0 D3.0	2001-03-01 2001-04-13	93% 100%	C	C	2001-06-14	2001-10-25	2
IEEE Std P802.11b-1999	A	Higher Speed PHY Extension in the 2.4 GHz Band	TGb	N/A	802.11-1999 802.11c 802.11a-1999	Actual	1997-12-09		1998-11-09	0%						C	C	1999-09-16		2
IEEE Std P802.11a-1999	A	Higher Speed PHY Extension in the 5GHz Band	TGa	N/A	802.11-1999	Actual	1997-09-16									C	C	1999-09-16	2000-02-04	2
IEEE Std P802.11f-2003	RP	Inter-Access Point Protocol Across Distribution Systems Supporting IEEE 802.11 Operation	TGf	N/A		Actual	2000-03-30		2001-05-15 2001-09-03 2002-03-10 2002-06-16	0% 0% 82% 96%	2002-07-27		D4.0 D4.1 D5.0 D6.0	2002-10-28 2002-12-19 2003-02-17 2003-04-08	88% 95% 97% 98%	C	C	2003-06-12		2
IEEE Std P802.11-1999	STD	Part II Wireless LAN Medium Access Control MAC and Physical Layer PHY Specifications	MAC/PHY	N/A		Actual	1997-12-09							2003-01-07 2003-04-09 2003-02-02	99% 99% 99%	C	C	1999-03-18	1999-07-15	2
IEEE Std P802.11c	A	Media Access Control MAC Bridges - Supplement for Support by IEEE 802.11	TGc	N/A	802.11-1999	Actual	1997-12-09													2
IEEE Std P802.11-1997	STD	IEEE Standard for Wireless LAN Medium Access Control MAC and Physical Layer PHY Specifications	MAC/PHY	N/A		Actual	1991-03-21									C	C	1997-06-26		1

Timeline Chart Notes:

C = Stage Completed or Currently In-Process
A / COR = Amendment / Corrigendum
Predicted = Current Date Estimate
Date = Actual or Start Date
LB = Letter Ballot

N/A = Not Applicable
RP = Recommended Practice
SB = Sponsor Ballot
STD = Standard and/or Revision
TG = Task Group

MEC = IEEE-SA Mandatory Editorial Coordination
Final 802.11 WG = Approval by 802.11 WG - Current WG Calendar
Final or Conditional 802 EC = Approval by 802 EC at Plenary Session - Current 802 EC Plenary Calendar
RevCom/Standards Board = Approval of RevCom / IEEE-SA Standards Board in Normal Session - Current IEEE-SA Calendar
ANSI = American National Standards Institute

MDR = 802.11 WG Mandatory Draft Review

This page is maintained by Stephen McCann and Alex Ashley . Comments are welcome.

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APPENDIX T

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    - Fuzzy Markup Language
  - Industry Applications (IAS) Groups
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  - SCC31 Groups
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APPENDIX U

IEEE 802.11 technical submissions

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IEEE 802.11 technical submissions, also known as draft standards, are **documents proposed and reviewed by the IEEE 802.11 working group to enhance the Wi-Fi technology**. Submissions are made by members and must follow specific formatting rules. These submissions are available on the "mentor" document server, which is accessible to the public. Draft standards and other members-only information are available in a password-protected area for members.

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IEEE802.org
https://www.ieee802.org › ...

IEEE 802.11, The Working Group Setting the Standards for ...

The IEEE has made available **IEEE 802** standards for free download. Under this program, a standard may be downloaded for free six months after the initial ...

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IEEE Standards Association - Documents

2025, 519, 5, TGbn, Minutes for **802.11** bn PHY ad-hoc Teleconference in March to May, Dongguk Lim (LG Electronics). 29-Apr-2025 22:30:41 ET.

Wiki 12 11 14

IEEE802.org
https://www.ieee802.org › abt80211

About 802.11 and How To Participate

The draft standard is ready for final approval once it has achieved at least a 75% approval rate and met various other critria (e.g., no new Disapprove votes on ...

IEEE Standards Association
https://standards.ieee.org › ieee › 802.11

IEEE SA - IEEE 802.11-2024

Technical corrections and clarifications to **IEEE** Std **802.11** for wireless local area networks (WLANs) as well as enhancements to the existing medium access ...

Missing: ~~submissions~~ | Show results with: submissions

Wikipedia
https://en.wikipedia.org › wiki › IEEE_802

IEEE 802.11

IEEE 802.11 is used in most home and office networks to allow laptops, printers, smartphones, and other devices to communicate with each other and access the ...

Missing: ~~submissions~~ | Show results with: submissions

Scholarly articles for **IEEE 802.11 technical submissions**

IEEE 802.11 n development: history, process, and ... - Perahia - Cited by 239

The **IEEE 802.11** universe - Hiertz - Cited by 500

Creating a wireless LAN standard: **IEEE 802.11** - Jakobs - Cited by 20

People also ask

What are the IEEE 802.11 standards?

What does IEEE 802.11 apply to?

What is the difference between IEEE 802.11 A and 802.11 B?

Is 802.11a 2.4 or 5ghz?

Feedback

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https://standards.ieee.org › beyond-standards › the-evol...

The Evolution of Wi-Fi Technology and Standards

May 16, 2023 — **IEEE 802.11**n™, or Wi-Fi 4, was introduced in 2009 to support the 2.4 GHz and 5GHz frequency bands, with up to 600 Mbit/s data rates, multiple ...

Ieee Sa Wi-Fi Timeline | Ieee Standards For Wi-Fi | Wi-Fi 7: The Next...

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IEEE Mentor
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doc.: IEEE 802.11-09/0002r4

DOC

The vote by the TG to request the WG to **submit** a draft standard or a revised standard to the WG ballot group is considered to be a **technical** vote. 4.7.4 Task ...

IEEE Mentor
https://mentor.ieee.org › 802.11 › dcn › 11-14-0...

802.11 Operation Manual

DOC

Complex **technical** changes to a draft shall be in a **submission** that has been accepted by document control according to document formats specified in section 3.7 ...

Spread Spectrum Scene
http://www.sss-mag.com › pdf

A Technical Tutorial on the IEEE 802.11 Protocol

PDF

by P Brenner · 1997 · Cited by 322 — This version of the document is actualized to Draft 4.0 of the Standard. Page 3. A **Technical** Tutorial on the **IEEE 802.11** Standard. 18 July, 1996.

TechTarget
https://www.techtarget.com › searchmobilecomputing

What is 802.11? Definition from TechTarget

802.11 is a family of evolving specifications for wireless local area networks (WLANs) developed and maintained by a working group of **IEEE**.

What Is 802.11? | What Does 802.11 Mean? | How Does 802.11 Work?

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APPENDIX V

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Welcome to the information portal sponsored by the **802 Working Groups**.

- IEEE 802 Executive Committee
- IEEE 802.1 Working Group
- IEEE 802.1 OmniRAN Task Group and subsequently on the 802.1 OmniRAN web page
- IEEE 802.11 Wireless LAN (WLAN) Working Group
- IEEE 802.15 Wireless Speciality Network (WSN) Working Group
- IEEE 802.16 Working Group on Broadband Wireless Access
- IEEE 802.18 Radio Regulatory Technical Advisory Group
- IEEE 802.19 Wireless Coexistence WG
- IEEE 802.21 Handover Services WG
- IEEE 802.22 WRAN WG
- IEEE 802 Whitespace SG(not an active group - archive)
- IEEE 802.23 Emergency Services Working Group(not an active group - archive)
- IEEE 802.24 Smart Grid Technical Advisory Group
- IEEE 802 EC Privacy Recommendation SG and subsequently on the 802.1 Security TG Web Page

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APPENDIX W

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DCN, Title, Author or Affiliation

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
28-Apr-2025 ET	2025	255	3	TGm	P2P TWT Harmonization	Brian Hart (Cisco Systems)	28-Apr-2025 13:34:11 ET	Download
28-Apr-2025 ET	2024	1925	6	TGm	REVmf Motions	Michael Montemurro (Huawei)	28-Apr-2025 12:17:19 ET	Download
28-Apr-2025 ET	2025	662	3	TGm	April 28 Teleconference Agenda	Michael Montemurro (Huawei)	28-Apr-2025 12:14:48 ET	Download
28-Apr-2025 ET	2025	371	1	TGm	NR-IE_6GHz_Bits	Abhishek Patil (Qualcomm)	28-Apr-2025 11:33:33 ET	Download
28-Apr-2025 ET	2025	345	5	TGm	PASN ID for MLO	Yan Li(ZTE)	28-Apr-2025 09:42:37 ET	Download
28-Apr-2025 ET	2025	676	1	TGbn	CC50 CR for CID3866	Bo Cao (ZTE)	28-Apr-2025 09:37:41 ET	Download
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28-Apr-2025 ET	2024	2080	1	TGbn	High-Capability Protection in DPS Follow Up	Maolin Zhang (Huawei)	28-Apr-2025 06:32:10 ET	Download
28-Apr-2025 ET	2025	3	2	TGbn	NPCA follow up	Yan Li(ZTE)	28-Apr-2025 04:45:27 ET	Download
28-Apr-2025 ET	2025	5	3	TGbn	MAP discovery follow up	Jay Yang(ZTE)	28-Apr-2025 03:46:33 ET	Download
28-Apr-2025 ET	2025	576	3	TGbq	TGbg April 2025 Teleconference Call Meeting Minutes	Jonghoe Koo (Samsung Electronics)	28-Apr-2025 02:10:27 ET	Download
28-Apr-2025 ET	2025	673	3	TGbn	CR for CC50 on subclause 37.x.x.x.x Allowed settings	Hong Won Lee(LG Electronics Inc.)	28-Apr-2025 01:26:53 ET	Download
28-Apr-2025 ET	2025	727	1	TGbk	Minutes for telecons in March-APril2025	Dibakar Das (Intel)	28-Apr-2025 01:04:27 ET	Download
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27-Apr-2025 ET	2025	723	1	TGm	802.11REVmf Editor's Report	Po-Kai Huang (Intel)	27-Apr-2025 21:29:07 ET	Download
27-Apr-2025 ET	2025	707	1	TGbn	CC50 CR for clause 6 part 2	Yan Li(ZTE)	27-Apr-2025 21:15:57 ET	Download
27-Apr-2025 ET	2024	1919	3	TGm	Protecting TSF values in Beacon frames	Henry Ptasinski (Morse Micro)	27-Apr-2025 14:18:24 ET	Download
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20-May-2015 ET	2015	714	0	TGm	Resolution to CID5164	Carlos Cordeiro (Intel)	20-May-2015 13:18:46 ET	Download
19-May-2015 ET	2015	704	1	802.11 WG	May 2015 China Interim Opening Report	Jon Rosdahl (CSR)	19-May-2015 23:29:08 ET	Download
19-May-2015 ET	2015	710	1	TGaj	Variable Length Guard Interval for 45GHz	Feng Huang (Gigaray)	19-May-2015 23:22:52 ET	Download
19-May-2015 ET	2015	713	0	TGaj	ieee-802-11aj-may-2015-closing-report	Xiaoming Peng (I2R)	19-May-2015 23:19:03 ET	Download
19-May-2015 ET	2015	698	3	TGaj	ieee-802-11aj-task-group-may-2015-report	Xiaoming Peng (I2R)	19-May-2015 23:04:39 ET	Download
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19-May-2015 ET	2015	709	2	TGaj	Variable Length LDPC Codes for 45GHz	Yan Li (Gigaray)	19-May-2015 17:20:59 ET	Download
19-May-2015 ET	2015	712	0	TGay	Task Group AY May 2015 Vancouver Meeting Minutes	Jeorge Hurtarte (Teradyne)	19-May-2015 14:16:33 ET	Download
19-May-2015 ET	2015	652	1	TGax	Reference Simulation Model for Dynamic CCA / DSC Calibration	Masahito Mori (Sony)	19-May-2015 06:04:05 ET	Download
19-May-2015 ET	2015	698	2	TGaj	ieee-802-11aj-task-group-may-2015-report	Xiaoming Peng (I2R)	19-May-2015 05:50:49 ET	Download
19-May-2015 ET	2015	705	2	TGaj	Control PHY Design for 40-50GHz Millimeter Wave Communication Systems	Chien-Fang Hsu (Mediatek Inc.)	19-May-2015 05:14:31 ET	Download
19-May-2015 ET	2015	706	2	TGaj	Bandwidth and Packet Type Detection Schemes for 40-50GHz Millimeter Wave Communication Systems	Chien-Fang Hsu (Mediatek Inc.)	19-May-2015 05:13:48 ET	Download
19-May-2015 ET	2015	703	1	TGaj	Proposed Resolutions to CID 1, 3, 4, 7, 13, 52, 64, 74, 84, 85 and 88 on TGaj D0.5 in CC20	Dejian Li (Huawei/HiSilicon)	19-May-2015 04:51:21 ET	Download
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18-May-2015 ET	2015	711	0	802.11 WG	Minutes-of-IEEE-802-11-WG-meeting-May-2015-Zhuhai-china-interim-session	Dorothy Stanley (Aruba Networks)	20-May-2015 06:43:45 ET	Download
18-May-2015 ET	2015	698	1	TGaj	ieee-802-11aj-task-group-may-2015-report	Xiaoming Peng (I2R)	18-May-2015 22:30:04 ET	Download
18-May-2015 ET	2015	702	1	802.11 WG	May 2015 WG China iInterim Agenda	Jon Rosdahl (CSR)	18-May-2015 22:25:03 ET	Download
18-May-2015 ET	2015	709	1	TGaj	Variable Length LDPC Codes for 45GHz	Yan Li (Gigaray)	18-May-2015 22:11:16 ET	Download
18-May-2015 ET	2015	710	0	TGaj	Variable Length Guard Interval for 45GHz	Feng Huang (Gigaray)	18-May-2015 22:09:31 ET	Download
18-May-2015 ET	2015	709	0	TGaj	Variable Length LDPC Codes for 45GHz	Yan Li (Gigaray)	18-May-2015 22:06:26 ET	Download
18-May-2015 ET	2015	708	0	TGaj	IEEE 802.11aj March Meeting Minutes	Jiamin Chen (Huawei/HiSilicon)	18-May-2015 21:38:43 ET	Download
18-May-2015 ET	2015	707	0	TGaj	Complete Proposal for IEEE 802.11aj (45 GHz)	Haiming Wang (SEU)	19-May-2015 02:15:13 ET	Download
18-May-2015 ET	2015	706	0	TGaj	Bandwidth and Packet Type Detection Schemes for 40-50GHz Millimeter Wave Communication Systems	Chien-Fang Hsu	18-May-2015 21:02:33 ET	Download
18-May-2015 ET	2015	705	0	TGaj	Control PHY Design for 40-50GHz Millimeter Wave Communication Systems	Chien-Fang Hsu	18-May-2015 20:59:32 ET	Download
18-May-2015 ET	2015	701	1	TGaj	Physical Channel Encoding for 45Ghz	Liguang Li (ZTE corporation)	18-May-2015 20:09:01 ET	Download
18-May-2015 ET	2015	521	3	802.11 WG	1st Vice Chair Report May 2015 Vancouver	Jon Rosdahl (CSR)	18-May-2015 15:21:35 ET	Download
18-May-2015 ET	2015	565	3	TGm	REVmc SB MAC comments	Mark Hamilton (Ruckus)	18-May-2015 14:05:19 ET	Download
18-May-2015 ET	2015	704	0	802.11 WG	May 2015 China Interim Opening Report	Jon Rosdahl (CSR)	18-May-2015 16:01:13 ET	Download
18-May-2015 ET	2014	1091	4	TGaj	TGaj Editor Report for CC20	Jiamin Chen (Huawei/HiSilicon)	18-May-2015 12:46:04 ET	Download
18-May-2015 ET	2015	703	0	TGaj	Proposed Resolutions to CID 1, 3, 4, 7, 13, 52, 64, 74, 84, 85 and 88 on TGaj D0.5 in CC20	Dejian Li (Huawei/HiSilicon)	19-May-2015 04:43:28 ET	Download
18-May-2015 ET	2015	702	0	802.11 WG	May 2015 WG China iInterim Agenda	Jon Rosdahl (CSR)	18-May-2015 15:57:45 ET	Download
18-May-2015 ET	2011	1149	44	802.11 WG	Draft Number Alignment Tool	Adrian Stephens (Intel Corporation)	18-May-2015 10:08:14 ET	Download
18-May-2015 ET	2014	1082	3	TGaj	PPDU Format for IEEE 802.11aj(45GHz)	SEU	18-May-2015 09:27:23 ET	Download
17-May-2015 ET	2014	1082	2	TGaj	PPDU Format for IEEE 802.11aj(45GHz)	SEU	17-May-2015 23:37:39 ET	Download
17-May-2015 ET	2015	701	0	TGaj	Physical Channel Encoding for 45Ghz	Liguang Li (ZTE corporation)	17-May-2015 21:31:21 ET	Download

15-May-2015 ET	2014	716	4	TGaj	PHY SIG Frame Structure for IEEE 802.11aj (45GHz	Shiwen He(SEU)	15-May-2015 22:01:32 ET	Download
15-May-2015 ET	2014	1082	1	TGaj	PPDU Format for IEEE 802.11aj(45GHz)	SEU	15-May-2015 22:00:06 ET	Download
15-May-2015 ET	2015	700	0	PUB SC	minutes-may-2015	Stephen McCann (BlackBerry)	15-May-2015 16:06:09 ET	Download
15-May-2015 ET	2015	482	4	802.11 WG	May 2015 WG Agenda	Adrian Stephens (Intel Corporation)	15-May-2015 13:20:25 ET	Download
15-May-2015 ET	2015	513	3	802.11 WG	May 2015 WG Motions	Dorothy Stanley (Aruba Networks)	15-May-2015 13:13:36 ET	Download
15-May-2015 ET	2015	521	2	802.11 WG	1st Vice Chair Report May 2015 Vancouver	Jon Rosdahl (CSR)	15-May-2015 12:43:37 ET	Download
15-May-2015 ET	2015	699	0	NGP SG	NGP overview May 2015	Jonathan Segev (Intel)	15-May-2015 11:32:50 ET	Download
15-May-2015 ET	2015	682	2	REG SC	Draft Response FCC PN DA 15-516	Carolyn Heide (Ruckus)	15-May-2015 11:01:45 ET	Download
15-May-2015 ET	2015	698	0	TGaj	ieee-802-11aj-task-group-may-2015-report	Xiaoming Peng (I2R)	17-May-2015 03:37:30 ET	Download
15-May-2015 ET	2015	697	0	TGaq	TGaq Meeting Minutes - May 2015 Session	Yunsong Yang (Huawei Technologies)	15-May-2015 02:28:02 ET	Download
14-May-2015 ET	2015	482	3	802.11 WG	May 2015 WG Agenda	Adrian Stephens (Intel Corporation)	14-May-2015 23:41:38 ET	Download
14-May-2015 ET	2015	513	2	802.11 WG	May 2015 WG Motions	Dorothy Stanley (Aruba Networks)	14-May-2015 23:36:16 ET	Download

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APPENDIX AA

wget - 1.25.0

Free Software Foundation
last updated November 11, 2024

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APPENDIX AB

IEEE P802.11
Wireless LANs

25.10.3 A-MPDU comment resolution

Date: 2016-09-12

Author(s):

Name	Affiliation	Address	Phone	email
Liwen Chu				

Abstract

This submission proposes resolutions for multiple comments related to TGax D0.1 with the following CIDs:

- 984, 70, 229, 191, 2670, 1379, 1380

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).

TGax Editor: Editing instructions preceded by "TGax Editor" are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.

CID	PP	LL	Comment	Proposed Change	Resolution

984	65	12	A-MPDU with multiple TIDs shall not be transmitted in an HE extended range SU PPDU either.	Suggest to change to "An A-MPDU with multiple TIDs shall not be transmitted in an HE SU PPDU or HE extended range SU PPDU."	Rejected Discussion: we believe multi-TID A-MPDU can also be used for SU PPDU.
70	65	14	"Multi-STA BlockAck frame shall be used to acknowledge the Multi-TID A-MPDU in MU PPDU. The value of TID field in Multi-STA BlockAck frame is TBD." The definition of Multi-STA BA does not support multi-STA multi-TID.	Revise the structure of Multi-STA BA to include multi-STA multi-TID BA.	Revised Agree in principal. TGax editor makes changes as specified in 11-16/1185r2.
229	83	8	There is a motion stating that the Ack Policy shall be set to normal Ack in QoS Data frames sent in a Trigger based PPDU. This statement neeeds to be added to this subclause (or maybe better to the UL MU operation in general). Also we do need to define what the Ack policy is going to be set in a multi-TID A-MPDU. Suggest to use the same value of the Ack Policy for all QoS Data frames that are aggregated in the DL A-MPDU (UL A-MPDU is covered by the motion above).	As in comment.	Revised Agree in principal. TGax editor makes changes as specified in 11-16/1185r2.
191	83	14	"The value of TID field in Multi-STA BlockAck frame is TBD." is not correct since the TID's values are already defined in the Multi-STA BlockAck frame format (see 9.3.1.7.something). Hence remove this statement.	As in comment.	Revised Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1185r2.
2670	65	8	When an AP intends to transmit a DL MU PPDU with multiple TIDs aggregated, it is not clear which EDCAF to be used for initiating a backoff.	Clarify rules for EDCA backoff mechanism in case multiple TIDs are aggregated in DL MU PPDU transmission in 10.22.2.2 of REVmc_D5.2.	Revised Agree in principal. TGax editor makes changes as specified in 11-16/1185r2.
~~1754~~	~~51~~	~~20~~	~~The statement on line 20, that "An A-MPDU with multiple TIDs shall not be transmitted in an SU PPDU" contradicts with the statements on lines 13 to lines 16, which allow transmission of A-MPDU containing multiple TIDs between the STAs if they are A-MPDU With Multiple TIDs capable.~~	~~Remove the statement "An A-MPDU with multiple TIDs shall not be transmitted in an SU PPDU." from line 20, page 50 to allow multi TIDs to be transmitted in an A-MPDU for SU.~~	
1379	37	38	Allowing an Action frame will cause trouble if there is also a Data frame (with Ack Policy	Delete this row	**Reject.**

			set to normal/implicit) since then two things will need to be immediately acked. The baseline does not allow this for the non-multi-TID case		Multi-STA BA differentiate Ack for Action and Ack for MPDU from different TIDs by using different TIDs in Per AID TID Info field (TID 14 is for Action Ack, TID 0 to 7 without BA bitmap are used for MPDUs from TID 0 to 7, at most one data MPDU from a TID is allowed).
1380	37	41	Allowing such a frame will cause trouble if there is also a Data frame (with Ack Policy set to normal/implicit) since then two things will need to be immediately acked. The baseline does not allow this for the non-multi-TID case. Also "At most one data frame of the TID" is too vague (need to rfer to the exact frame (sub)type and the other constraints, e.g. Ack Policy)	Delete this row	**Reject.** Multi-STA BA differentiate Ack for Action and Ack for MPDU from different TIDs by using different TIDs in Per AID TID Info field (TID 14 is for Action Ack, TID 0 to 7 without BA bitmap are used for MPDUs from TID 0 to 7, at most one data MPDU from a TID is allowed).

Discussion: although we reject CID 1379 and 1380, we believe that aggregating Data frame which asks for Ack and Action frame in multi-TID A-MPDU should be optional. The reason is that aggregating Data frame which asks for Ack and Action frame in multi-TID A-MPDU requires TX and RX implementation change.

9.4.2.213 HE Capabilities element

TGax Editor: Add one-bit "Ack Enabled Multi-TID A-MPDU Support" subfield in Figure 9-ax2.

TGax Editor: Add the following paragraph at 9.4.2.213:

The Ack Enabled Multi-TID A-MPDU Support subfield indicates support by an HE STA for the reception of data MPDU in multi-TID A-MPDU which asks for Ack or Action frame in multi-TID A-MPDU. Set to 0 otherwise.

25.10.3 A-MPDU with multiple TIDs

TGax Editor: Add the following paragraph after the first paragraph of 25.10.3:

An HE STA with dot11MPDUAskedforAckInMultiTIDAMPDU set to true shall set dot11AMPDUwithMultipleTIDOptionImplemented to true. An HE STA with dot11MPDUAskedforAckInMultipleTIDAMPDU set to true shall set the Ack Enabled Multi-TID A-MPDU Support subfield of the HE Capabilities element it transmits to 1; otherwise, the HE STA shall set it to 0. A HE transmitter shall not aggregate MPDU that asks for Ack in a multiple-TID A-MPDU to the HE recipient unless the recipient sets Ack Enabled Multi-TID A-MPDU Support subfield to 1 in its announced HE Capabilities element.

An HE STA shall construct a multi-TID A-MPDU as defined in 9.7 (Aggregate MPDU (A-MPDU)) and 10.13 (A-MPDU operation) except that the EOF subfield shall be set to 1 in a nonzero length MPDU delimiter that precedes a QoS Data frame, or Action frame if the QoS Data frame or Action frame solicits an immediate Ack frame.
A multi-TID A-MPDU may contain multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 1, one for each TID that solicits Ack and/or multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 0, one for each TID that solicits BlockAck.

An HE STA that receives a multi-TID A-MPDU shall respond with a Multi-STA BlockAck frame that contains (see 25.4 (Block acknowledgement):

- One Per STA Info field indicating an Ack for each successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 1 (TID value equals that of the QoS Data/QoS Null frame or 15 for the Action frame),
- One Per STA Info field indicating a BlockAck for each TID of a successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame).

TGax Editor: Change the last paragraph of 25.10.3 as following (70, 229, 191):

Multi-STA BlockAck frame shall be used to acknowledge the Multi-TID A-MPDU ~~in MU PPDU~~. The ~~value of TID field in Multi-STA BlockAck frame is TBD~~rules for Multi-STA BlockAck are defined in subclause 25.4.

TGax Editor: Add the following paragraph at the end of 25.10.3(2670):

An HE AP may aggregate MPDUs from any TIDs in multi-TID A-MPDU for DL MU PPDU transmission and the number of TIDs in multi-TID A-MPDU shall not be more than the Multi-TID Aggregation Support announced by the recipient.

APPENDIX AC

IEEE P802.11
Wireless LANs

HE Variant HT Control – A-MPDU Content

Date: 2016-09-12

Author(s):

Name	Affiliation	Address	Phone	email
Liwen Chu				

Abstract

This submission proposes resolutions for multiple comments related to TGax D0.1 with the following CIDs (24 **CIDs**):

- 805, 1354, 1356, 1357, 1358, 1360, 1359, 668, 1792, 2475, 2477, 2478, 2479, 2480, 1527, 2263, 120, 1366, 10, 1368, 1369, 1371, 1372, 1374, 1375, 394, 11,12, 669, 1378, 1376, 2455, 2592, 1381, 1384, 2456, 1377, 1635, 1804, 2309, 1367, 670, 2593, 2594, 2595, 1386

Revisions:

- Rev 0: Initial version of the document.

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).

TGax Editor: Editing instructions preceded by "TGax Editor" are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.

CID	PP	LL	Comment	Proposed Change	Resolution

805	35	43	Trigger Frame, Multi-STA block ACK frame, etc. need to be a single A-MPDU contents in other contexts	Insert Trigger Frame, Multi-STA BlockAck frame, QoS Null MPDUs with Ack Policy set to No Acknowledgment cases in other A-MPDU contexts (immediate, no immediate, PSMP, control response)	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1354	36	10	The concept "multiple TID A-MPDU" is not defined; also in next cell down	Reword the para as something like "The A-MPDU contains QoS Data MPDUs with different TIDs and is transmitted outside a PSMP sequence by a TXOP holder in DL/UL MU frame exchange or a STA in UL MU frame exchange sequence including potential immediate responses."; also in next cell down	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1356	36	10	"The multiple TID A-MPDU is transmitted outside a PSMP sequence by a TXOP holder in DL/UL MU frame exchange or a STA in UL MU frame exchange sequence" -- what is a "DL/UL MU frame exchange"? Does it mean an exchange that is both, or either one or the other exclusively, or one or the other or both? Also in next cell down	Clarify	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1357	36	10	"The multiple TID A-MPDU is transmitted outside a PSMP sequence by a TXOP holder in DL/UL MU frame exchange or a STA in UL MU frame exchange sequence" -- why can the TXOP holder do DL/UL but other STAs only do UL? Also in next cell down	Clarify	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1358	36	23	"An A-MPDU intended for a STA that is UL MU capable" -- what does "intended for" mean?	Change "intented for" to "addressed to"	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1360	36	23	The non-multiple-TID baseline equivalent has a reference to the NOTE which seems appropriate here too	Add "See NOTE." to the end of the cell	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.

1359	36	23	Isn't the UL MU Context context potentially also a Data Enabled [No] Immediate Response with Multiple TID Support context, e.g. a TXOP holder sending outside a PSMP sequence a DL MU PPDU with multiple TIDs to a STA that is UL MY capable?	Ensure that the contexts do not overlap by adding restrictions in the context definitions	**Revised.** **Revised.** TGax editor makes changes as shown in the as specified in 11-16/1186r0.
668	36	5	Mixing tx seqeunce initiating frames (e.g: data frames sent under HT immediate block ack agreement, Trigger frames, BAR) with response frames (e.g: BlockAck, Multi-STA BlockAck) in a Multiple TID A-MPDU content, complicate the transmit & receive processes. Instead, separate them into two different Multiple TID A-MPDU types: 1. Multiple TID A-MPDU with tx sequence initiating frames; 2. Multiple TID A-MPDU wtih tx sequence response frame (a technical contribution will be followed later)	In Table 9-409, split the cell of "Data Enabled Immediate Response with Multiple TID Support", into two separate cells: 1. Data Enabled Immediate Response with Multiple TID Support with Tx sequence initiating frames; 2. Responses with Multiple TID support with Tx sequence response frames. (a technical contribution will be submitted later)	**Rejected.** **Discussion: 11ax already allows cascading MU frame wxchange where data frames, trigger frames, BA feames should be aggregated in one A-MPDU. Another observation is that 11mc already allows BAR, data frames, BA in one A-MPDU.**
1792	36	10	The use of the A-MPDU contexts by an HE AP and an HE non-AP STA is not clear. Under what conditions do the contexts apply? For example, in the case of an HE non-AP STA responding to a HE MU PPDU does the Control Response context apply? What context appl	Define contexts based on direction: "DL context" and "UL context". Enumerate the possible MPDUs that can be included in the each context and the conditions under which they can be present. Remove the current three contexts.	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
2475	36	5	Table 9-420 needs to be updated because the HE trigger-based PPDU including the following A-MPDU can be transmitted from a non-TXOP holder. - Data Enabled No Immediate Response - Control Response - VHT single MPDU context	As per comment	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
2477	36	27	In Table 9-421 (A-MPDU contents in the data enabled immediate response context), add Trigger control frame.	As per comment	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
2478	36	27	In Table 9-422 (A-MPDU contents in the data enabled no immediate response	As per comment	**Revised.** Agree in principal.

			context), add Trigger control frame.		TGax editor makes changes as shown in the as specified in 11-16/1186r0.
2479	36	27	In Table 9-424 (A-MPDU contents MPDUs in the control response context), add Trigger control frame.	As per comment	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
2480	36	27	In Table 9-425 (A-MPDU contents in the VHT single MPDU context), add Trigger control frame as a conditional content. The condition is that Trigger frame can be present in S-MPDU if it is contained in the HE PPDU.	As per comment	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1527	36	4	There seems to be no context for "I want to trigger UL MU but I don't want to use multiple TIDs"	Add a "UL MU Data Enabled Immediate Response" context	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
2263	36	12	TXOP holder in case of UL MU frame must be defined. If it is AP, is it possible for AP to transmit multiple TID A-MPDU in UL MU frame exchange?	Need to clarify	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
120	54	22	I am not certain we need new tables here. Rather simply add new columns to the existing tables of REVmc D5.0 to accommodate the new additions for Trigger frame, multi-TID operation (UL/DL MU operation, MU BAR, M-STA BA etc). If prefer to keep separate tables please add the missing parts so that all frames that cna be present are covered in the A-MPDU.	As in comment.	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1366	37	10	I have no idea what "If the AP schedule resource for following UL MU transmission and HE A-Control field in data/management frames don't include trigger information." means	Reword	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
10	37	20	Table 426-a: would "At most one of the MPDUs is present" mean that an AP cannot send BA/ACK to a set of STAs and send BAR to another set of STAs within an AMPDU? I think this is a case that should be allowed.	As in the comment.	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.

1368	37	10	Doesn't the Ack frame have to be at the start (as in the baseline non-multi-TID version)? Ditto for the next page	Add ", a single Ack frame at the start of the A-MPDU" as in the baseline	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1369	37	17	Doesn't the BlockAck frame have to be at the start (as in the baseline non-multi-TID version)? Ditto for the next page	Add ", in which case it occurs at the start of the A-MPDU" as in the baseline	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1371	37	22	Doesn't the Multi-STA BlockAck frame have to be at the start (as in the baseline non-multi-TID version)? Ditto for the next page	Add ", in which case it occurs at the start of the A-MPDU" as in the baseline	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1372	37	22	It says "Multi-STA BlockAck frame", but the cell to the right makes it clear it's a Multi-TID BlockAck frame. Ditto for the next page	Change "Multi-STA" to "Multi-TID"	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1374	37	30	"QoS Data frames with the multiple TIDs, with TID being corresponding to an HT-immediate block ack agreement" is weird -- the baseline non-multi-TID version has a note on the Ack Policy	Add a "See NOTE." and at the end of the table a "NOTE--These MPDUs all have the Ack Policy field equal to the same value, which is either Implicit Block Ack Request or Block Ack."	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1375	37	34	"In an HE BSS," -- this context only applies to an HE BSS anyway. Ditto for the next page	Delete the cited text and adjust the following capitalisation	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
394	37	9	These tables are confusing ... change "MPDU description" to "MPDU" and change "conditions" to "Restrictions on listed MPDU in this A-MPDU context" and be specific ... include Then more liberally, such as "If the AP schedules resources for an immediately following UL MU transmission and the HE A-Control field in a data/mgmt frame does not include trigger information [by what specific fields?] then <what exactly?.. then include {at most} one Trigger frame>, "Then at most one of the MDPUs is present ..." "Zero or more Action No Ack frames are included" etc	As in comment. Note multiple embeded technical and editorial corrections in comment also. Also, fix "TID being corresponding" at L30 and fix "sent under <what next?>" at L37L46. Ditto P38	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.

11	37	1	Table 426-a: this restriction is unnecessary "If the AP schedule resource for following UL MU transmission and HE A-Control field in data/management frames don't include trigger information". An AP might support both Trigger frame and trigger info within HE A-Control.	As in the comment.	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
12	37	1	Table 426-a and -b: The content and intention of this table could be made more clear.	As in the comment.	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
669	37	24	Mult-STA BlockAck frame inside Multiple TID A-MPDU , should contain only one Per STA Info field	Add "at most one Per STA Info field" allowed inside the Mult-STA BlockAck frame", into the Conditions	**Rejected.** **Discussion: The** Mult-STA BlockAck for multi-TID A-MPDU and acknowledgement of UL MU has unified frame format**. This can make acknowledgement decoding easier.**
1378	37	46	"At most one data frame for one TID that there is no data frames sent under" -- huh?	Reword. Note the baseline says "At most one BlockAckReq frame with a TID that corresponds to an HT- immediate block ack agreement. This is the last MPDU in the A-MPDU. It is not present if any QoS Data frames for that TID are present."	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1376	37	23	"for multiple TIDs for which an HT-immediate block ack agreement exists," is not clear	Change to "for multiple TIDs, where an HT-immediate block ack agreement exists for each TID,"	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
2455	37	42	"At most one data frame of the TID" It shall be limited to QoS DATA frame. Change it as the following: "At most one QoS data frame of the TID"		Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
2592	37	24	Multi-STA BlockAck frame is a variant of a BlockAck frame. Therefore, including both BlockAck frame and Multi-STA BlockAck frame is not consistent.	Removing a row for Multi-STA BlockAck frame and includes explanation on Multi-STA variant and Multi-TID variants of BlockAck in the row for MlockAck frame.	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.

1381	37	8	The "MPDU Description" column does not need "frame" (see the baseline)	Delete all the "frame"s from this column	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1384	37	4	Basically just align this table technically with Table 9-421, except for the specific changes due to multi-TIDness	As it says in the comment	
2456	37	43	"Data frame with TID that has no block ack agreement and with Ack Policy set to Normal Ack" The Ack frame of the Data frame can be the Trigger based UL MU Ack. Change it as the following: "Data frame with TID that has no block ack agreement and with Ack Policy set to either Normal Ack or Trigger based UL MU Ack"		**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1377	37	30	The baseline has a restriction "Of these, at most one of the following is present in a non-DMG BSS: --- One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request --- A BlockAckReq frame"	Add such a restriction (without the "in a non-DMG BSS" bit)	**Revised.** Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1635	37	4	Need text that indicates how to aggregate various control subtypes within an AMPDU. While the new table 9-246 includes a trigger frame, it is not clear whether a DATA type must also be included, or if the DATA type is optional. We need a case where trigger is aggregated with, for example, only BA, but no DATA and it is not clear in the table if that is allowed.	Clarify if the table 9-246, is the DATA entry zero or more instances? Add text in clause 10 that describes what the rules are for aggregation - when can a particular aggregation context be used or not used?	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1804	37	14	Aggregating an ACK frame with other MPDUs in an A-MPDU complicates the recipient implementation. An ACK frame does not have a TA so the transmitter is inferred by the sequence. For SU sequences (Data/ACK or Management/ACK) this is not too complicated to handle. But with the A-MPDU where subsequent frames may be Data frames that require	Add a rule that ACK be sent stand-alone. Add a rule that Multi-STA BA (ack equivalent form) is used when aggregated with other MPDUs.	Rejected. Discussion: With MU transmission, RU identifier already tells the TA. Allowing Ack in A-MPDU avoids the transmission of separate PPDU for TID without BA negotiation.

			security engine setup or other context, it makes things complicated. The recipient needs special handling for the case where ACK is the first frame in the A-MPDU and TA needs to be derived from elsewhere. Overall, the benefit of allowing ACK together with other MPDU types is minimal.		
2309	37	45	The text for condition of Immediate BlockAckReq frames seems to be incomplete.	Following sentence has to be completed; "At most one data frame for one TID that there is no data frames sent under"	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1367	38	7	I have no idea what "If the AP schedule resource for following UL MU transmission and HE A-Control field in data/management frames don't include trigger information." means	Reword	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
670	38	46	"MPDU with trigger information in MAC header": no such trigger information field is defined in MAC in the draft	In table 9-426c, it implies that there is a "trigger information" field in MAC header, but no such field is defined anywhere in the draft.	**Rejected.** **Discussion: HE variant HT Control defines trigger info in MAC header.**
2593	38	8	A trigger frame always solicits immediate response frame. Therefore, the trigger frame cannot be included in this context	Delete the row for "Trigger frame" in Table 9-426b.	**Rejected.** **It depends on MSDUs' service policy. If all MSDUs in UL A-MPDU don't ask for acknowledgement (QoSNoack), no acknowledgement will follow UL MU PPDU.**
2594	38	43	"can" is not appropriate in clause 9.	Modify the text from "One or more Trigger frames can be included" to "A control frame of subtype Trigger".	**Rejected.** **Dissussion: "can" is used in many places in clause 9.**
2595	38	47	Normative text ("may") is not appropriate in clause 9.	Modify the text from "One or more MPDUs with trigger information in the MAC header may be included" to "MPDU with trigger information in the MAC header"	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.
1386	38	1	Basically just align this table technically with Table 9-422, except for the specific changes due to multi-TIDness	As it says in the comment	Revised. Agree in principal. TGax editor makes changes as shown in the as specified in 11-16/1186r0.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

TGax Editor: Changes the definition of VHT single MPDU as following:

very high throughput (VHT) single medium access control (MAC) protocol data unit (VHT single MPDU): An MPDU that is the only MPDU in an aggregate MPDU (A-MPDU) carried in a VHT physical layer (PHY) protocol data unit (PPDU) or HE physical layer (PHY) protocol data unit (PPDU) and that is carried in an A-MPDU subframe with the EOF subfield of the MPDU delimiter field equal to 1.

9.7.3 A-MPDU contents

TGax Editor: Changes the 7th paragraph as following:

An A-MPDU is transmitted in one of the contexts specified in Table 9-420 (A-MPDU Contexts) as defined by the description in the "Definition of context" column~~, independently of whether the A-MPDU is contained in a VHT MU PPDU or an SU PPDU~~. The further restrictions of A-MPDU content are defined in the conditions of various contexts. Ordering of MPDUs within an A-MPDU is not constrained, except where noted in these tables. See 10.13.1 (A-MPDU contents).

TGax Editor: Changes Table9-420 as following:

Table9-420 A-MPDU contexts

Name of Context	Definition of Context	Table defining permitted contents
Data Enabled Immediate Response	The A-MPDU is transmitted outside a PSMP sequence by a TXOP holder, TXOP responder or an RD responder including potential immediate responses.	Table 9-421 (A-MPDU contents in the data enabled immediate response context)
Data Enabled No Immediate Response	The A-MPDU is transmitted outside a PSMP sequence by a TXOP holder, TXOP Responder that does not include or solicit an immediate response. See NOTE.	Table 9-422 (A-MPDU contents in the data enabled no immediate response context)
PSMP	The A-MPDU is transmitted within a PSMP sequence.	Table 9-423 (A-MPDU contents in the PSMP context)
Control Response	The A-MPDU is transmitted by a STA that is neither a TXOP holder nor an RD responder that also needs to transmit one of the following immediate response frames: Ack BlockAck frame with a TID for which an HT-immediate block ack agreement exists Multi-TID BA for acknowledging multi-TID A-MPDU ~~The A-MPDU is transmitted by a STA that is a TXOP holder that also needs to transmit the following frames:~~ ~~Trigger~~	A-MPDU contents MPDUs in the control response context
VHT single MPDU context	The A-MPDU is transmitted within a VHT PPDU or a HE PPDU and contains a VHT single MPDU.	Table 9-425 (A-MPDU contents in the VHT single MPDU context)
NOTE—This context includes cases when no response is generated or when a response is generated later by the operation of the delayed block ack rules.		

TGax Editor: Changes Table9-421 as following:

Table 9-421 A-MPDU contents in the data enabled immediate response context

MPDU Description	Conditions	
Ack	If the preceding PPDU contains an MPDU that requires an Ack frame response, a single Ack frame at the start of the A-MPDU.	In a non-DMG STA other than HE STA: at most one of ~~these~~ Ack and HT-immediate BlockAck MPDUs is present. In a non-DMG HE STA: at most one of these MPDUs is present. In a DMG STA: at most one Ack frame is present, and zero or more HT-immediate BlockAck frames are present.
HT-immediate BlockAck	In a non-DMG STA: if the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, at most one BlockAck frame for this TID, in which case it occurs at the start of the A-MPDU. In a DMG STA: if the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, one or more copies of the same BlockAck for this TID.	
Multi-STA BA	In a non-DMG HE STA: If the preceding PPDU that carried multiple-TID A-MPDU contains implicit or explicit block ack requests for multiple TIDs for which HT-immediate block ack agreement exist, at most one Multi-STA BA frame, in which case it occurs at the start of the A-MPDU.	
Delayed BlockAcks	BlockAck frames with the BA Ack Policy subfield equal to No Acknowledgment with a TID for which an HT-delayed block ack agreement exists.	
Delayed block ack data	QoS Data frames with a TID that corresponds to a Delayed or HT-delayed block ack agreement. These have the Ack Policy field equal to Block Ack.	
Action No Ack	Action No Ack frames.	
Delayed BlockAckReqs	BlockAckReq frames with a TID that corresponds to an HT-delayed block ack agreement in which the BA Ack Policy subfield is equal to No Acknowledgment.	
Data frames without HT-immediate block ack agreement	QoS Data frames with multiple TIDs which have no HT-immediate block ack agreement See NOTE1.	Of these, at most one of the following is present in a non-DMG BSS except HE BSS: — One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request — A BlockAckReq frame Of these, at most one of the following is present in a DMG BSS: — One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request
Data frames sent under an HT-immediate block ack agreement	QoS Data frames with the same TID, which corresponds to an HT-immediate block ack agreement QoS Data frames with multiple TIDs, which correspond to multiple HT-immediate block ack agreements See NOTE1.	

QoS Null MPDUs with Ack Policy set to No Ack	In a DMG BSS, QoS Null MPDUs with Ack Policy set to No Ack. In a HE BSS, QoS Null MPDUs with Ack Policy set to No Ack.	— QoS Null MPDU with Ack Policy set to No Acknowledgment — A BlockAckReq frame with an optional QoS Null MPDU with Ack Policy set to No Acknowledgment Of these, atmost one of the following is present between two HE STAs: — One or more QoS Data frames from multiple TIDs with the Ack Policy field equal to Implicit Block Ack Request/Trigger based UL MU Ack/ AckRequest, at most one Action, optional QoS Null with Ack Policy set to No Ack, Trigger frame only when AP transmits the A-MPDU — QoS Null MPDU with Ack Policy set to No Ack — One of BolckAckReq and Multi-TID BlockAckReq frame — Trigger frame only when AP transmits the A-MPDU
Immediate BlockAckReq	At most one BlockAckReq frame with a TID that corresponds to an HT-immediate block ack agreement. This is the last MPDU in the A-MPDU. It is not present if any QoS Data frames for that TID are present. At most one of the following cases: 1), Multi-TID BlockAckReq frame with TIDs that correspond to an HT-immediate block ack agreement. This is after data and management frames in the A-MPDU. This is the last MPDU in the A-MPDU	
Action	At most one Action frame	
Trigger	At most 1 or more Trigger frame of which the Trigger Type is Basic Trigger, MU-BAR, BSRP. See Note2	
NOTE1— ~~These~~ The MPDUs from same TID all have the Ack Policy field equal to the same value, which is ~~either~~ one of Implicit Block Ack Request (Ack Request), Trigger based UL MU Ack, or Block Ack. NOTE2:- An AP including trigger frame and blockack is not required to include QoS Data in that A-MPDU		

TGax Editor: Changes Table9-422 as following:

Table 9-426—A-MPDU contents in the data enabled no immediate response context

MPDU Description	Conditions

Delayed BlockAcks	BlockAck frames for a TID for which an HT-delayed block ack agreement exists with the BA Ack Policy subfield equal to No Acknowledgment.
Delayed Block Ack data	QoS Data frames with a TID that corresponds to a Delayed or HT-delayed block ack agreement. These have the Ack Policy field equal to Block Ack.
Data without a block ack agreement	QoS Data frames with a TID that does not correspond to a block ack agreement. These have the Ack Policy field equal to No Ack and the A-MSDU Present subfield equal to 0.
Action No Ack	Action No Ack frames.
Delayed BlockAckReqs	BlockAckReq frames with the BA Ack Policy subfield equal to No Acknowledgment and with a TID that corresponds to an HT-delayed block ack agreement.
Trigger	1 or more Trigger frame of which the Trigger Type is Basic Trigger, MU-BAR, BSRP when AP transmits the A-MPDU. See Note1

Note1---- An AP including trigger frame and blockack is not required to include QoS Data in that A-MPDU

Table 9-428—A-MPDU contents MPDUs in the control response context

MPDU	Conditions	
Ack	Ack frame transmitted in response to an MPDU that requires an Ack frame.	One of ~~these~~ Ack and BlockAck is present at the start of the A-MPDU in a BSS other than HE BSS. One of these is present at the start of the A-MPDU between two HE STAs.
BlockAck	BlockAck frame with a TID that corresponds to an HT-immediate block ack agreement.	
Multi-STA BA	If the preceding PPDU that carried multi-TID A-MPDU contains implicit or explicit block ack requests for multiple TIDs for which HT-immediate block ack agreement exist, at most one M-BA frame.	
Action No Ack	+HTC Action No Ack frames carrying a Management Action Body containing an explicit feedback response or BRP frame.	

APPENDIX AD

Multi-TID A-MPDU in MU Transmission

Date: 2016-01-18

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1404

Single TID vs Multiple TIDs in an PSDU

- In 802.11 baseline, two methods are defined for TC (=TID) selection in an A-MPDU.
  - An A-MPDU in PSMP aggregates MPDUs from multiple TC.
  - An A-MPDU in other frame exchanges aggregates MPDUs from one TC.

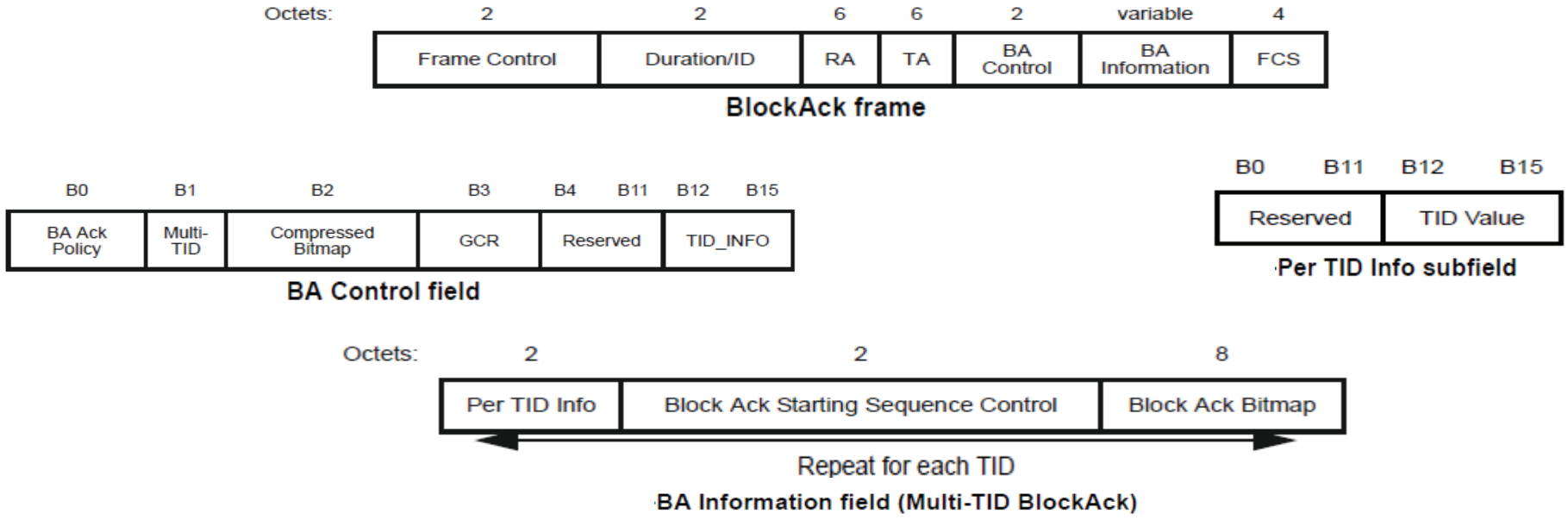
- 11ax passed the motion about multiple TIDs in a PSDU:
  - The spec shall allow multiple TIDs in a single PSDU between AP and a STA for DL/UL OFDMA/MU-MIMO. Multiple TIDs aggregation rules are TBD if necessary.

1405

Multi-TID BA Recap

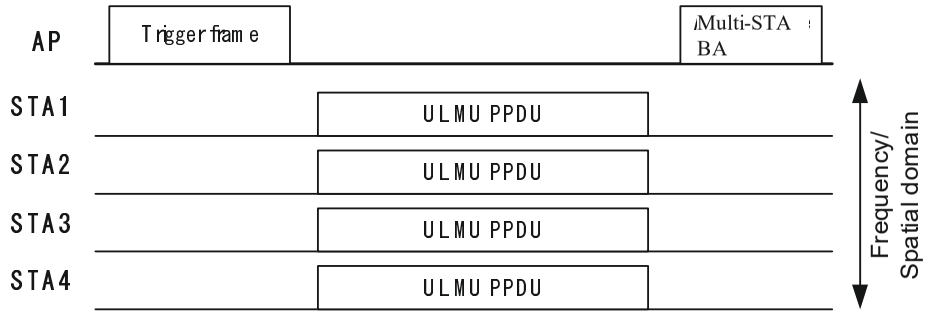
- Multi-TID BA acknowledges MPDUs of multiple TIDs from one STA.
- Frames from a TID without BA negotiation can't be acknowledged by Multi-TID BA.
- Management frame in A-MPDU can't be acknowledged by Multi-TID BA.

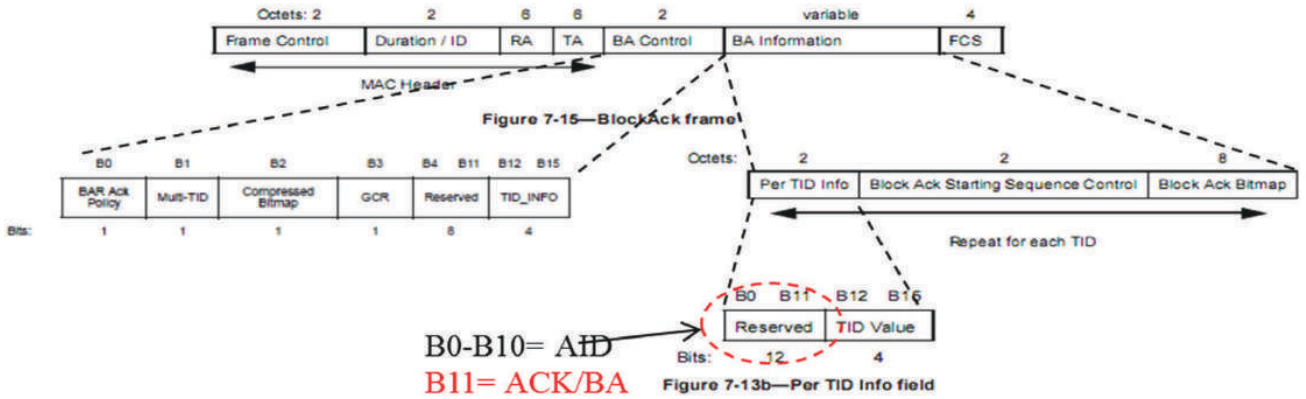
1406



Multi-STA BA Recap

- Multi-STA BA is used to acknowledge UL MU A-MPDUs from multiple STAs.
- Multi-STA BA supports BA acknowledgement and Ack acknowledgement for multiple TIDs of a STA.
- The management frame in A-MPDU can't ask for acknowledgement.



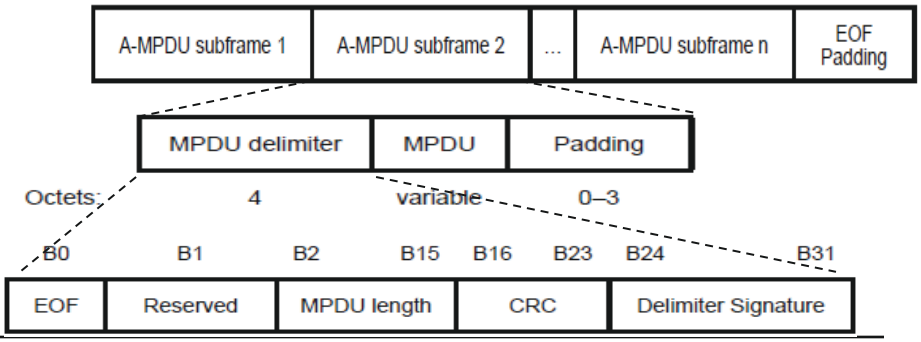


1407

OFDMA A-MPDU Aggregation Rules

- MPDUs from multiple TIDs that need to acknowledged by Ack or BA can be aggregated in one A-MPDU.
  - A STA doesn't need to do BA negotiation for each TID in order to aggregate MPDUs to A-MPDU.
  - MPDUs in A-MPDU should indicate whether Ack or BA is used to carry acknowledgement information.
- When EoF is 1, MPDU length is not 0 and Ack Policy of the MPDU is Normal Ack Request, the MPDU asks for acknowledgement by Ack SIFS after the OFDMA transmission.
  - At most one such data MPDU for a TID is allowed in an A-MPDU.
  - At most one such management MPDU is allowed in an A-MPDU.
- When EoF is 0 and MPDU length is not 0 and Ack Policy of the MPDU is Implicit Block Ack Request or related TID of the MPDU is indicated by Block Ack Request, the MPDU asks for acknowledgement by BA SIFS after the OFDMA transmission.
- When EoF is 0 and MPDU length is not 0, Ack Policy of the MPDU is Block Ack Request , and the related TID of the MPDU is not indicated by Block Ack Request, the MPDU asks for acknowledgement by BA in the future (no immediate response frame).

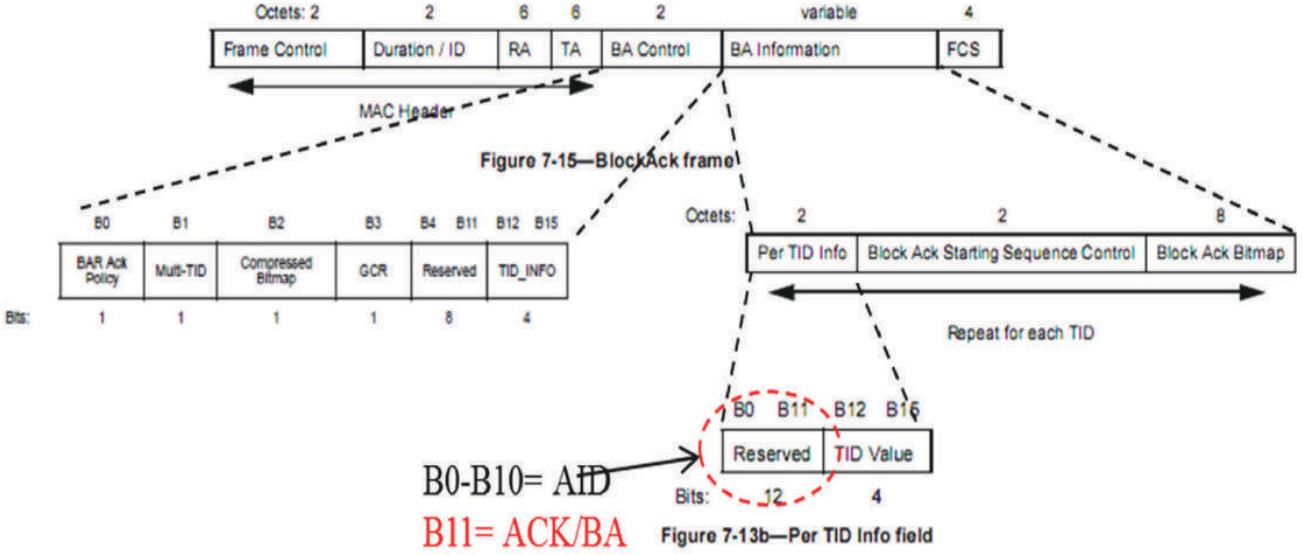
1408



Enhanced (Single STA) Multi-TID BA

- The Multi-STA M-BA is also used for single STA acknowledgement
  - when DL MU A-MPDU includes multiple TIDs, or
  - when UL multi-TID MU A-MPDUs are acknowledged by DL OFDMA/MU PPDU.
- When Multi-STA M-BA is used for single user, RA is unicast MAC address
  - AID field is TBD.

1409



References

- [1] Draft P802.11REVmc_D5.0
- [2]11-15/132r13 Specification Framework for TGax

Straw Poll 1

Do you agree to add the following text to the SFD 4.1 General?

- **MPDUs from multiple TIDs that ask for Ack and/or BA acknowledgement and management frame that asks for Ack acknowledgement may be aggregated in one A-MPDU of MU transmission**

1411

Straw Poll 2

Do you agree to add the following text to the SFD subclause 4.2 DL MU Operation:

- **The spec shall allow UL MU transmission of Multi-STA Block ACK frame in response to multi-TID A-MPDU of DL MU transmission. The value of the AID field in M-BA is TBD**

1412

APPENDIX AE

1 **IEEE P802.11**
2 **Wireless LANs**

Proposed TGax draft specification

Date: 2016-03-02

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Abstract

This document contains a proposal for the TGax draft amendment. It captures the feature requirements outlined in the TGax specification framework document (11-15/0132) in detailed draft text.

1 Preface

1.1 Revision history

Revision	Date	Changes
0	January 15, 2016	Initial draft
1	March 2, 2016	Created a new MAC clause and moved most of the MAC stuff there. Added text contributions for recent SFD additions. Additional authors.

1.2 Notation

Editing instructions are shown in ***bold italic***.

Editor's notes in ***red bold italics*** are provided to aid in drafting the document. For example, missing text or indicating the placement of future text.

1.3 Baseline document

This document is written as an amendment to the Draft P802.11-REVmc/D5.00 revision of the 802.11 specification as amended by Draft P802.11ai/D6.3 and Draft P802.11ah/D6.0.

2 Normative references

3 Definitions, acronyms, and abbreviations

3.1 Definitions

3.2 Definitions specific to IEEE Std 802.11

3.3 Definitions specific to IEEE 802.11 operation in some regulatory domains

3.4 Abbreviations and acronyms

Insert the following acronym definitions:

DL	Dowlink
DL MU	Downlink multi-user
HE	High Efficiency
OFDMA	Orthogonal Frequency-Division Multiple Access
MU-RTS	Multi-user request to send
UL	Uplink

3.5 Abbreviations and acronyms in some regulatory domains

4 General description

4.3 Components of the IEEE Std 802.11 architecture

4.3.12a High efficiency (HE) STA

The IEEE Std 802.11 HE STA operates in frequency bands between 1 GHz and 6 GHz.

An HE STA is VHT STA that, in addition to the features supported as a VHT STA, supports the MAC features defined in Clause 25 and the PHY features defined in Clause 26.

5 MAC service definition

6 Layer management

6.3 MLME SAP interface

6.3.7 Associate

6.3.7.2 MLME-ASSOCIATE.request

6.3.7.2.2 Semantics of the service primitive

Insert the following new parameter into the primitive:

HE Capabilities

Insert the following new entiry to the unnumbered table in this subclause:

HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

6.3.7.3 MLME-ASSOCIATE.confirm

6.3.7.3.2 Semantics of the service primitive

Insert the following new parameter into the primitive:

HE Capabilities

Insert the following new entiry to the unnumbered table in this subclause:

HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

6.3.8 Reassociate

6.3.8.2 MLME-REASSOCIATE.request

6.3.8.2.2 Semantics of the service primitive

Insert the following new parameter into the primitive:

HE Capabilities

Insert the following new entiry to the unnumbered table in this subclause:

HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

6.3.8.3 MLME-REASSOCIATE.confirm

6.3.8.3.1 Semantics of the service primitive

Insert the following new parameter into the MLME-START.request primitive:

HE Capabilities

Insert the following new entiry to the unnumbered table in this subclause:

HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

6.3.11 Start

6.3.11.2 MLME-START.request

6.3.11.2.2 Semantics of the service primitive

Insert the following new parameters into the MLME-START.request primitive:

HE Capbilities

HE Operation

Insert the following new entires to the unnumbered table in this subclause:

Name	Type	Valid Range	Description
HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	The HE capabilities to be advertised for the BSS. The parameter is present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.
HE Operation	As defined in frame format HE Operation element.	As defined in 9.4.2.214 (HE Operation element)	The additional HE capabilities to be advertised for the BSS. The parameter is present if BSSType = INFRASTRUCTURE and dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

7 DS SAP specification

8 PHY service specification

9 Frame formats

9.1 General requirements

9.2 MAC frame formats

9.2.4 Frame fields

9.2.4.1 Frame Control field

9.2.4.1.3 Type and Subtype fields

Change the row below and insert a new row immediately after it in Table 8-1 as follows:

Table 9-1 - Valid type and subtype combinations

Type value B3 B2	Type	Subtype value B7 B6 B5 B4	Subtype description
01	Control	0000-~~0011~~<ANA>	Reserved
01	Control	<ANA>	Trigger

9.2.4.1.10 Order field

Change as follows:

The Order field is 1 bit in length. It is used for two purposes:

— It is set to 1 in a non-QoS Data frame transmitted by a non-QoS STA to indicate that the frame contains an MSDU, or fragment thereof, that is being transferred using the StrictlyOrdered service class.

— It is set to 1 in a QoS Data or Management frame transmitted with a value of HT_GF, HT_MF, ~~or~~ VHT, or HE for the FORMAT parameter of the TXVECTOR to indicate that the frame contains an HT Control field.

Otherwise, the Order field is set to 0.

NOTE—The Order field is always set to 0 for frames transmitted by a DMG STA.

9.2.4.6 HT Control field

9.2.4.6.1 General

Remove Figure 9-7 (HT Control field).

Insert Table 9-9a (HT Control field) as follows:

Table 9-9a – HT Control field

Variant	Bit 0 (value)	Bit 1 (value)	Bit 2-29	Bit 30	Bit 31
HT variant	VHT (0)	HT Control Middle		AC Constraint	RDG/More PPDU
VHT variant	VHT (1)	HE (0)	VHT Control Middle	AC Constraint	RDG/More PPDU
HE variant	VHT(1)	HE (1)	Aggregated Control		

Change the paragraphs below of 9.2.4.6.1 as follows:

The HT Control field has ~~two~~ different forms, the HT variant, ~~and~~ the VHT variant, and the HE variant. These forms differ in the values of the VHT and/or HE subfields and in their formats, which are shown in Table 8-9a (HT Control field).

The VHT subfield is set to 0 to indicate a HT variant HT Control field. The VHT subfield is set to 1 and the HE subfield is set to 0 to indicate a VHT variant HT Control field. The VHT subfield is set to 1 and the HE subfield is set to 1 to indicate a HE variant HE Control field.

The two forms differ in the format of tThe HT Control Middle subfield, described is defined in 8.2.4.6.2 (HT variant) for the HT variant and

The VHT Control Middle subfield is defined in 8.2.4.6.3 (VHT variant)~~ for the VHT variant and in the value of the VHT subfield~~.

The Aggregated Control subfield is defined in 8.2.4.6.4 (HE variant).

~~The VHT subfield of the HT Control field indicates whether the HT Control Middle subfield is the VHT Variant or the HT Variant. The VHT subfield is set to 1 to indicate that the HT Control Middle subfield is the VHT Variant and is set to 0 to indicate that the HT Control Middle subfield is the HT Variant.~~

9.2.4.6.3 VHT variant

Change the paragraph below as follows:

The format of the VHT Control Middle subfield of the VHT variant HT Control field is shown in Figure 9-12 (VHT Control Middle subfield of the VHT variant HT Control field).

Change Figure 9-12 as follows:

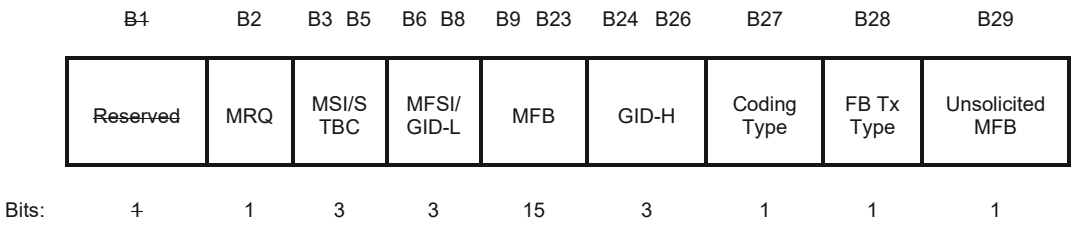


Figure 9-12 — VHT Control Middle subfield of the VHT variant HT Control field

Insert a new subclause 9.2.4.6.4 following 9.2.4.6.3:

9.2.4.6.4 HE variant

9.2.4.6.4.1 General

The format of the Aggregated Control (A-Control) subfield of the HE variant HT Control is shown in Figure 9.14a (HE variant HT Control field format).

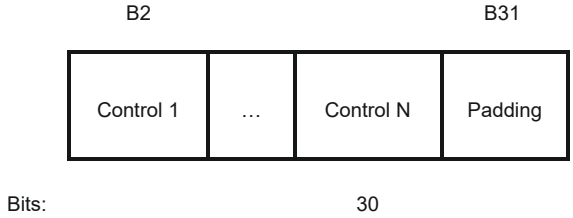


Figure 9-14a - A-Control subfield of the HE variant HT Control field

The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined in Figure 9.14b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence.

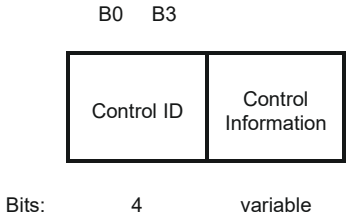


Figure 9-14b - Control subfield format

The Control ID subfield indicates the type of information carried in the Control Information subfield, and the length of the Control Information subfield, which is fixed and that corresponds to each value of the Control ID subfield. The values of the Control ID subfield and the associated length of the Control Information subfield are defined in Table 9-18a (Control ID subfield values).

Table 9-18a - Control ID subfield values

Control ID value	Meaning	Length, in bits, of the Control Information subfield	Contents of the Control Information subfield
0	UL MU response scheduling	*TBD*	See 8.2.4.6.4.2 (UL MU response scheduling)
1	Receive operation mode indication	*TBD*	See 8.2.4.6.4.3 (Receive operation mode indication)
2	HE link adaptation	*TBD*	See 8.2.4.6.4.4 (HE link adaptation)
TBD	…		
8-15	Reserved		

The Control Information subfield carries control information that depends on the Control ID value, as defined in Table 9-18a (Control ID subfield values).

The Padding subfield follows the last Control subfield and is set to a sequence of zeros so that the length of the A-Control subfield is 30 bits.

9.2.4.6.4.2 UL MU response scheduling

The Control Information subfield, when the Control ID subfield is 0, contains scheduling information for an HE trigger-based PPDU that carries an immediate acknowledgement, which is sent as a response to the soliciting A-MPDU (see 9.42.2 (UL MU operation)).

The format of the Control Information subfield is defined in Figure 9-14c (Control Information subfield format when Control ID subfield is 0).

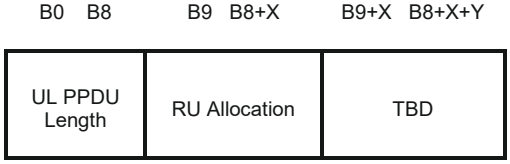




Figure 9-14c - Control Information subfield format when Control ID subfield is 0

The UL PPDU Length subfield indicates the length of the HE trigger-based PPDU response and is set to a nonzero value that is TBD.

The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE trigger-based PPDU response and is set to TBD.

9.2.4.6.4.3 Receive operation mode indication

The Control Information subfield, when the Control ID subfield is 1, contains information related to the receive operation mode of the STA transmitting the frame containing this information (see 25.8 (Receive operating mode indication)).

The format of the Control Information subfield is defined in Figure 9-14d (Control Information subfield format when Control ID subfield is 1).

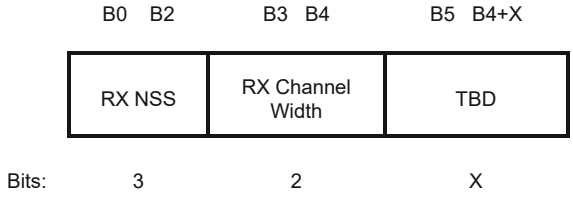


Figure 9-14d - Control Information subfield format when Control ID subfield is 1

The RX NSS subfield indicates the maximum number of spatial streams, N_{SS}, supported by the STA in reception, and is set to $N_{SS} - 1$.

The RX Channel Width subfield indicates the operating channel width supported by the STA in reception, and is set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, and 3 for 160 MHz.

9.2.4.6.4.4 HE link adaptation

The Control Information subfield, when the Control ID subfield is 2, contains information related to the HE link adaptation procedure (see 9.31.4 (Link adaptation using the HE variant HT Control field)).

The format of the Control Information subfield is defined in Figure 9-14e (Control Information subfield format when Control ID subfield is 2).

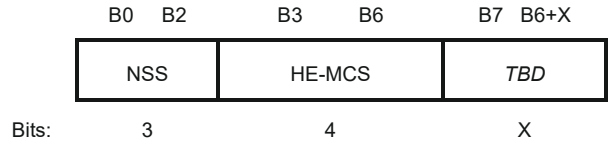


Figure 9-14e - Control Information subfield format when Control ID subfield is 2

The NSS subfield indicates the recommended number of spatial streams, N_{SS}, and is set to $N_{SS} - 1$.

The HE-MCS subfield indicates the recommended HE-MCS, and is set to the HE-MCS Index value (defined in 26.5 (Parameters for HE-MCSs)).

9.2.5 Duration/ID field (QoS STA)

9.2.5.2 Setting for single and multiple protection under enhanced distributed channel access (EDCA)

Change item a) of the 2nd paragraph of this subclause as follows:

The Duration/ID field is determined as follows:

a) Single protection settings.
   1) In an RTS frame that is not part of a dual clear-to-send (CTS) exchange, the Duration/ID field is set to the estimated time, in microseconds, required to transmit the pending frame, plus one CTS frame, plus one Ack or BlockAck frame if required, plus any NDPs required, plus explicit feedback if required, plus applicable IFSs.

   1a) In an MU-RTS frame, the Duration/ID field is set to the estimated time, in microseconds, required for the pending transmission.

Change item b) of the 2nd paragraph of this subclause as follows:

b) Multiple protection settings. The Duration/ID field is set to a value D as follows:
   1) If $T_{TXOP} = 0$ and $T_{END\_NAV} = 0$, then $D = T_{SINGLE\text{-}MSDU} - T_{\text{PPDU}}$
   2) Else if $T_{TXOP} = 0$ and $T_{END\_NAV} > 0$, then $D = \max(0, T_{END\text{-}NAV} - T_{PPDU})$
   3) Else if $T_{END\text{-}NAV} = 0$, then $\min(T_{PENDING}, T_{TXOP} - T_{PPDU}) \le D \le T_{TXOP} - T_{PPDU}$
   4) Else $T_{END\text{-}NAV} - T_{PPDU} \le D \le T_{TXOP\text{-}REMAINING} - T_{PPDU}$

   where

   $T_{SINGLE\text{-}MSDU}$ is the estimated time required for the transmission of the allowed frame exchange sequence defined in 9.22.2.8 (TXOP limits) (for a TXOP limit of 0), including applicable IFSs

   $T_{PENDING}$ is the estimated time required for the transmission of
   - Pending MPDUs of the same AC
   - Any associated immediate response frames
   - Any HT NDP, VHT NDP, or Beamforming Report Poll frame transmissions and explicit feedback response frames
   - Applicable IFSs
   - Any RDG
   - Any DL MU PPDUs
   - Any HE trigger-based PPDUs
   - Any Trigger frames to solicit HE trigger-based PPDUs

   T_{TXOP} is the duration given by dot11EDCATable-TXOPLimit (dot11QAP-EDCATableTXOPLimit for the AP) for that AC

   $T_{TXOP\text{-}REMAINING}$ is T_{TXOP} less the time already used time within the TXOP

   $T_{END\text{-}NAV}$ is the remaining duration of any NAV set by the TXOP holder, or 0 if no NAV has been established

   T_{PPDU} is the time required for transmission of the current PPDU

9.2.5.7 Setting for control response frames

Insert a new paragraph after the 2nd paragraph of this subclause:

In a CTS frame that is transmitted in response to an MU-RTS frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the MU-RTS frame that elicited the CTS frame minus the time, in microseconds, between the end of the PPDU carrying the MU-RTS frame and the end of the PPDU carrying the CTS frame.

9.3 Format of individual frame types

9.3.1 Control frames

9.3.1.3 CTS frame format

Change the 2nd paragraph of this subclause as follows:

When the CTS frame is a response to an RTS frame, the value of the RA field of the CTS frame is set to the address from the TA field of the RTS frame with the Individual/Group bit forced to the value 0. When the CTS frame is a response to an MU-RTS frame, the value of the RA field of the CTS frame is set to the address from the TA field of the MU-RTS frame with the Individual/Group bit forced to the value 0.

9.3.1.9 BlockAck frame format

Change Figure 9-32 as follows:

	B0	B1	B2	B3	B4	~~B4~~B5 B11	B12 B15
	BA Ack Policy	Multi-TID	Compressed Bitmap	GCR	Multi-STA	Reserved	TID_INFO
Bits	1	1	1	1	1	~~8~~7	4

Figure 9-32 - BA Control field

Change the 6th paragraph of this subclause as follows:

For BlockAck frames sent under Delayed and HT-delayed agreements, the BA Ack Policy subfield of the BA Control field has the meaning shown in Table 9-23 (BA Ack Policy subfield). For BlockAck frames sent under other types of agreement, the BA Ack Policy subfield is reserved. A BlockAck frame with the Multi-STA subfield equal to 1 is not sent under Delayed and HT-delayed agreements.

Change Table 9-24 as follows:

Table 9-24 - Block Ack frame variant encoding

Multi-TID subfield value	Compressed Bitmap subfield value	GCR subfield value	Multi-STA Subfield value	BlockAck frame variant
0	0	0	0	Basic BlockAck
0	1	0	0	Compressed BlockAck
1	0	0	0	Extended Compressed BlockAck
1	1	0	0	Multi-TID BlockAck
0	0	1	0	Reserved
0	1	1	0	GCR Block Ack
1	0	1	0	Reserved
1	1	1	0	Reserved
0	0	0	1	Reserved
0	1	0	1	Reserved
1	0	0	1	Reserved
1	1	0	1	Multi-STA BlockAck
0	0	1	1	Reserved
0	1	1	1	Reserved
1	0	1	1	Reserved
1	1	1	1	Reserved

Change the 7th paragraph of this subclause as follows:

The values of the Multi-TID, Compressed Bitmap, ~~and~~ GCR and Multi-STA subfields of the BA Control field determine which of the BlockAck frame variants is represented, as indicated in the Table 9-24.

9.3.1.9.3 Compressed BlockAck variant

Change subclause 9.3.1.9.3 as follows:

The TID_INFO subfield of the BA Control field of the Compressed BlockAck frame contains the TID for which this BlockAck frame is sent.

The BA Information field of the Compressed BlockAck frame comprises the Block Ack Starting Sequence Control subfield and the Block Ack Bitmap subfield, as shown in Figure 9-34 (BA Information field (Compressed BlockAck)). The Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield contains the sequence number of the first MSDU or A-MSDU for which this BlockAck frame is sent. The value of this subfield is defined in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA). ~~The Fragment Number subfield of the Block Ack Starting Sequence Control subfield is set to 0.~~

When the Fragment Number subfield is 0, ~~T~~the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is 8 octets in length and is used to indicate the received status of up to 64 MSDUs and A-MSDUs. Each bit that is equal to 1 in the compressed Block Ack Bitmap field acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number, with the first bit of the Block Ack Bitmap field corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

When the Fragment Number subfield is 1, the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is used to indicate the receive status of up to 16 MSDUs and A-MSDUs. Bit position *n* of the Block Ack Bitmap field, if equal to 1, acknowledges receipt of an MPDU with sequence number value, *SN* and fragment number value, *FN* with *n* equal to 4 × (*SN* – *SSN*) + *FN*, where *SSN* is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield and the operations on the sequence numbers are performed modulo 4096. When bit position *n* of the Block Ack Bitmap field is equal to 0 it indicates that the MPDU has not been received.

NOTE—When the Fragment Number subfield is equal to 1 then the BlockAck Bitmap field is split into 16 subbitmaps, each of which indicates receive status for 4 fragments of each of the 16 MSDUs.

Insert a new subclause after 9.3.1.9.6:

9.3.1.9.7 Multi-STA BlockAck variant

The TID_INFO subfield of the BA Control field of the Multi-STA BlockAck frame is reserved.

The BA Information field of the Multi-STA BlockAck frame comprises one or more instances of the Per STA Info subfields. The Per STA Info subfield is shown in Figure 9-37a.

	Per-AID TID Info	Block Ack Starting Sequence Control	Block Ack Bitmap
Octets	2	0 or 2	0 or 8

Figure 9-37a - Per STA Info subfield format

The Per AID TID Info subfield is shown in Figure 9-37b.

	B0 B10	B11	B12-B15
	AID	ACK Type	TID
Bits	11	1	4

Figure 9-37b - Per AID TID Info subfield format

The AID field carries the AID of the STA for which the Per STA Info field is intended.

The TID field contains the TID for which the acknowledgement or block acknowledgement applies.

If the ACK Type field is 0, then the Block Ack Starting Sequence Control and Block Ack Bitmap are not present and the Per STA Info field indicates the acknowledgement of successful reception of either a single MPDU or of all the MPDUs carried in the eliciting (A-) MPDU. If the ACK Type subfield is 1, then the Block Ack Starting Sequence Control and Block Ack Bitmap fields are present.

When the Fragment Number subfield is 1, the Block Ack Starting Sequence Control subfield is as shown in Figure 9-27. The Block Ack Bitmap subfield of the BA Information field of the Multi-STA BlockAck frame contains an 8-octet block ack bitmap. Each bit that is equal to 1 in the Block Ack Bitmap subfield acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number with the first bit of the Block Ack Bitmap subfield corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

When the Fragment Number subfield is 1, the Block Ack Bitmap subfield of the BA Information field of the Multi-STA Block Ack frame is used to indicate the receive status of up to 16 MSDUs and A-MSDUs. Bit position *n* of the Block Ack Bitmap field, if equal to 1, acknowledges receipt of an MPDU with sequence number value, *SN* and fragment number value, *FN* with n equal to $4 \times (SN - SSN) + FN$, where *SSN* is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield and the operations on the sequence numbers are performed modulo 4096. When bit position *n* of the Block Ack Bitmap field is equal to 0 it indicates that the MPDU has not been received.

NOTE—When the Fragment Number subfield is equal to 1 then the BlockAck Bitmap field is split into 16 subbitmaps, each of which indicates receive status for 4 fragments of each of the 16 MSDUs.

Insert a new subclause after 9.3.1.22:

9.3.1.23 Trigger frame

The Trigger frame is used to allocate resource for UL MU transmission and to solicit an UL MU transmission at [TBD IFS] after the PPDU that carries the Trigger frame. The Trigger frame also carries other information required by the responding STA to send UL MU.

The frame format for the Trigger frame is as defined in Figure 9-51a (Trigger frame).

	Frame Control	Duration	(RA)	TA	Common Info	Per User Info	…	Per User Info	Padding	FCS
Octets:	2	2	6	6	TBD	TBD		TBD		4

Figure 9-51a - Trigger frame

The Duration/ID field is set as defined in 9.2.5 (Duration/ID field (QoS STA)).

The RA field of the Trigger frame is the address of the recipient STA. Whether RA is not part of Trigger frame is TBD.

The TA field value is the address of the STA transmitting the Trigger frame.

The Common Info field is defined in Figure 9-51b.

	Length	Cascade Indication	CS Required	HE-SIG-A Info	CP and LTF Type	Trigger Type	Trigger-dependent Common Info
Bits:	12	1	1	TBD	TBD	TBD	variable

Figure 9-51b - Common Info field

The Length subfield of the Common Info field indicates the value of the L-SIG Length field of the HE trigger-based PPDU that is the response to the Trigger frame.

If the Cascade Indication subfield is 1, then a subsequent Trigger frame follows the current Trigger frame. Otherwise the Cascade Indication subfield is 0.

The CS Required subfield is set to 1 to indicate that the STAs identified in the Per User Info fields are required to use ED to sense the medium and to consider the medium state and the NAV in determining

whether or not to repond. The CS Requred subfield is set to 0 to indicate that the STAs identified in the Per User Info fields are not required consider the medium state or the NAV in determining whether or not to respond.

The HE-SIG-A Info subfield of the Common Info field indicates the content of the HE-SIG-A field of the HE trigger-based PPDU response. The TBD bits in HE-SIG-A of the HE trigger-based PPDU that may be implicitly known by all responding STAs can be excluded.

The CP and LTF Type subfield of the Common Info field indicates the CP and HE-LTF type of the HE trigger-based PPDU response. The CP and LTF field encoding is defined in Table 9-2.

Table 9-2 - CP and LTF field encoding

CP and LTF field value	Description
0	2x LTF + 0.8 μs CP
1	2x LTF + 1.6 μs CP
2	4x LTF + 3.2 μs CP
3-TBD	Reserved

The Trigger Type subfield indicates the type of the Trigger frame. The Trigger frame can include an optional type-specific Common Info and optional type-specific Per User Info. Table 9-3 defines the valid Trigger Type.

Table 9-3 - Trigger Type field encoding

Trigger Type value	Trigger Type description
0	Basic Trigger
1	Beamforming Report Poll Trigger
2	MU-BAR
3	MU-RTS
4-TBD	Reserved

The Per User Info field is defined in Figure 9-1.

	User Indentifier	RU Allocation	Coding Type	MCS	DCM	SS Allocation	Trigger dependent Per User Info
Bits:	12	TBD	TBD	TBD	TBD	TBD	variable

Figure 9-1 - Per User Info field

The User Identifier subfield of the Per User Info field indicates the AID of the STA allocated the RU to transmit the MPDU(s) in the HE trigger-based PPDU.

The RU Allocation subfield of the Per User Info field indicates the RU used by the HE trigger-based PPDU of the STA identified by User Identifier subfield. The length and coding of RU Allocation subfield are TBD.

The Coding Type subfield of the Per User Info field indicates the code type of the HE trigger-based PPDU response of the STA identified by User Identifier subfield. Set to 0 for BCC and set to 1 for LDPC.

The MCS subfield of the Per User Info field indicates the MCS of the HE trigger-based PPDU response of the STA identified by User Identifier field. The encoding of the MCS field is as defined in Section XXX.

The DCM subfield of the Per User Info field indicates dual carrier modulation of the HE trigger-based PPDU response of the STA identified by User Identifier subfield. A value of 1 indicates that the HE trigger-based PPDU response shall use DCM as defined in section XXX. Set to 0 to indicate that DCM shall not be used.

The SS Allocation subfield of the Per User Info field indicates the spatial streams of the HE trigger-based PPDU response of the STA identified by User Identifier field.

The Padding field extends the frame length to give the recipient STAs more time to prepare a response. The length and the content of Padding field are TBD.

9.3.1.23.1 MU-BAR variant

If the Trigger frame is an MU-BAR vaiant, then the Trigger-dependent Common Info field is define in Figure 9-2.

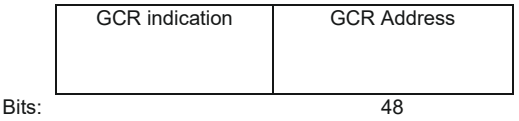


Figure 9-2 – Trigger-dependent Common Info field for MU-BAR variant

If the Trigger frame is an MU-BAR vaiant, then the Trigger-dependent Per User Info field is define in Figure 9-3.

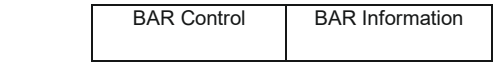


Figure 9-3 - Trigger-dependent Per User Info field for MU-BAR variant

The BAR Control subfield is defined in 9.3.1.8 (BlockAckReq frame format).

The BAR Information subfield is defined in 9.3.1.8 (BlockAckReq frame format).

9.3.1.23.2 MU-RTS variant

The MU-RTS frame format is a variant of Trigger frame format as shown in Figure 9-51a.

If an MU-RTS frame requests a STA to respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU, the RU Allocation subfield in the Per-User Info field addressed to the STA indicates whether the CTS frame is transmitted on the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel.

The Duration/ID field is defined in 9.2.5.2 Duration/ID field (QoS STA).

9.3.2 Data frames

9.3.3 Management frames

9.3.3.2 Beacon frame format

Insert the following new rows (header row shown for convenience) into Table 9-27 (Beacon frame body):

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	TWT	The TWT element is optionally present when the dot11TWTOptionActivated is true; otherwise it is not present.

9.3.3.5 Association Request frame format

Insert the following new rows (header row shown for convenience) into Table 9-29 (Association frame body):

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.6 Association Response frame format

Insert the following new rows (header row shown for convenience) into Table 9-30 (Beacon frame body):

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.7 Reassociation Request frame format

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.8 Reassociation Response frame format

Insert the following new rows (header row shown for convenience) into Table 9-32 (Reassociation Response frame body):

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.9 Probe Request frame format

Insert the following new rows (header row shown for convenience) into Table 9-33 (Probe Request frame body):

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.10 Probe Response frame format

Insert the following new rows (header row shown for convenience) into Table 9-34 (Probe Response frame body):

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.4 Management and Extension frame body components

9.4.1 Fields that are not elements

Insert the following two sublauses:

9.4.1.62 HE Compressed Beamforming Report field

The format of the HE Compressed Beamforming Report field is based on the VHT Compressed Beamforming Report field in 9.4.1.48 (VHT Compressed Beamforming Report field) except for the following modifications.

The supported values for the tone grouping factor Ng shall be *Ng* = 4 and *Ng* = 16 for SU-MIMO, MU-MIMO and OFDMA. Here, the tone grouping factor Ng is defined with respect to data tones of the HE PPDU.

Other modification are TBD.

9.4.1.63 HE MU Exclusive Beamforming Report field

The HE MU Exclusive Beamforming Report Field is based on the VHT Exclusive Beamforming Report Field in 9.4.1.50, except for the following modifications.

The MU Exclusive Beamforming Report information consists of Delta SNR subfields for each space-time stream (1 to *Nc*) of a subset of the subcarriers spaced *Ng* apart (where *Ng* is the tone grouping factor). Specifically, the locations of the feedback tones for delta SNR subfields shall be identical to the tone locations of the compressed V matrices fed back.

Other modification are TBD.

9.4.2 Elements

9.4.2.1 General

Insert the following new rows into Table 9-75 Element IDs (header row shown for convenience):

Element	Element ID	Element ID Extension	Extensible
HE Capabilities (see 9.4.2.213 (HE Capabilities element))	<ANA>	N/A	Yes
HE Operation (see 9.4.2.214 (HE Operation element))	<ANA>	N/A	Yes

9.4.2.196 TWT element

Change bit B3 from "Reserved" to "Broadcast" in Figure 8-577ax (Control field format).

Insert the following paragraph after Table 9-248l (TWT Setup Command field values):

The Broadcast field indicates if the TWT SP indicated by the TWT element is a broadcast TWT as defined in 9.44.3 (Broadcast TWT Operation). The Broadcast field is set to 1 to indicate that the TWT(s) defined by the TWT element are broadcast TWT(s); otherwise, it is set to 0.

Change bit B4 from "Reserved" to "Trigger" in Figure 9-577ay (Request Type field format).

Insert the following paragraph after Table 9-248l (TWT Setup Command field values):

The Trigger field indicates if the TWT SP indicated by the TWT element includes Trigger frames as defined in 10.44 (Target wake time (TWT)). The Trigger field is set to 1 to indicate that at least one Trigger frame is transmitted during the TWT SP. The Trigger field is set to 0 otherwise.

Change the text as shown in subclause 9.4.2.196 TWT element:

For a TWT SP that is not a broadcast TWT SP, Tthe TWT Flow Identifier subfield contains a 3-bit value which identifies the specific information for this TWT request uniquely from other requests made between the same TWT requesting STA and TWT responding STA pair. For a TWT SP that is a broadcast TWT SP, the TWT Flow Identifier subfield contains a value that indicates recommendations on the types of frames that are transmitted during the broadcast TWT SP, encoded according to Table 9-248l1 (TWT Flow Identifier field for a broadcast TWT element).

Table 9-248l1 - TWT Flow Identifier field for a broadcast TWT element

TWT Flow Identifier field value	Description when transmitted in a broadcast TWT element
0	No constraints on the frames transmitted during a broadcast TWT SP.

1	Frames transmitted during a broadcast TWT SP are recommended to be limited to: PS-Poll, CQI, QoS Null with buffer status, Sounding Feedback, Management Action Trigger frames transmitted by the AP during the broadcast TWT SP do not contain RUs for random access.
2	Frames transmitted during a broadcast TWT SP are recommended to be limited to: PS-Poll, CQI, QoS Null with buffer status, Sounding Feedback, Management Action, (Re)Association Request Trigger frames transmitted by the AP during the broadcast TWT SP contain at least one RU for random access.
3-7	Reserved

Change the paragraph below as follows:

In a TWT element transmitted by a TWT requesting STA, the TWT wake interval is equal to the average time that the TWT requesting STA expects to elapse between successive TWT SPs. In a TWT element transmitted by a TWT responding STA, the TWT wake interval is equal to the average time that the TWT-responding STA expects to elapse between successive TWT SPs. In a TWT element contained in a TWT request/response that is sent to negotiate the wake intervals for beacon frames containing broadcast TWT, the TWT wake interval indicates the value of the listen interval (see 10.44.3.4 (Negotiation of TBTT and listen interval).

The TWT Wake Interval Exponent subfield is set to the value of the exponent of the TWT wake interval value in microseconds, base 2. The TWT wake interval of the requesting STA is equal to (TWT Wake Interval Mantissa) × 2^(TWT Wake Interval Exponent).

Change the paragraph below as follows:

When transmitted by a TWT requesting STA or a TWT scheduled STA, the Target Wake Time field contains a positive integer which corresponds to a TSF time at which the STA requests to wake, or a value of zero when the TWT Setup Command subfield contains the value corresponding to the command "Request TWT". When a TWT responding STA or a TWT scheduling STA with dot11TWTGroupingSupport equal to 0 transmits a TWT element to the TWT requesting STA, the TWT element contains a value in the Target Wake Time field which corresponds to a TSF time at which the TWT responding STA requests the TWT requesting STA or TWT scheduled STA to wake and it does not contain the TWT Group Assignment field.

Change Table 9-248l – TWT Setup Command field values by adding two new columns as shown:

Table 9-248l – TWT Setup Command field values

TWT Setup Command field value	Command name	Description when transmitted by a TWT requesting STA	Description when transmitted by a TWT responding STA	Description when transmitted by a TWT scheduled STA	Description when transmitted by a TWT scheduling STA
0	Request TWT	The Target Wake Time field of the TWT element contains 0s as the TWT responding STA specifies the target wake time value for this case, other TWT parameters* are suggested by the TWT requesting	N/A	The Target Wake Time field of the TWT element contains 0s as the TWT scheduling STA specifies the target wake time value for this case, other TWT parameters* are suggested by the TWT scheduled STA in the TWT request.	N/A

		STA in the TWT request.			
1	Suggest TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodate, then the TWT setup might still be accepted.	N/A		N/A
2	Demand TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodate, then the TWT setup will be rejected.	N/A		N/A
3	TWT Grouping		N/A	N/A	N/A
4	Accept TWT	N/A	TWT responding STA accepts the TWT request with the TWT parameters* indicated in the TWT element transmitted by the responding STA.	N/A	TWT scheduling STA accepts the TWT request with the TWT parameters* indicated in the TWT element transmtted by the TWT scheduled STA.
5	Alternate TWT	N/A	TWT responding STA suggests TWT parameters that are different from TWT requesting STA suggested or demanded TWT parameters	N/A	N/A
6	Dictate TWT	N/A	TWT responding STA demands TWT parameters that are different from TWT requesting STA TWT suggested or demanded parameters	N/A	
7	Reject TWT	N/A	TWT responding STA rejects TWT setup	N/A	TWT scheduling STA rejects TWT setup
*TWT Parameters are: TWT, Nominal Minimum Wake Duration, TWT Wake Interval and TWT Channel subfield values indicated in the element.					

Insert the following new subclauses after the last subclause in 9.4.2:

9.4.2.213 HE Capabilities element

An HE STA declares that it is an HE STA by transmitting the HE Capabilities element.

The HE Capabilities element contains a number of fields that are used to advertise the HE capabilities of an HE STA. The HE Capabilities element is defined in Figure 9-554aa (HE Capabilities element format).

	Element ID	Length	HE Capabilities Information	PPE Thresholds (optional)
Octets:	1	1	2	variable

Figure 9-554aa - HE Capabilities element format

The Element ID and Length fields are defined in 9.4.2.1 (General).

The format of the HE Capabilities Information field is defined in Figure 9-554ab (HE Capabilities field format).

	B0	B1	B2	B3 B4	B5 B15
	PPE Thresholds Present	TWT Requester Support	TWT Responder Support	Fragmentation Support	Reserved
Bits:	1	1	1	2	12

Figure 9-554b - HE Capabilities field format

The PPE Thresholds Present field indicates if the HE PPE Thresholds field is present or not. A value of 1 in this field means that the PPE Thresholds field is present. A value of 0 in this field means that the HE PPE Thresholds field is not present because no packet extension is ever required for the STA transmitting this field.

The TWT Requester Support field indicates support by an HE STA for the role of TWT requesting STA as described in 10.44 (Target wake time (TWT)). The field is set to 1 if dot11TWTOptionActivated is true, the STA is an HE STA and the STA supports TWT requester STA functionality (see 10.44 (Target wake time (TWT))). Set to 0 otherwise.

The TWT Responder Support field indicates support by an HE STA for the role of TWT responder STA as described in 10.44 (Target wake time (TWT)). The field is set to 1 if dot11TWTOptionActivated is true, the STA is an HE STA and the STA supports TWT responder STA functionality (see 10.44 (Target wake time (TWT))). Set to 0 otherwise.

The Fragmentation Support field indicates the level of HE fragmentation that is supported by a STA. The encoding of this field is described in Table 9-554ae (Fragmentation Support field encoding).

Table 9-554ae - Fragmentation Support field encoding

Fragmentation Support field value	Meaning
0	No support for HE Fragmentation
1	Support for fragments that are contained within a VHT single MPDU, no support for fragments within an A-MPDU
2	Support for up to one fragment per MSDU within a single A-MPDU
3	Support for multiple fragments per MSDU within an A-MPDU

The format of the PPE Thresholds field is defined in Figure 9-554ac (PPE Thresholds field format).

	B0 B1	B2 B3		
	NSS M1	RU Count	PPE Threshold Info	PPE Pad
Bits:	3	2	variable	variable

Figure 9-554ac -- PPE Thresholds field format

The NSS M1 subfield contains an unsigned integer that is equal to the number of NSS values minus one for which PPE threshold information is included in the PPE Thresholds field. For example, if the number of NSS values represented is 4, then the NSS M1 subfield contains the value 3.

The RU Count subfield contains an unsigned integer that is equal to the number of RU allocation values for which HE PPE threshold information is included in the PPE Thresholds field. The value of zero for this field is reserved. The value of three for this field is reserved.

The PPE Threshold Info field is (NSS M1 + 1) x RU Count x 6 bits in length. The format of the PPE Threshold Info field is defined in Figure 8-554ae (PPE Threshold Info field format).

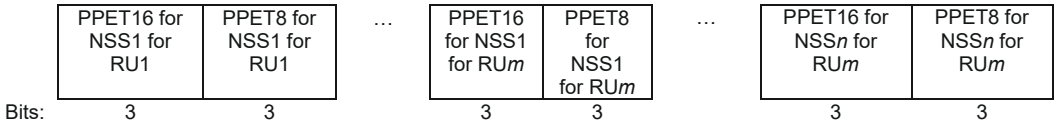


Figure 9-554ae - PPE Threshold Info field format

Each PPET8 for NSS*n* for RU*m* subfield contains a Constellation Index value.

Each PPET16 for NSS*n* for RU*m* subfield contains a Constellation Index value.

All the PPET8 for NSS*n* for RU*m* subfield and PPET16 for NSS*n* for RU*m* subfield values are combined to encode the minimum duration of the post-FEC padding and packet extension for HE PPDUs that are transmitted to the STA sending this field, for each value of NSS and RU specified by the field and implicitly, for values of NSS and RU not explicitly indicated in the field. The encoding is described in Table 9-554af (PPET8 and PPET16 encoding).

Table 9-554af - PPET8 and PPET16 encoding

Result of comparison of the constellation index *x* of an HE PPDU with NSS value *n* and RU value m to the value in the PPET8 for NSS*n* for RU*m* subfield	**Result of comparison of the constellation index of an HE PPDU with NSS value *n* and RU value m to the value in the PPET16 for NSS*n* for RU*m* subfield**	**Combined minimum total duration of the post-FEC padding and packet extension requirement for an HE PPDU transmitted to this STA using the constellation index = *x*, NSS = *n* and RU = *m***
X < PPET8 or PPET8 == NONE	X < PPET16 or PPET16 == NONE	0 μs
X > PPET8	X < PPET16 or PPET16 == NONE	8 μs
X > PPET8 or PPET8 == NONE	X > PPET16	16 μs
PPET8 == NONE	PPET16 == NONE	0 μs
PPET8 not present	PPET16 not present	0 μs

The RU Allocation Index encoding is indicated in Table 9-554ag (RU Allocation Index encoding).

Table 9-554ag - RU Allocation Index encoding

RU Allocation Index value	RU allocation value
0	2x996
1	996
2	484
3	242

The Constellation Index encoding is indicated in Table 9-554ah (Constellation Index encoding).

Table 9-554ah - Constellation Index encoding

Constellation Index value	Corresponding Transmission Constellation
0	BPSK
1	QPSK
2	16-QAM
3	64-QAM
4	256-QAM
5	1024-QAM

6	Reserved
7	NONE

The PPE Pad field contains all zeros. The number of bits in the PPE Pad field is the number of bits required to round the length of the PPE Thresholds field up to the next integer quantity of octets.

STA that declare support for HE trigger-based PPDU shall also declare whether they belong to class A or class B. Class A STAs that are high capability devices and Class B STAs are low capability devices.

9.4.2.214 HE Operation element

The operation of HE STAs in an HE BSS is controlled by the HT Operation element, the VHT Operation element and the HE Operation element. The format of the HE Operation element is defined in Figure 9-554ba (HE Operation element format).

	Element ID	Length	HE Operation Parameters
Octets:	1	1	2

Figure 9-554ba - HE Operation element format

The Element ID and Length fields are defined in 9.4.2.1 (General).

The format of the HE Operation Parameters field is defined in Figure 9-554bb (HE Operation Parameters field format).

	B0		B15
	BSS Color	Reserved	
Bits:	TBD	TBD	

Figure 9-554bb - HE Operation Parameters field format

The BSS Color field is an unsigned integer whose value is the BSS Color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS Color for this BSS.

9.4.3 Subelements

9.4.4 TLV encodings

9.4.5 Access network query protocol (ANQP) elements

9.4.6 Registered location query protocol (RLQP) elements

9.5 Fields used in Management and Extension frame bodies and Control frames

9.6 Action frame format details

9.7 Aggregate MPDU (A-MPDU)

9.7.3 A-MPDU contents

Change the first paragraph as follows:

In a non-DMG PPDU, an A-MPDU is a sequence of A-MPDU subframes carried in a single PPDU with one of the following combinations of RXVECTOR or TXVECTOR parameter values:

— The FORMAT parameter set to VHT

— The FORMAT parameter set to HT_MF or HT_GF and the AGGREGATION parameter set to 1

— The FORMAT parameter set to HE

Insert the following paragraph:

An A-MPDU carried in a HE MU PPDU may include MPDUs with different values of the TID field. Additional rules are TBD.

Insert the following three rows in Table 9-420 (A-MPDU Contexts):

Name of Context	Definition of Context	Table defining permitted content
Data Enabled Immediate Response with Multiple TID Support	The multiple TID A-MPDU is transmitted outside a PSMP sequence by a TXOP holder in DL/UL MU frame exchange or a STA in UL MU frame exchange sequence including potential immediate responses.	Table 9-426a (Multiple TID A-MPDU contents in the data enabled immediate response context)
Data Enabled No Immediate Response with Multiple TID Support	The multiple TID A-MPDU is transmitted outside a PSMP sequence by a TXOP holder in DL/UL MU frame exchange or a STA in UL MU frame exchange sequence that does not solicit immediate responses.	Table 8-426b (Multiple TID A-MPDU contents in the data enabled no immediate response context)
UL MU Context	An A-MPDU intended for a STA that is UL MU capable	Table 9-426c (A-MPDU content in the UL MU Context)

Insert the following two tables at the end of the subclause:

Table 9-426a - Multiple TID A-MPDU contents in the data enabled immediate response context

MPDU Description	Conditions	
Trigger frame	If the AP schedule resource for following UL MU transmission and HE A-Control field in data/management frames don't include trigger information.	
Ack frame	If the preceding PPDU contains an MPDU that requires an Ack frame response.	At most one of the MPDUs is present
BlockAck frame	If the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, at most one BlockAck frame for this TID.	
Multi-STA BlockAck frame	If the preceding PPDU contains implicit or explicit block ack request for multiple TIDs for which an HT-immediate block ack agreement exists, at most one Multi-TID BA frame.	
Action No Ack	Action No Ack frames	
Data frames sent under an HTimmediate block ack agreement	QoS Data frames with the multiple TIDs, with TID being corresponding to an HT-immediate block ack agreement	
QoS Null MPDUs with Ack Policy set to No Acknowledgment	In an HE BSS, QoS Null MPDUs with Ack Policy set to No Acknowledgment.	
Action frame	At most one Action frame	
Data frame whith TID that has no block ack agreement and with Ack Policy set to Normal Ack	At most one data frame of the TID	
Immediate BlockAckReq frames	At most one data frame for one TID that there is no data frames sent under	

Table 9-426b – Multiple TID A-MPDU contents in the data enabled no immediate response context

MPDU Description	Conditions	
Trigger frame	If the AP schedule resource for following UL MU transmission and HE A-Control field in data/management frames don't include trigger information.	
Ack frame	If the preceding PPDU contains an MPDU that requires an Ack frame response.	

BlockAck frame	If the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, at most one BlockAck frame for this TID.	At most one of the MPDUs is present
Multi-STA BlockAck frame	If the preceding PPDU contains implicit or explicit block ack request for multiple TIDs for which an HT-immediate block ack agreement exists, at most one Multi-TID BA frame.	
Action No Ack	Action No Ack frames	
Data frames without immediate block ack agreement and with Ack Policy set to No Ack	QoS Data frames with TIDs that does not correspond to a block ack agreement. These have the Ack Policy field equal to No Ack.	
QoS Null MPDUs with Ack Policy set to No Acknowledgment	In an HE BSS, QoS Null MPDUs with Ack Policy set to No Acknowledgment.	

Table 9-426c – A-MPDU content in the UL MU context

MPDU Description	Condition
A control frame of subtype Trigger	One or more Trigger frames can be included.
MPDU with trigger information in the MAC header	One or more MPDUs with trigger information in the MAC header may be included

10MAC sublayer functional description

10.1 Introduction

10.2 MAC architecture

10.3 DCF

10.3.1 General

Change as follows:

The virtual CS mechanism is achieved by distributing reservation information announcing the impending use of the medium. The exchange of RTS and CTS frames prior to the actual Data frame is one means of distribution of this medium reservation information. The RTS and CTS frames contain a Duration field that defines the period of time that the medium is to be reserved to transmit the actual Data frame and the returning Ack frame. A STA receiving either the RTS frame (sent by the originating STA) or the CTS frame (sent by the destination STA) shall process the medium reservation. Thus, a STA might be unable to receive from the originating STA and yet still know about the impending use of the medium to transmit a Data frame. The exchange of MU-RTS and simultaneous CTS responses by HE STAs prior to the actual Data frames as defined in 10.3.2.8a is one means of distribution of this medium reservation information.

10.3.2 Procedures common to the DCF and EDCAF

10.3.2.1 CS mechanism

Change as follows:

A virtual CS mechanism shall be provided by the MAC. This mechanism is referred to as the NAV. The NAV maintains a prediction of future traffic on the medium based on duration information that is announced in RTS/CTS frames by non-DMG STAs, MU-RTS/CTS by HE STAs as defined in 10.3.2.8a, and RTS/DMG CTS frames by DMG STAs prior to the actual exchange of data. The duration information is also available in the MAC headers of all frames sent during the CP other than PS-Poll frames, and during the BTI, the A-BFT, the ATI, the CBAP, and the SP. The mechanism for setting the NAV using RTS/CTS or MU-RTS/CTS or RTS/DMG CTS in the DCF is described in 10.3.2.4 (Setting and resetting the NAV),

use of the NAV in PCF is described in 10.4.3.3 (NAV operation during the CFP), and use of the NAV in HCF is described in 10.22.2.2 (EDCA backoff procedure) and 10.22.3.4 (NAV operation of a TXOP under HCCA). Additional details regarding NAV use appear in 10.3.2.5 (RTS/CTS with fragmentation), 10.3.2.13 (NAV distribution), 10.36.10 (Updating multiple NAV timers), and 10.26 (Protection mechanisms).

10.3.2.4 Setting and resetting the NAV

Insert the following at the end of 10.3.2.4:

An HE AP may use a TBD mechanism to configure the use of RTS/CTS initiated by non-AP STA.

Insert a new subclause following 10.3.2.8:

10.3.2.8a MU RTS/CTS procedure

The MU-RTS/CTS procedure allows an AP to protect MU transmission for HE STAs. An HE AP may transmit an MU-RTS frame to solicit simultaneous CTS responses from one or more HE STAs.

Figure 10-1 shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect DL MU PPDU and acknowledgement responses.

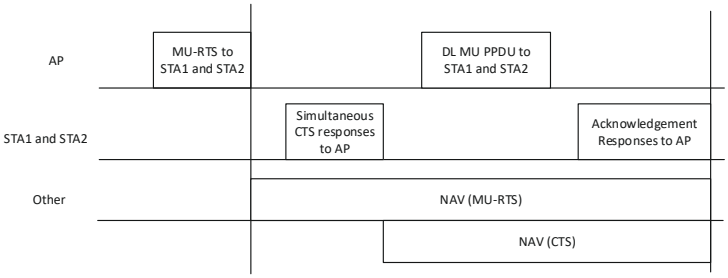


Figure 1 – Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting

Figure 10-1 – Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting

Figure 10-2 shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect the scheduled HE trigger-based PPDU and Multi-STA BlockAck frame.

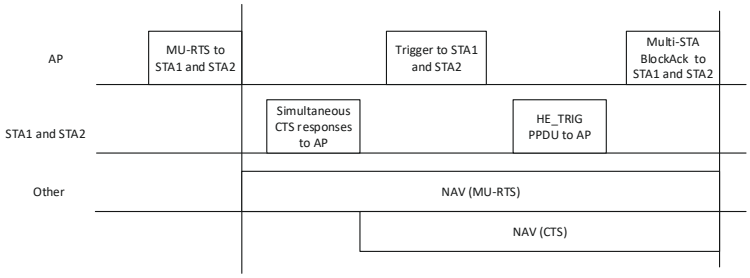


Figure 2 – Example of MU-RTS/CTS/Trigger/HE_TRIG PPDU/Multi-STA BlockAck and NAV setting

Figure 10-2 - Example of MU-RTS/CTS/Trigger/HE trigger-based PPDU/Multi-STA BlockAck and NAV setting

9.3.2.8a.1 MU-RTS procedure

An MU-RTS frame shall not request a STA to send CTS responses in any 20 MHz channel that is not occupied by the immediately preceding DL PPDU that contains an MU-RTS frame. In each 20 MHz channel occupied by the immediately preceding DL PPDU that contains an MU-RTS frame, there is at least one STA that is requested to send CTS responses on the 20 MHz channel.

If an MU-RTS frame requests a STA to send CTS responses in a non-HT or non-HT duplicate PPDU, the RU Allocation subfield in the Per-User Info field addressed to the STA shall be set to a value indicating either primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel. Other indications are TBD.

9.3.2.8a.2 CTS Repsonse to MU-RTS

If a HE STA receives an MU-RTS frame, the HE STA shall commence the transmission of a CTS response at the SIFS time boundary after the end of a received PPDU when all the following conditions are met:

— The MU-RTS frame has one of the Per-User Info fields addressed to the STA.

— The UL MU CS condition described in 25.5.2.4 (UL MU CS mechanism) indicates the medium is idle

— Other transmission conditions TBD are met.

HE STAs may transmit CTS responses to an MU-RTS frame in a non-HT or non-HT duplicate PPDU with frame format as defined in 9.3.1.3 based on the request in MU-RTS frame. The method of request is TBD.

The Scrambler Initialization in the SERVICE field of the CTS sent in response to an MU-RTS frame shall be copied from the Scrambler Initialization in the SERVICE field of the MU-RTS frame. The rate of the CTS response is defined in 10.7.6.

The CTS sent in response to an MU-RTS frame shall be transmitted on one or more 20 MHz channels.

If the CTS sent in response to an MU-RTS frame is transmitted in a non-HT or non-HT duplicate PPDU, then the CTS response shall be transmitted on the indicated 20 MHz channels identified in the RU Allocation subfield of the Per-User Info field.

Figure 10-3 shows an example of the exchange of MU-RTS and simultaneous CTS responses on primary 40 MHz channel. In this example, MU-RTS is transmitted in a 40 MHz non-HT duplicate PPDU on primary 40 MHz channel. Further, MU-RTS requests STA1 to transmit CTS response in a non-HT PPDU on primary 20 MHz channel and STA2 to transmit CTS response in a 40 MHz non-HT duplicate PPDU on primary 40 MHz channel.

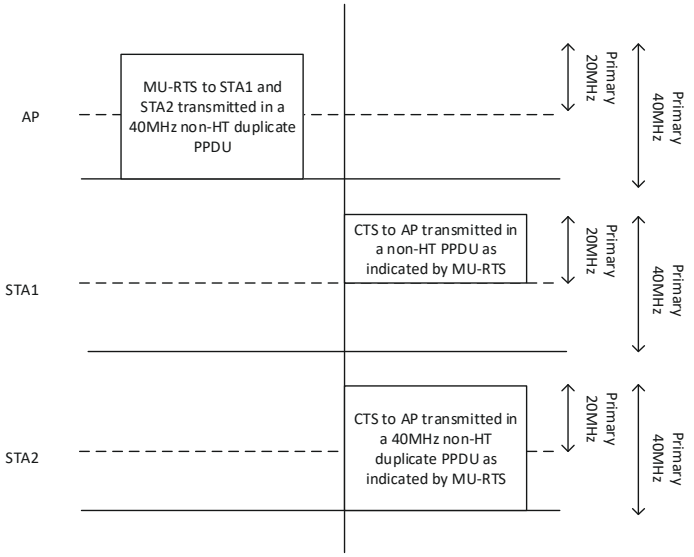


Figure 3 - Example of MU-RTS and CTS Responses on Primary 40MHz Channel

Figure 10-3 - Example of MU-RTS and CTS responses on the primary 40 MHz channel

10.3.2.11 MU acknowledgment procedure

Insert a new subclause heading before the first paragraph of 10.2.3.11:

10.3.2.11.1 General

Insert a new subclauses at the end of 10.2.3.11:

10.3.2.11.2 MU acknowledgement procedure for DL MU PPDU in SU format

The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU.

NOTE—All MPDUs transmitted within a VHT MU PPDU or an HE MU PPDU are contained within A-MPDUs, and the rules specified in 9.7.3 (A-MPDU contents) prevent an immediate response to more than one of the A-MPDUs.

Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-11 (An example of a TXOP containing a VHT MU PPDU transmission with an immediate acknowledgment to the VHT MU PPDU) and Figure 10-12 (An example of a TXOP containing a VHT MU PPDU transmission with no immediate acknowledgment to the VHT MU PPDU).

Recovery within the TXOP that contains a VHT MU PPDU or an HE MU PPDU can be performed according to the rules of 10.22.2.7 (Multiple frame transmission in an EDCA TXOP). BlockAckRequest frames related to A-MPDUs within a VHT MU PPDU or an HE MU PPDU can be transmitted in a TXOP separate from the one that contained the VHT MU PPDU or the HE MU PPDU.

NOTE 1—A BlockAck frame or an Ack frame is sent in immediate response to the BlockAckReq frame for HT-immediate or HT-delayed Block Ack, respectively. An Ack frame might be sent in immediate response to a VHT single MPDU in the VHT MU PPDU or the HE MU PPDU.

10.3.2.11.3 MU acknowledgement procedure for HE MU PPDU in MU format

A non-AP STA that is the recipient, within a HE MU PPDU, of an MPDU that solicits an immediate response with Ack Policy ‘01’ in QoS Control field, shall send the immediate response according to the scheduling information defined by the UL trigger information that is carried either in the Trigger frame(s) or in MAC header. If no valid Trigger frame(s) or MAC header containing UL trigger information is received, then the STA shall not respond. An example of UL OFDMA acknowledgement to an HE MU PPDU is shown in Figure 10-4.

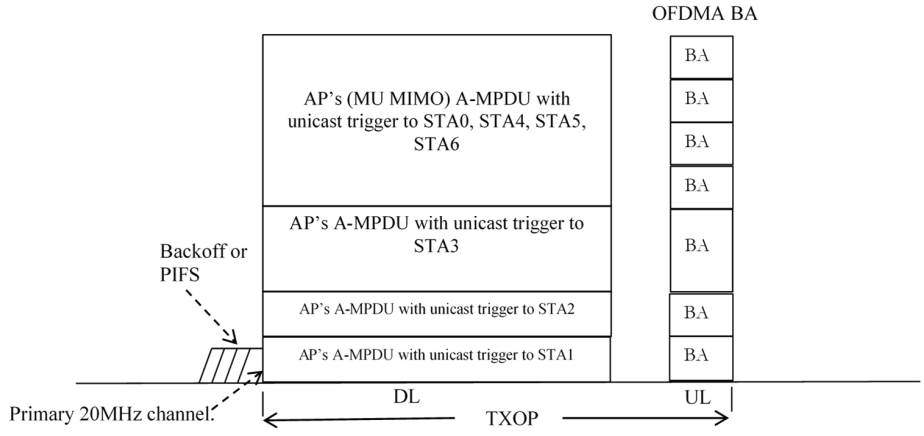


Figure 10-4 - An example of a TXOP containing an HE MU PPDU transmission with an immediate UL OFDMA acknowledgement

An AP shall not set Ack Policy to "01" in QoS Control field in MPDUs of HE MU PPDU if both UL MU OFDMA Capable subfield and UL MU MIMO Capable subfield of the HE Capabilities element of the receiver of the MPDUs are set to 0.

10.3.2.11.4 MU acknowledgement procedure for an UL MU transmission

When receiving multiple frames from more than one STA that are part of an UL MU transmission (Clause 9.42.2) and that require an immediate acknowledgement, an AP may send multiple BlockAck frames (or ACK frames) in an OFDMA HE MU PPDU or a Multi-STA BlockAck (M-BA) frame. Additional conditions to transmit multiple BlockAck frames (or ACK frames) in an OFDMA HE MU PPDU or Multi-STA BlockAck are TBD. After a successful reception of an UL frame requiring acknowledgment, transmission of the DL acknowledgement shall commence after a SIFS, without regard to the busy/idle state of the medium.

The example of DL OFDMA BA shown in Figure 10-5, and examples for Multi-STA BlockAck frame acknowledgement to a UL MU PPDU is given in Figure 10-6, Figure 10-7 and Figure 10-8.

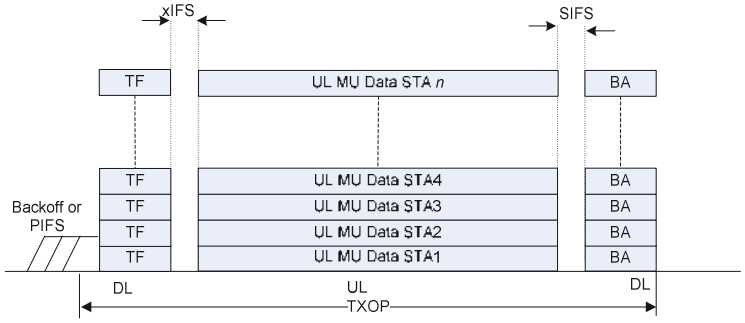


Figure 10-5 - An example of a TXOP containing an UL MU transmission with an immediate DL MU transmission containing unicast BlockAck frames acknowledging the frames received from the respective STAs

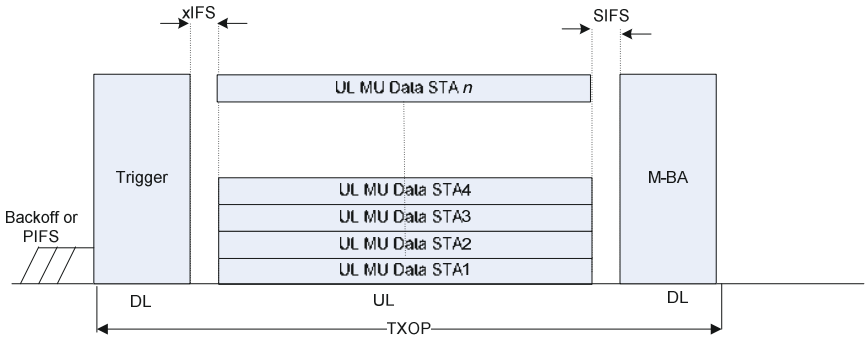


Figure 10-6 - An example of a TXOP containing UL MU transmissions with an immediate Multi-STA BlockAck (M-BA) frame acknowledging the MPDUs that were correctly received from each STA. The UL MU transmission may be OFDMA or MU-MIMO

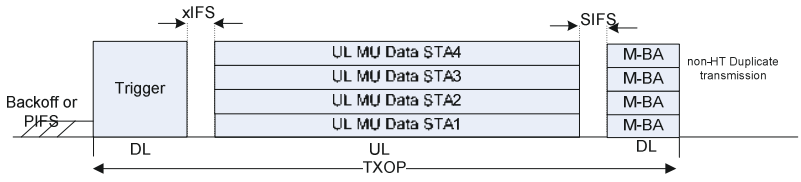


Figure 10-7 - An example of a TXOP containing UL MU transmissions with an immediate DL non-HT duplicate PPDU containing the M-BA frame. The UL MU transmissions may be OFDMA or MU-MIMO.

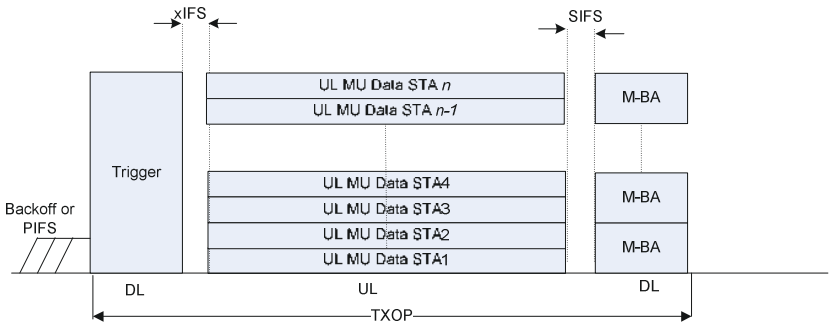


Figure 10-8 - An example of a TXOP containing UL MU transmissions with an immediate OFDMA HE MU PPDU containing Multi-STA BlockAck frames. The UL MU transmissions may be OFDMA or MU-MIMO.

10.7 Multirate support

10.7.6 Rate selection for Control frames

10.7.6.5 Rate selection for control response frames

10.7.6.5.2 Selection of a rate or MCS

Insert the following at the end of the subclause:

Within a MU RTS/CTS exchange, the simultaneous CTS shall be transmitted with the primary rate based on the rate or MCS of the MU-RTS frame that triggers the simultaneous CTS. The primary rate is defined to be the highest rate in the BSSBasicRateSet parameter that is less than or equal to the rate (or non-HT reference rate; see 10.7.10 (Non-HT basic rate calculation)) of the previous MU-RTS frame. If no rate in the BSSBasicRateSet parameter meets these conditions, the primary rate is defined to be the highest mandatory rate of the attached PHY that is less than or equal to the rate (or non-HT reference rate; see 10.7.10 (Non-HT basic rate calculation)) of the previous frame.

If a Multi-STA BlockAck frame or DL OFDMA ackowlegement frame is sent as an immediate response to an UL HE PPDU, the AP may ignore the <HE-MCS, NSS> tuples that are used for MPDUs in UL HE PPDU from non-AP STAs that elicits the DL acknowledgement.

A Multi-STA BlockAck frame is carried in a non-HT PPDU shall be transmitted by the AP using a rate supported by all the recipients.

A Multi-STA BlockAck frame is carried in an HT or VHT PPDU shall be transmitted by the AP using an HT-MCS or <VHT-MCS, NSS> tuple supported by all the recipients.

A Multi-STA BlockAck frame is carried in an HE PPDU shall be transmitted by the AP using an <HE-MCS, NSS> tuple supported by all the recipients.

10.9 HT Control field operation

If the value of dot11HTControlFieldSupported is true, a STA shall set the +HTC Support subfield of the HT Extended Capabilities field of the HT Capabilities element to 1 in HT Capabilities elements that it transmits. If the value of dot11VHTControlFieldOptionImplemented is true, a STA shall set the +HTC-VHT Support subfield of the VHT Capabilities Information field of the VHT Capabilities element to 1 in VHT Capabilities elements that it transmits. If the value of the dot11HEControlFieldOptionImplemented is true, a STA shall set the +HTC-HE Support subfield of the HE Capabilies Information field of the HE Capabilities element to 1 in HE Capabilities elements that it transmits.

A STA that has a value of true for at least one of dot11RDResponderOptionImplemented, dot11MCSFeedbackOptionImplemented, and dot11AlternateEDCAActivated shall set dot11HTControlFieldSupported or dot11VHTControlFieldOptionImplemented or both to true. A STA that has a value of true for at least one of dot11ULMUOFDMAOptionImplemented,

dot11MCSFeedbackOptionImplemented, and dot11ROMIOptionImplemented shall set the dot11HEControlFieldOptionImplemented to true.

An HT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HT in the HT Extended Capabilities field of its HT Capabilities element (see 9.4.2.55 (HT Capabilities element)).

A VHT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-VHT in the VHT Capabilities Information field of its VHT Capabilities element.

NOTE—An HT STA that does not support +HTC (HT or VHT variant) that receives a +HTC frame addressed to another STA still performs the CRC on the actual length of the MPDU and uses the Duration/ID field to update the NAV, as described in **Error! Reference source not found.**.

An HE variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HE in the HE Capabilities Information field of its HE Capabilities element. The HE variant HT Control field carried in the frame may contain aControl subfield supported by the intended receiver that has:

- A value of 0 in the Control ID subfield when the transmitting STA expects an UL MU PPDU that carries an immediate acknowledgement, as described in 9.42.2 (UL MU operation).
- A value of 1 in the Control ID subfield when the transmitting STA changes the receive operation mode, as described in 10.45.2 (Receive operating mode indication).
- A value of 2 in the Control ID subfield when the transmitting STA follows the HE link adaptation procedure, as described in 10.31.4 (Link adaptation using the HE variant HT Control field).
- ...

If the HT Control field is present in an MPDU aggregated in an A-MPDU, then all MPDUs of the same frame type (i.e., having the same value for the Type subfield of the Frame Control field) aggregated in the same A-MPDU shall contain an HT Control field. The HT Control field of all MPDUs containing the HT Control field aggregated in the same A-MPDU shall be set to the same value.

10.22HCF

10.22.2 HCF contention based channel access (EDCA)

10.22.2.9 Truncation of TXOP

Insert the following at the end of subclause 10.22.2.9:

An HE STA that receives a CF-End frame should not reset its NAV if:

- The CF-End did not originate from the STA's associated BSS or any BSS of a multi-BSSID set that the STA's associated BSS belongs to and the most recent NAV update was due to a PPDU originating from the STA's associated BSS or any BSS of a multi-BSSID set that the STA's associated BSS belongs to.
- The CF-End originated from the STA's associated BSS or any BSS of a multi-BSSID set that the STA's associated BSS belongs to and the most recent NAV update was not due to a PPDU originating from the STA's associated BSS or any BSS of a multi-BSSID set that the STA's associated BSS belongs to.

10.24Block acknowledgment (block ack)

10.24.10 GCR block ack

Insert the following sentences at the end of 2nd paragraph of section 10.24.10.3:

The originator may send a MU-BAR frame (MU-BAR Trigger variant of UL-Trigger Frame) to one or more of the HE STAs that have a GCR block ack agreement for this group address. Upon reception of the BlockAck frame, an originator may send a MU-BAR frame to other one or more HE STAs that have a block ack agreement for this group address, and this process may be repeated multiple times.

Insert the following sentences at the end of 4th paragraph of section 10.24.10.3:

When HE STA receives a MU-BAR frame with User identifier field set to the AID of the HE STA, the HE STA shall transmit BlockAck frame in the indicated resource unit SIFS after the Trigger frame. The BlockAck frames acknowledge the HE STA's reception status of the block of group addressed frames requested by the MU-BAR frame.

Insert the following sentences and a picture at the end of 5th paragraph of section 10.24.10.3:

Figure 10-9 (Example of a frame exchange with GCR block ack retransmission policy) shows another example of a frame exchange when the GCR block ack retransmission policy is used. The HE AP sends several A-MSDUs using the GCR block ack retransmission policy. The HE AP then sends a MU-BAR to group member 1 and 2 of the GCR group, waits for the BlockAck frames, and then sends a MU-BAR to group member 3. After receiving the BlockAck frame from GCR group member 3, the HE AP determines whether any A-MSDUs need to be retransmitted and sends additional A-MSDUs (some of which might be retransmissions of previous A-MSDUs) using the GCR block ack retransmission policy.

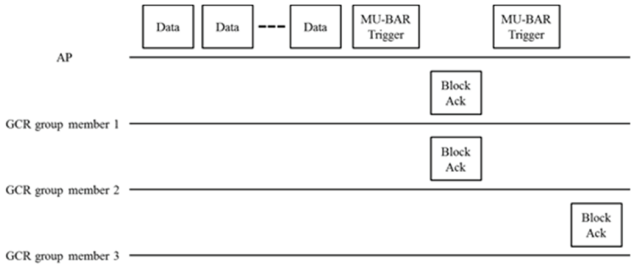


Figure 10-9 - Example of a frame exchange with GCR block ack retransmission policy

Change the following sentences in 6th paragraph of section 10.24.10.3:

After completing the BlockAckReq and BlockAck frame exchanges or the MU-BAR and BlockAck frame exchanges, the originator determines from the information provided in the BlockAck bitmap and from the missing BlockAck frames which, if any, A-MSDUs need to be retransmitted.

Change the following sentences in 7th paragraph of section 10.24.10.3

An originator adopting the GCR block ack retransmission policy for a GCR group address chooses a lifetime limit for the group address. The originator may vary the lifetime limit for the group address at any time and may use different lifetime limits for different GCR group addresses. The originator transmits and retries each A-MSDU until the appropriate lifetime limit is reached or until each one has been received by all group members to which a BlockAckReq frame or an MU-BAR frame has been sent, whichever occurs first.

Insert the following sentences at the end of 8th paragraph of section 10.24.10.3

An originator may also regularly send an MU-BAR frame with User identifier field set to AIDs of HE STAs that transmit the BlockAck frames and the Block Ack Starting Sequence Control subfield set to the Sequence Number field of the earliest A-MSDU of the GCR stream that has not been acknowledged by all group members and has not expired due to lifetime limits, in order to minimize buffering latency at receivers in the GCR group.

Change the following in 12th paragraph of section 10.24.10.3

If the beginning of such reception does not occur during the first slot time following a SIFS in case of a BlockAckReq frame or a [TBD IFS] in case of an MU-BAR, then the originator may perform error recovery

by retransmitting a BlockAckReq frame or an MU-BAR PIFS after the previous BlockAckReq frame or an MU-BAR frame when both of the following conditions are met:

— The carrier sense mechanism (see 10.3.2.1 (CS mechanism)) indicates that the medium is idle at the TxPIFS slot boundary (defined in 10.3.7 (DCF timing relations)) after the expected start of a BlockAck frame, and

— The remaining duration of the GCR TXOP is longer than the total time required to retransmit the GCR BlockAckReq frame or an MU-BAR frame plus one slot time.

10.44 Target wake time (TWT)

10.44.1 TWT overview

Change the 2nd paragraph of 9.44.1 as follows:

A TWT requesting STA communicates wake scheduling information to its TWT responding STA and the TWT responding STA devises a schedule and delivers TWT values to the TWT requesting STA when a TWT agreement has been established between them as described in 10.44.2 (Individual TWT agreements). When explicit TWT is employed, a TWT requesting STA wakes and performs a frame exchange and receives the next TWT information in a response from the TWT responding STA as described in 10.44.2.2 (Explicit TWT operation). When implicit TWT is used, the TWT requesting STA calculates the Next TWT by adding a fixed value to the current TWT value as described in 10.44.3 (Implicit TWT operation). An HE AP can additionally devise schedules and deliver TWT values to HE non-AP STAs without requiring that an individual TWT agreement has been established between them, as described in 10.44.4 (Broadcast TWT operation).

Insert a subclause heading after the 2nd paragraph of 10.44.1 (rest of dependent subclauses become dependent of this new subclause):

10.44.2 Individual TWT agreements

Change the 2 paragraphs (4th, 5th) of 9.44.1 as follows:

A STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT requesting STA shall set the TWT Requester Support subfield to 1 in all S1G Capabilities or HE Capabilities elements that it transmits. A STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT responding STA shall set the TWT Responder Support subfield to 1 in all S1G Capabilities or HE Capabilities elements that it transmits.

If the TWT Responder Support subfield of the S1G Capabilities or of the HE Capabilities element received from its associated AP is equal to 1, a non-AP STA with dot11TWTOptionActivated equal to true may transmit a TWT element to the AP with a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1.

Insert a new paragraph after the 9th paragraph as follows:

A STA that transmits a frame carrying a TWT element to an HE STA may set the Trigger subfield of the element to 1. Otherwise, the STA shall set the Trigger subfield to 0. In a TWT response, a Trigger field equal to 1 indicates a trigger-enabled TWT. The TWT responding STA of a trigger-enabled TWT agreement shall schedule for transmission a Trigger frame to the TWT requesting STA, as described in **Error! Reference source not found.** (UL MU operation), within each TWT SP for that TWT agreement. The TWT responding STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indicaion field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. Otherwise, it shall set the Cascade Indicaion field to 0.

Insert a sentence at the end of the 10th paragraph of 10.44.1 as follows:

An HE STA that transmits a TWT element to another HE STA shall set the Implicit subfield of the element to 1 and the NDP Paging Indicator subfield of the element to 0.

Insert a sentence at the end of the 12th paragraph of 10.44.1 as follows:

A TWT requesting STA transmits a frame during a trigger-enabled TWT SP in response to a Trigger frame (see 25.5.2 (UL MU operation)).

Change the last 2 paragraphs of 10.44.1 as follows:

The Flow Type field in the TWT response that successfully set up a TWT agreement indicates the type of interaction between the TWT requesting STA and the TWT responding STA within each TWT SP for that TWT agreement. Flow Type field equal to 0 indicates an announced TWT. The TWT responding STA of an announced TWT agreement shall not transmit a frame, except for a Trigger frame within a trigger-enabled TWT SP, to the TWT requesting STA within a TWT SP until it has successfully received a PS-Poll frame or APSD trigger frame (see 10.2.2.5 (Power management with APSD)) from the TWT requesting STA. Flow Type field equal to 1 indicates an unannounced TWT. The TWT responding STA of an unannounced TWT agreement may transmit a frame to the TWT requesting STA within a TWT SP before it has successfully received a frame from the TWT requesting STA.

An S1G TWT requesting STA indicates which single channel it desires to use as a temporary primary channel during a TWT SP by setting a single bit to 1 within the TWT Channel field of the TWT element, according to the mapping described for that field. An S1G TWT responding STA indicates which single channel the TWT requesting STA is permitted to use as a temporary primary channel during a TWT SP by setting a single bit to 1 within the TWT Channel field of the TWT element, according to the mapping described for that field. During a TWT SP, access to a channel which is not the primary channel of the BSS shall be performed according to the procedure described in 9.49 (Subchannel Selective Transmission (SST)). An HE STA indicates *TBD*.

10.44.3 Implicit TWT operation

Change the 3rd paragraph of 9.44.4 of as follows:

A TWT requesting STA awake for an implicit TWT SP may transition to the doze state after AdjustedMinimumTWTWakeDuration time has elapsed from the TWT SP start time as identified by the TWT requesting STA. A TWT requesting STA awake for a trigger-enabled TWT SP may transition to the doze state if it receives a Trigger frame from the TWT responding STA with a Cascade Indicaion field equal to 0 that is not intended to it.

Insert a sentence at the end of the 4rd paragraph of 10.44.4 as follows:

An HE STA shall not generate BAT, TACK, or STACK frames.

Insert a new subclause, and dependent subclauses, at the end of 10.44 as follows:

10.44.4 Broadcast TWT operation

10.44.4.1 General

A TWT scheduling STA is an HE AP with dot11TWTOptionActivated equal to true that includes a TWT element in the Beacon frame, and follows the rules described in 9.44.3.2 (Rules for TWT scheduling STA).

A TWT scheduled STA is an HE non-AP STA that:

— TBD: Declares support of being a TWT scheduled STA

— Receives a broadcast TWT element transmitted by an HE AP that is a TWT scheduling STA and,

— Has not negotiated any implicit TWT agreement with the HE AP as described in 10.44.2 (Individual TWT agreements).

A TWT scheduled STA follows the schedule provided by the TWT scheduling STA as described in **Error! Reference source not found.** (Rules for TWT scheduled STA). A TWT scheduled STA can negotiate the TBTT and listen interval for Beacon frames it intends to receive as described in 10.44.4.3 (Negotiation of TBTT and listen interval).

An example of broadcast TWT operation is shown in Figure 10-10 (Example of broadcast TWT operation), where the AP is the TWT scheduling STA and STA 1 and STA 2 are the TWT scheduled STAs.

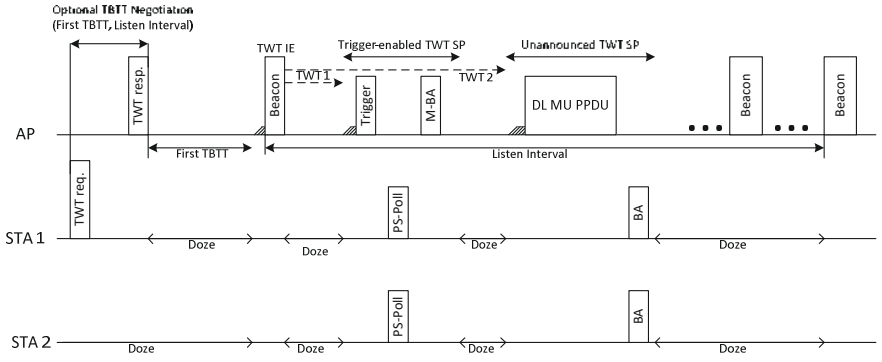


Figure 10-10 - Example of broadcast TWT operation

10.44.4.2 Rules for TWT scheduling STA

A TWT scheduling STA may include a TWT element in a Beacon frame scheduled at a TBTT (see 10.1.3.2 (Beacon generation in non-DMG infrastructure networks)). The TWT scheduling STA shall include one or more TWT parameter sets in the TWT element, and each TWT parameter set may indicate a periodic occurrence of TWTs. Each TWT parameter set specifies the TWT parameters of a broadcast TWT that are valid within a broadcast TWT SP.

The TWT scheduling STA sets the TWT parameters of each set as described below:

— The TWT scheduling STA shall set the Trigger field to 1 to indicate a trigger-enabled TWT. Otherwise, it shall set the Trigger field to 0. The TWT scheduling STA shall schedule for transmission a Trigger frame intended to one or more TWT scheduled STAs during a trigger-enabled TWT SP. The TWT scheduling STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indicaion field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. Otherwise, it shall set the Cascade Indicaion field to 0.

— The TWT scheduling STA shall set the TWT Flow Identifier field according to Table 8.248n1 (TWT Flow Identifier field for a broadcast TWT element). The TWT scheduling STA should only send frames that satisfy the TWT flow identifier recommendations listed in Table 8.248n1 (TWT Flow Identifier field for a broadcast TWT element) during the TWT SP(s).

— The TWT scheduling STA shall set the TWT field to the TSF[TBD X: TBD Y] time at which the first TWT is scheduled.

— The TWT scheduling STA shall include the value of the TWT wake interval in the TWT Wake Interval Exponent and TWT Wake Interval Mantissa fields for a periodic TWT. The TWT parameters are valid for each successive TWT of the periodic TWT.

— TBD

10.44.4.3 Negotiation of TBTT and listen interval

A TWT scheduled STA that intends to operate in power save mode (see 10.2.2.2 (STA Power Management modes)) may transmit a TWT request frame to the TWT scheduling STA that identifies the TBTT of the next Beacon frame the STA intends to receive and the interval between subsequent Beacon frames it intends to receive. The TWT request frame shall contain:

- The value of the requested first TBTT in the Target Wake Time field when the TWT Command field is Suggest TWT or Demand TWT.
- The value of the listen interval between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.

A TWT scheduling STA that receives a TWT request frame from a STA whose value of the TWT wake interval is equal to the STA's listen interval shall respond with a TWT response frame that contains either Accept TWT or Reject TWT in the TWT Command field and, in the case of an Accept TWT, it shall also contain:

- The value of the allocated first TBTT in the Target Wake Time field, and
- The value of the listen interval between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.

After successfully completing the negotiation, the TWT scheduled STA may go to doze state until its TSF matches the next negotiated TBTT provided that the STA is in power save mode, and no other condition requires the STA to remain awake. The TWT scheduled STA shall be in the awake state to listen to Beacon frames transmitted at negotiated TBTTs and shall operate as described in in **Error! Reference source not found.** (Rules for TWT scheduled STA).

Either STA can tear down an established negotiation following the tear down procedure described in 10.44.8 (TWT Teardown).

25High Efficiency (HE) MAC specification

25.1 Introduction

25.2 Channel access

25.2.1 Updating two NAVs

Mandatory or optional support of two NAVs is TBD.

For the two NAVs maintained by a HE STA, one is identified as Intra-BSS NAV, and the second one is identified as regular NAV.

A STA that receives at least one valid frame in a PSDU and identifies the frame as Intra-BSS can update its Intra-BSS NAV with the information from any valid Duration field in the PSDU.

A STA that receives at least one valid frame in a PSDU and identifies the frame as Inter-BSS can update its regular NAV with the information from any valid Duration field in the PSDU.

A STA that receives at least one valid frame in a PSDU and cannot identify the frame as Intra-BSS or Inter-BSS can update its regular NAV with the information from any valid Duration field in the PSDU.

A STA that receives a valid HE-SIG-A in a HE PPDU and identifies the HE-SIG-A as Intra-BSS can update its Intra-BSS NAV with the information from the TXOP Duration field in the HE-SIG-A.

A STA that receives a valid HE-SIG-A in a HE PPDU and identifies the HE-SIG-A as Inter-BSS can update its regular NAV with the information from the TXOP Duration field in the HE-SIG-A.

When the received frame's RA is equal to the STA's own MAC address, the STA shall not update its Intra-BSS NAV or regular NAV with the information from the Duration field.

When a STA receives both a valid HE-SIG-A in a HE PPDU and a valid frame in the PSDU of the HE PPDU, the STA shall not update its Intra-BSS NAV or regular NAV with the information from the TXOP Duration field in the HE-SIG-A.

For all other received frames that are identified by the STA as Intra-BSS, the STA shall update its Intra-BSS NAV when the received value of the Duration field is greater than the STA's current Intra-BSS NAV value.

For all other received frames that are identified by the STA as Inter-BSS or cannot be identified as Intra-BSS or Inter-BSS, the STA shall update its regular NAV when the received value of the Duration field is greater than the STA's current regular NAV value.

For all other received HE-SIG-As that are identified by the STA as Intra-BSS, the STA shall update its Intra-BSS NAV when the received value of the TXOP Duration field is greater than the STA's current Intra-BSS NAV value.

For all other received HE-SIG-As that are identified by the STA as Inter-BSS, the STA shall update its Inter-BSS NAV when the received value of the TXOP Duration field is greater than the STA's current regular NAV value.

25.3 Fragmentation

25.3.1 General

An HE STA can dynamically fragment individually addressed MSDUs or MMPDUs and defragment received MPDUs as defined in this subclause, and using the fragmentation/defragmentation processes defined in 10.2.7 (Fragmentation/defragmentation overview) without being subject to the rules defined in that subclause.

25.3.2 Procedure at the originator

A dynamic fragment is an MPDU, the payload of which carries a portion of an MSDU or MMPDU, which generation follows the rules defined in 9.5 (Fragmentation), except for:

- Reception of dynamic fragments is not mandatory. An HE STA declares its capability of receiving dynamic fragments by setting the HE Fragmentation Support field of the HE Capabilities element it transmits to a nonzero value as described below.
- The length of each fragment is not required to be equal for all fragments. The length of each fragment may be of any nonzero value. Other conditions may be TBD.

An HE STA may transmit to a receiver STA an individually addressed (A)-MPDU that contains:

- One dynamic fragment of an MSDU or MMPDU in a VHT single MPDU if the receiver STA has indicated a nonzero value in the HE Fragmentation Support field of its HE Capabilities element
    - The originator STA shall follow the rules defined in 9.13.8 (Transport of VHT single MPDUs) for generating the VHT single MPDU
- Up to one dynamic fragment for each MSDU in an A-MPDU if the receiver STA has indicated a value of 2 in the HE Fragmentation Support field of its HE Capabilities element
    - The originator STA shall follow the rules defined in in 9.24.7 (HT-immediate block ack extensions) for generating the A-MPDU
- Up to four dynamic fragments for each MSDU in an A-MPDU if the receiver STA has indicated a value of 3 in the HE Fragmentation Support field of its HE Capabilities element
    - The originator STA shall set the Fragment Number subfield of each MPDU to a value less than 4
    - The originator STA shall follow the rules defined in 10.24.7 (HT-immediate block ack extensions) for generating the A-MPDU with the following exceptions:

- The A-MPDU should contain MPDUs whose range of the Sequence Number subfields does not exceed 16. Other conditions may be TBD.

An HE STA shall not transmit a PSDU that contains dynamic fragments of an MSDU or MMPDU whose number is greater than the maximum number of fragments or that are carried in an A-MPDU format that is not supported by the receiver STA, as determined by the value of the HE Fragmentation Support field of the HE Capabilities element sent by the receiver STA.

25.3.3 Procedure at the receiver

An HE STA that transmits an HE Capabilities element with a nonzero value in the HE Fragmentation Support subfield shall set dot11DynamicFragmentation to true. Otherwise, the HE STA may set dot11DynamicFragmentation to false.

Defragmentation of dynamic fragments shall follow the rules defined in 10.6 (Defragmentation), except for:

— The receiver STA may support the concurrent reception of dynamic fragments of TBD number of MSDUs/MMPDUs under TBD conditions

NOTE— The receiver STA is still subject to the Receive Timer rules for each fo the MSDUs/MMPDUs as defined in 9.6 (Defragmentation).

Upon reception of a PSDU that carries one or more dynamic fragments, the receiver STA responds with:

— An Ack frame when the received fragment is contained in a VHT single MPDU that solicits the immediate response

  - The receiver STA shall follow the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame

— A BlockAck frame when the received fragments, up to one fragment for each MSDU, are contained in the A-MPDU that solicits the immediate response and is sent by an HE STA whose HE Fragmentation Support subfield in its HE Capabilities element is 2

  - The receiver STA shall follow the rules defined in 10.24.7 (HT-immediate block ack extensions) for generating the BlockAck frame, except that the STA shall:
    - Set to 1 each bit of the Block Ack Bitmap field that corresponds to a Sequence Number subfield of a successfully received fragment contained in the soliciting A-MPDU
    - Update the corresponding block acknowledgement record when an MSDU that is received in fragments is successfully reconstructed (see 10.6 (Defragmentation)).

— A BlockAck frame when the received fragments, one or more fragments for each MSDU, are contained in an A-MPDU that solicits the immediate response and is sent by an HE STA whose HE Fragmentation Support subfield in its HE Capabilities element is 3

  - The receiver STA shall follow the rules in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA) for generating the BlockAck frame, except that the STA shall:
    - Set to 1 the Fragment Number subfield in the Block Ack Starting Sequence Control subfield of the BlockAck frame
    - Set to 1 each bit in location *B* of the Block Ack Bitmap field that corresponds to a successfully received fragment and shall set it to 0 otherwise, with *B* calculated as:
      $B = SC - SSN$, where *SC* and *SSN* are treated as 14-bit unsigned integers
      SC is the value of the Sequence Control subfield of an MPDU containing the fragment for which the receive status is indicated

SSN is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield of the BlockAck frame

- Update the corresponding block acknowledgement record when an MSDU that is received in fragments is successfully reconstructed (see 9.6 (Defragmentation)).

25.4 Block acknowledgement

25.4.1 Selection of BlockAck and BlockAckReq variants

An HE STA may send a Multi-STA BlockAck frame in response to an HE trigger-based PPDU. A Multi-STA BlockAck frame contains one or more BA Information fields with one or more AIDs and one or more different TIDs. A Multi-STA BlockAck frame with BA Information for multiple AIDs shall have RA field set to the broadcast address.

An HE STA that supports Multi-STA BA shall examine each received Mulit-STA sent by an STA with which it has a BA agreement. On receiving such a Multi-STA BlockAck frame a STA performs the following for each BA Information field with its AID:

— If the ACK type field is 1 then the BA Start Sequence Control, TID and BA Bitmap of the BA information field are processed according the procedure given in 10.24.7.

— If the ACK type field is 0, the field indicates an ACK of either a single MPDU or all MPDUs carried in the eliciting PPDU that was transmitted by the STA.

25.5 MU operation

25.5.1 HE DL MU operation

25.5.1.1 General

HE DL MU operation allows an AP to transmit simultaneously to one or more non-AP STAs in DL OFDMA, DL MU-MIMO or both.

An AP shall not transmit to a STA an HE MU PPDU with the HE-SIG-B allocating more than one RUs (see 25.3.9.8.3), unless the STA set the DL OFDMA Capable subfield of the HE Capabilities element to 1.

An AP shall not transmit to a STA a HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA set the DL MU MIMO Capable subfield of the HE Capabilities element to 1.

The transmission for all the STAs in an HE MU PPDU in either DL OFDMA or DL MU MIMO shall end at the same time, indicated by the L-SIG field as described in 26.3.9.5.

The padding procedure for each A-MPDU in an HE MU PPDU is the same as for an A-MPDU in a VHT PPDU and defined in 10.13.6 (A-MPDU padding for VHT PPDU).

25.5.1.2 HE MU PPDU payload

The content of each individual A-MPDU in an HE MU PPDU is based on the rules specified in 10.13.1 (A-MPDU contents).

The frame type and address type (unicast, groupcast) of MPDUs may be different across A-MPDUs within a same HE MU PPPDU.

A groupcast frame in a groupcast RU of an HE MU PPDU shall not include information intended for a STA that is identified as the recipient of another RU in the same HE MU PPDU.

25.5.2 UL MU operation

25.5.2.1 General

The UL MU operation allows an AP to solicit immediate simultaneous response frames from one or more non-AP STAs. Non-AP STAs transmit their response frames in HE trigger-based PPDU format, in either UL MU OFDMA UL MU-MIMO, or both.

An HE STA with dot11ULMUOFDMAOptionImplemented set to true shall set the UL MU OFDMA Capable subfield of the HE Calabilities element it transmits to 1; otherwise, the STA shall set it to 0.

An HE STA with dot11ULMUMIMOOptionImplemented set to true shall set the UL MU MIMO Capable subfield of the HE Calabilities element it transmits to 1; otherwise, the STA shall set it to 0.

A non-AP STA with dot11ULMUOFDMAOptionImplemented or dot11ULMUMIMOOptionImplemented equal to true is referred to as an UL MU capable STA.

25.5.2.2 Rules for soliciting UL MU frames

25.5.2.2.1 General

An AP shall not send to a STA a frame soliciting the transmission of a PPDU with the TXVECTOR parameter FORMAT set to HE_TRIG, unless the STA is UL MU Capable.

An AP may transmit a PPDU that elicits elicits an HE trigger-based PPDU from one or more UL MU capable STAs by including in the PPDU at least one of:

- A Trigger frame that includes one or more per-User Info field addressed to the recipient STA(s).
  - For recipient STAs that are associated with the AP, the per-User Info field is addressed to a recipient STA if the value of the AID subfield of the Per-User Info field is equal to the AID of the STA.
  - For recipient STAs that are not associated with the AP, TBD
- An “Trigger Information TBD contained in the MAC Header” of individually addressed MPDUs contained in the PPDU

The following two frames shall not be present at the same time in an A-MPDU

- A Trigger frame with a per-User Info field addressed to a STA
- an MPDU addressed to the same STA that includes “Trigger Information Field info in MAC header TBD”

If a Trigger frame is aggregsated with other frames in an A-MPDU, the Trigger frame shall be the first frame in the A-MPDU.

25.5.2.2.2 Allowed settings of the Trigger frame fields

If dot11MultiBSSIDActivated is true and at least two of the Trigger frame recipient STAs are associated with two different BSSIDs, then the TA shall be set to a common address TBD; in all other cases the TA shall be set to the BSSID of the AP to which all recipient STAs are associated.

An AP shall not set any subfields of the Commin Info field to a value that is not supported by all the recipient STAs of the Trigger frame.

An AP shall not set any subfields of a Per User Info field to a value that is not supported by the recipient STAs of the Per User Info field.

If a Trigger frame is transmitted in a broadcast RU of a HE MU PPDU, then the Trigger frame shall not include any Per User Info fields addressed to a STA that is identified as recipient of another RU or spatial stream of the same HE MU PPDU.

25.5.2.2.3 AP access procedures for UL MU operation

An UL OFDMA MPDU/A-MPDU is the acknowledgement of the Trigger frame. When the AP receives MPDU correctly from at least one STA indicated by trigger frame, the frame exchange initiated by the trigger frame is successful.

25.5.2.3 STA behavior

A STA shall not transmit an HE trigger-based PPDU unless is it explicitly enabled by an AP in one of the operation modes described in this section.

The inter frame space between a PPDU that contains a Trigger frame and the triggered HE trigger-based PPDU is SIFS.

A STA shall commence the transmission of an HE trigger-based PPDU at the SIFS time boundary after the end of a received PPDU, when all the following conditions are met

— The received PPDU contains a Trigger Frame with a Per User Info field addressed to the STA, or the PPDU contains an MPDU addressed to the STA which carries a "Trigger Information Field info in MAC header TBD". The Per User Info field is addressed to a STA if the AID subfield is equal to the AID of the STA, if the STA is associated with the AP. If the STA is not associated with the AP, TBD.

— The UL MU CS Condition described in 25.5.2.4 (UL MU CS mechanism) indicates the medium is idle, or the CS Required subfield in a Trigger frame is 0.

A STA transmitting an HE trigger-based PPDU shall set the TXVECTOR parameter as follows:

— The L_LENGTH parameter shall be set to the value indicated by the L-SIG Length field of the eliciting Trigger frame or of the "Trigger Information Field info in MAC header TBD".

— The CP_LTF_TYPE parameter shall be set to the value indicated by the CP-LTF subfield of the Common Info field of the eliciting Trigger frame

— The SIG-A_CONT parameter shall be set to the value indicated by the SIG-A subfield of the Common Info field of the eliciting Trigger frame [TBD, depending on how the TXVECTOR is defined we may spell out all the subfields of SIG-A]

— The DCM parameter shall be set to the value indicated by the DCM subfield of the per-User Info field of the eliciting Trigger frame

— The CODING_TYPE parameter shall be set to the value indicated by the Coding Type subfield of the Per User Info field of the eliciting Trigger frame

— The RU parameter shall be set to the value indicated by the RU Allocation field of the trigger frame

— The NSTS parameter shall be set to TBD

The MAC padding procedure is descried in 10.42.2.1.2

The content of each individual A-MPDU in an HE MU PPDU is based on the rules specified in 9.13.1 (A-MPDU contents) and the additional rules described in this clause.

If the Trigger Type value of a Trigger frame is not equal to 0, the STA shall include in the reponse A-MPDU at least one MPDU of the required type. If the STA does not have a frame of the required type, the STA should transmit QoS Null frame.

NOTE--The frame type of MPDUs may be different across A-MPDUs within a same HE trigger-based PPPDU

25.5.2.4 UL MU CS mechanism

The ED-based CCA and virtual CS functions are used to determine the state of the medium if CS is required before responding to a received Trigger frame. ED-based CCA is described in and virtual CS is defined in 10.3.2.1 (CS mechanism).

When two NAVs are supported by a STA, if one or both of the NAVs are considered and the considered NAV's counter is nonzero, then the virtual CS indicates busy. Otherwise, the virtual CS is idle.

When only one NAV is supported by a STA, if the NAV is considered and the NAV counter is nonzero, then virtual CS is busy. Otherwise, the virtual CS is idle.

Note that the previous sentence is only needed if support for two NAVs is optional. Mandatory or optional support for two NAVs is still TBD.

A NAV is considered in virtual CS for a STA that is polled from a Trigger frame for UL MU transmission unless one of the following conditions is met:

- The NAV was set by a frame originating from the AP sending the Trigger frame
- The response generated by the STA contains an Ack frame or a BlockAck frame and the duration of the HE trigger-based PPDU is less than a TBD value
- The NAV was set by a frame originating from an intra-BSS STA
- The CS Required subfield in the Trigger frame is 0
- Other condition TBD

If the CS Required subfield in a Trigger frame is set to 1, the STA shall consider the status of the CCA (using Energy Detect) and the virtual carrier sense (NAV) before UL MU transmission in response to the Trigger Frame. In this case, the STA shall sense the medium using energy-detect (ED) after receiving the PPDU that contains the Trigger frame (i.e. during the SIFS time), and it shall perform the energy-detect (ED) at least in the subchannel that contains the STA's UL allocation, where the sensed subchannel consists of either a single 20 MHz channel or multiple of 20 MHz channels. The STA may transmit an HE trigger-based PPDU when the 20 MHz channels containing the allocated UL RUs in the Trigger frame are considered idle; if the STA detects that the 20 MHz channels containing the allocated UL RUs are not all idle, then the STA shall not transmit anything in the allocated UL RUs.

If the CS Required subfield in a Trigger frame is set to 0, the STA may transmit an HE trigger-based PPDU without the carrier sense.

The AP shall set the CS Required subfield to 1 except under the following conditions:

- All HE trigger-based PPDU(s) solicited by the Trigger frame containing ACK/BA and the length of the HE trigger-based PPDU is below a TBD threshold.
- Other conditions are TBD.

25.5.2.5 HE buffer status feedback operation for UL MU

The buffer status report from HE STAs may be utilized to support the efficient UL MU operation. An AP may poll HE STAs for buffer status reports using the frame carrying the trigger information. The frame may be a broadcast Trigger frame, a unicast Trigger frame, a Trigger frame for random access, or a Data type of frame carrying the trigger information. An AP may request an HE STA to send its buffer status information by TBD indication in the Trigger frame or in the HE A-Control field in a Data type of frame. In this case, an AP may indicate TBD granularity of the Queue Size for an HE STA to report (signalling method TBD). Upon reception of the frame including the TBD indication in the Trigger frame or in the HE A-Control field, the HE STA may respond with the frame including the Queue Size subfield in a QoS Control field or TBD HE A-Control field. To report the buffer status for a given TID, an HE STA shall set the Queue Size subfield in a QoS Data or a QoS Null frame to the amount of queued traffic present in the output queue belonging to the TID.

25.5.2.6 UL OFDMA-based random access

UL OFDMA-based distributed random access is a random access mechanism for HE STAs that randomly select resource units (RUs) assigned by an AP for transmission of UL PPDUs. The HE AP indicates a TBD

parameter in the Trigger frame for HE STAs to initiate random access following the Trigger frame transmission.

25.5.2.6.1 Random access procedure

In this sub-section, the random access procedure is described with respect to UL OFDMA contention parameters. The procedure is also illustrated in Figure 25-1. An HE STA that uses the random access procedure maintains an internal counter termed as OBO counter. The OFDMA contention window (OCW) is an integer with an initial value of OCWmin. Other parameters for random access are TBD.

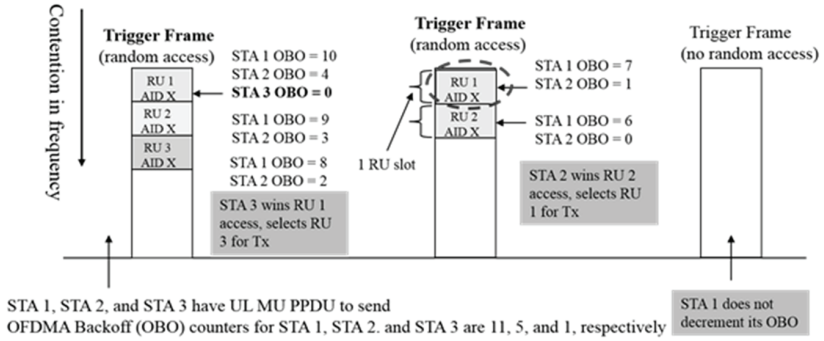


Figure 25-1 - Illustration of the UL OFDMA-based random access procedure

An HE AP indicates the value of OCWmin for the random access operation. The method of indication of the OCWmin value is TBD.

The random access procedure initiates with an HE STA receiving a Trigger frame for random access.

For an initial UL PPDU transmission, when an HE STA obtains the value of OCWmin from the HE AP, it shall set the value of OCW to the OCWmin and shall initialize its OBO counter to a random value in the range of 0 and OCWmin.

If the OBO counter for an HE STA is smaller than the number of RUs assigned to AID value TBD in a Trigger frame, then the HE STA shall decrement its OBO counter to zero. Otherwise, the HE STA decrements its OBO counter by a value equal to the number of RUs assigned to AID value TBD in a Trigger frame. For instance, as shown in Figure 25-1, HE STA 1 and HE STA 2 decrement their non-zero OBO counters by 1 in every RU assigned to AID value TBD for random access within the Trigger frame.

If the OBO counter for an HE STA is a zero value or if the OBO counter decrements to 0, it randomly selects any one of the assigned RUs for random access and transmits its UL PPDU in the selected RU. Otherwise, the STA resumes with its OBO counter in the next Trigger frame for random access.

25.5.3 HE MU cascading operation

A TXOP can include both DL MU and UL MU transmissions.

A HE AP can initiate a cascading sequence of MU PPDUs in a TXOP, allowing alternating HE MU PPDUs and HE trigger-based PPDUs starting with a DL MU PPDU in the same TXOP, as illustrated in Figure 25-2.

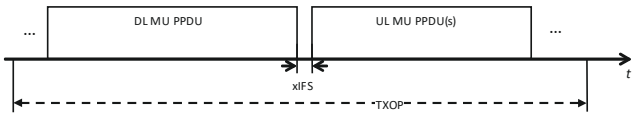


Figure 25-2 - An example of cascading sequence of MU PPDUs

The cascading sequence has only one DL transmitter. The cascading sequence may have different UL transmitters within each HE trigger-base PPDU. The cascading sequence may have a different set of transmitters in HE trigger-based PPDUs as compared to the DL HE MU PPDU that follows the HE trigger-based PPDUs within the same TXOP.

25.6 HE sounding protocol

The HE sounding protocol is initiated by an AP sending an NDP Announcement frame (TBD) followed by an HE NDP transmitted a SIFS after the end of the PPDU carrying the NDP Announcement (TBD).

An HE AP may use the Trigger frame to solicit HE beamforming feedback from a STA provided that the UL MU Capable field of the most recently received HE Capabilities element from that STA is 1 (see 25.5.2 (UL MU operation)).

An HE AP may solicit beamforming feedback from multiple STAs sequentially through SU transmission.

An example of the HE sounding protocol using MU operation to solicit feedback is shown in Figure 25-3.

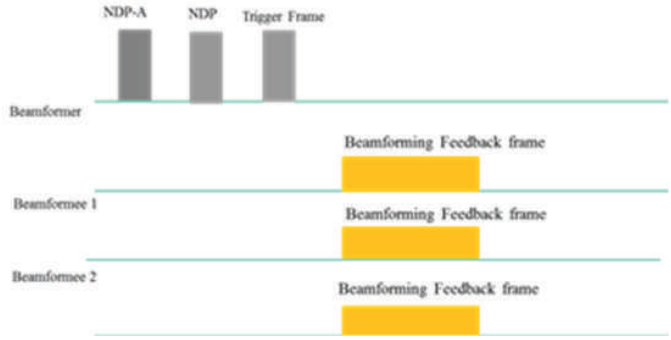


Figure 25-3 – An example of the HE sounding protocol using MU operation

25.7 TWT operation

25.8 Receive operating mode

25.8.1 General

An HE STA can change its operating mode setting either using the procedure described in 10.41 (Notificaion of operating mode changes), or the procedure describes in this subclause. Receive operating mode (ROM) indication is a procedure for a first HE STA to indicate the maximum operating channel width and the maximum number of spatial streams it can receive to a second HE STA.

When the first HE STA chooses to indicate its ROM setting, this can be signaled using the ROM subfield in the HE variant HT Control field sent in a frame of type Data. The ROM subfield is set to indicate that the first HE STA supports receiving frames with a bandwidth up to and including the value indicated by the Channel Width subfield and with a number of spatial streams up to and including the value indicated by the Rx NSS subfield (see [HE variant HT Control field]). The dot11ROMIOptionImplemented defines whether the HE AP implements the reception of the ROM setting and the AP transmits according to the ROM setting to the transmitter of the ROM setting. An HE AP shall set dot11ROMIOptionImplemented to true.

ROM indication allows an HE STA to adapt the maximum operating channel width or the maximum number of spatial streams it can receive. In doing so, an HE STA may save power by changing to a ROM setting that consumes less power, or by changing to a ROM setting that supports higher throughput operation. Unlike 11.41 (Notification of operating mode changes), ROM indication can be signaled in the MAC header of a Data frame as opposed to a management frame exchange. Hence, there is minimal impact on channel efficiency.

25.8.2 Rules for ROM indication

An HE STA may transmit an individually address frame of type Data that contains the ROM subfield to indicate that the transmitting HE STA supports receiving frames with a bandwidth up to and including the value indicated by the Channel Width subfield and with a number of spatial streams up to and including the value indicated by the Rx NSS subfield of the ROM subfield.

The transmitting HE STA shall support for receiving frames with a bandwidth up to and including the value indicated by the Channel Width subfield and with a number of spatial streams up to and including the value indicated by the Rx NSS subfield of the ROM subfield indicated in the eliciting frame immediately after receiving a successful acknowledgement from the responding HE STA.

If there is a change to the current maximum operating channel width or the maximum number of spatial streams, the transmitting HE shall adjust to the most recently sent ROM settings within a time TBD [Outage Time] following the receipt of an immediate acknowledgement response. The transmitting HE STA shall support receiving frames with a bandwidth up to and including the most recent value indicated by the Channel Width subfield and with a number of spatial streams up to and including the most recent value indicated by the Rx NSS subfield of the ROM subfield.

NOTE—In the event of transmission failures, the transmitting HE STA can attempt recovery procedure as defined in 9.19.2.4 (Multiple frame transmission in an EDCA TXOP), and can defer from changing to the new ROM settings indicated in the eliciting frame until a successful acknowledgement from the responding STA is received.

The responding HE STA shall use the value indicated by the Channel Width subfield most recently received from the transmitting HE STA as the current maximum operating channel width that the transmitting HE STA indicated as supported for receiving frames.

The responding HE STA shall use the value indicated by the Rx NSS subfield most recently received from the transmitting HE STA as the current maximum number of spatial streams that the transmitting HE STA indicated as supported for receiving frames.

The responding HE STA shall not transmit a subsequent PPDU to the transmitting HE STA that uses a bandwith or a number of spatial stream not indicated as currently supported by the transmitting HE STA.

If there is a change to the current maximum operating channel width or the maximum number of spatial stream that the transmistting STA is capable of receiving, the responding HE STA shall not sent any PPDU to the transmitting HE STA within a time TBD [Outage Time] following the transmission of an immediate acknowledgement response.

25.9 Spatial reuse operation

25.9.1 General

The objective of the HE spatial reuse operation is to improve the system level performance and the utilization of the spectrum resources in dense deployment scenarios by early identification of signals from overlapping basic service sets (OBSSs) and interference management.

25.9.2 Color code based CCA rules

An STA determines whether a detected frame is an inter-BSS or an intra-BSS frame by using BSS color or MAC address in the MAC header. The detected frame is intra-BSS frame if one of the following conditions is true:

— The BSS color in the detected PPDUis same as the BSS color announced by its associated AP,

— The RA or TA of the detected frame is same as the BSSID or its bandwidth signalling variant of its associated AP

— Its associated AP is identified by TBD Multiple BSSID element and the RA or TA of the detected frame is same as one of the BSSID or its bandwidth signalling variant defined by TBD Multiple BSSID element

If the detected frame is an inter-BSS frame, under TBD condition, uses TBD OBSS PD level that is greater than the minimum receives sensitivity level.

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

A STA should revise the NAV depending on TBD conditions at the recipient of the ongoing OBSS frame.

25.9.3 Adaptive CCA and transmit power control

When the color code based CCA rule is used, as described in **Error! Reference source not found.**, an HE STA is allowed to adjust the OBSS_PD threshold in conjunction with transmit power control to improve the system level performance and the utilization of the spectrum resources.

To further improve the possibilities of spatial reuse, an STA is allowed to adjust the setting of one or more following parameters, CCA ED level, 802.11 signal detect CCA or TXPWR threshold values. The constraints on selecting threshold values are TBD.

25.10 A-MPDU operation

25.10.1 General

A-MPDU operation for an HE PPDU is as defined in 10.13 (A-MPDU operation), except for A-MPDU padding, which is defined in 25.10.2 and except for an A-MPDU that includes QoS Data frames from from two or more different TSs, the rules for which are defined in 25.10.3.

25.10.2 A-MPDU padding

The A-MPDU padding per each HE STA in an HE MU PPDU follows the same procedure as for VHT STA11ac procedure as defined in Section 10.13.6 (A-MPDU padding for VHT PPDU).

A non-AP STA that transmits an HE trigger-based PPDU shall construct the PSDU carried in the HE trigger-based PPDU as follows.

The STA computes the PSDU_LENGTH based on the TXVECTOR parameters.

The STA may add A-MPDU subframes to the A-MPDU contained in the PSDU provided that the following constraints are fullfilled:

— The A-MPDU content constraints (see 10.13.1 (A-MPDU contents)) for the intended recipient

— The Length limit constraints (see 9.7.1 (A-MPDU format) and 10.13.2 (A-MPDU length limit rules)) for the intended recipient

— The MPDU start spacing constraints (see 10.13.3 (Minimum MPDU Start Spacing field)) for the intended recipient

And provided that

— The A-MPDU subframes have a value greater than 0 in the MPDU Length field, or have a value 0 in the MPDU Length field and a value 0 in the EOF field.

— After incrementing the A-MPDU_Length with the length of each such added A-MPDU subframe, the relationship A-MPDU_Length ≤ PSDU_LENGTH is true.

Then, padding shall be added such that the resulting A-MPDU contains exactly PSDU_LENGTH octets as follows:

- First, while A-MPDU_Length < PSDU_LENGTH and A-MPDU_Length mod 4 != 0, add an octet to the final A-MPDU subframe's Padding subfield and increment A-MPDU_Length by 1.
- Then, while A-MPDU_Length + 4 < PSDU_LENGTH, add an EOF padding subframe to the EOF Padding Subframes field and increment A-MPDU_Length by 4.
- Finally, while A-MPDU_Length < PSDU_LENGTH, add an octet to the EOF Padding Octets subfield and increment A-MPDU_Length by 1.

The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1. The STA shall not add an an A-MPDU subframe with EOF equal to 1 and with MPDU Length field equal to 0 before an A-MPDU subframe that contains a VHT single MPDU (see 10.13.7 (Setting the EOF field of the MPDU delimiter)).

25.10.3 A-MPDU with multiple TIDs

An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true shall set the A-MPDU with Multiple TIDs Capable subfield of the HE Calabilities element it transmits to 1; otherwise, the HE STA shall set it to 0.

An HE AP shall not send A-MPDU with multiple TIDs to an HE non-AP STA that associates with the AP, unless the HE non-AP STA is A-MPDU With Multiple TIDs capable.

An HE non-AP STA shall not send an A-MPDU with multiple TIDs to its associated HE AP, unless the HE AP is A-MPDU With Multiple TIDs capable.

In an HE MU PPDU, an HE STA may aggregate the frames in an A-MPDU with multiple TIDs as defined in Table 9-426a (Multiple TID A-MPDU contents in the data enabled immediate response context) or Table 9-426b (Multiple TID A-MPDU contents in the data enabled no immediate response context). An A-MPDU with multiple TIDs shall not be transmitted in an SU PPDU.

Multi-STA BlockAck frame shall be used to acknowledge the Multi-TID A-MPDU in MU PPDU. The value of TID field in Multi-STA BlockAck frame is TBD.

25.11 TXVECTOR parameters STA_ID_LIST, UPLINK_FLAG and BSS_COLOR for an HE PPDU

Each element of the TXVECTOR parameter STA_ID_LIST identifies the STA or group of STAs that is the recipient of an RU in the HE MU PPDU. If an RU is intended for a single STA, then the STA_ID_LIST element for that RU is set to the STA's AID. If an RU is intended for a group of STAs then the STA_ID_LIST element is set as follows:

- For a single BSS AP, if the RU is intended for all STAs in the BSS, the STA_ID_LIST element is set to 0;
- For a multiple BSS AP, if the RU is intended for all STAs in one of its BSSs, the STA_ID_LIST element is set to the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation;
- For a multiple BSS AP, if the RU is intended for all STAs on all its BSSs, the STA_ID_LIST element is set to 2047.

The Uplink Flag is carried in the TXVECTOR parameter UPLINK_FLAG of an HE SU PPDU, HE extended range SU PPDU, and HE MU PPDU and is set as follows:

- A STA transmitting an HE PPDU that is addressed to an AP shall set the TXVECTOR parameter UPLINK_FLAG to 1

— An AP transmitting an HE PPDU that is addressed to a non-AP STA shall set the TXVECTOR parameter UPLINK_FLAG to 0

— A STA transmitting an HE PPDU in a direct path to a (T)DLS peer STA, or to a member of an IBSS, shall set the TXVECTOR parameter UPLINK_FLAG to 0

NOTE—The (T) DLS peer STA or the member of an IBSS can identify that the HE PPDU is sent in a direct path from the To DS and From DS fields of the MAC header of its MPDU(s)

The TXVECTOR parameter UPLINK_FLAG is not present for HE trigger-based PPDUs.

The BSS Color is an identifier of the BSS and is used to assist a receiving STA in identifying the BSS from which a PPDU originates so that the STA can use the channel access rules as described in 9.X.Y (Spatial Reuse) or reduce power consumption as described in 25.13.1 (Intra-PPDU power save for HE non-AP STAs).

An HE AP shall select a value in the range 1 to TBD to include in the BSS Color subfield of the HE Operation elements that it transmits and shall maintain that single value of the BSS Color subfield for the duration of the existence of the BSS. An HE AP transmitting an HE PPDU shall set the TXVECTOR parameter BSS_COLOR to the value indicated in the BSS Color subfield of its HE Operation element.

A non-AP HE STA transmitting an HE PPDU shall set the TXVECTOR parameter BSS_COLOR to the value indicated in the BSS Color subfield of the HE Operation element received from the AP with which it is associated.

The virtual APs which are defined by TBD Multiple BSSID element shall select a same BSS Color.

25.12HE PPDU post FEC padding and packet extension

An HE STA with dot11PPEThresholdsRequired set to false may set the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 0.

An HE STA with dot11PPEThresholdsRequired set to true shall set the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 1.

A STA that sets the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 1 shall indicate its minimum post-FEC padding and packet extension duration value per constellation, NSS and RU allocation by setting the subfields of the PPE Thresholds field according to 9.4.2.213 (HE Capabilities element) and using the corresponding values from dot11PPEThresholdsMappingTable.

A STA transmitting an HE PPDU to a receiving STA shall include a minimum post-FEC padding asetermined by the post-FEC padding a-factor (see 26.3.10 (Data field) and after including the post-FEC padding, the transmitting STA shall include a packet extension that yields a total post-FEC padding plus packet extension that corresponds to at least the value indicated in the HE Capabilities element received from the receiving STA.

25.13Power management

25.13.1 Intra-PPDU power save for HE non-AP STAs

An HE non-AP STA that is in awake state (see 11.2.2.2 (STA Power Management modes)) and has dot11IntraPPDUPowerSaveOptionActivated equal to true operates in intra-PPDU power save mode.

An HE non-AP STA that is in intra-PPDU power save mode may enter the doze state until the end of a received PPDU when one of the following conditions is met:

— The PPDU is an HE MU PPDU with:

  o The value of the RXVECTOR parameter BSS_COLOR equal to the BSS color of the BSS with which the STA is associated and,

- The value of the RXVECTOR parameter UL_FLAG is equal to 0 and,
- The values obtained from the RXVECTOR parameter STA_ID_LIST do not match the identifier of the STA or the broadcast identifier(s) intended for the STA

— The PPDU is an HE MU PPDU, HE SU PPDU, or HE extended range SU PPDU with:

- The value of the RXVECTOR parameter BSS_COLOR equal to the BSS color of the BSS with which the STA is associated and,
- The value of the RXVECTOR parameter UL_FLAG is equal to 1

— The PPDU is an HE trigger-based PPDU with:

- The value of the RXVECTOR parameter BSS_COLOR equal to the BSS color of the BSS with which the STA is associated

An HE STA that is in intra-PPDU power save mode and has entered doze state shall continue to operate its NAV timer and consider the medium busy during doze state and shall transition into awake state at the end of the PPDU.

NOTE—The STA can contend for access to the medium immediately on the expiry of the NAV timer.

25.13.2 Power save with UL OFDMA-based random access

This section illustrates the power save mechanisms for HE STAs using random access procedure (see 25.5.2.6.1).

An HE AP may indicate values of one or multiple Trigger frame start time(s) for random access in the Beacon. The power save operation with the indication of one value of Trigger frame start time in a Beacon for random access is shown in Figure 25-4.

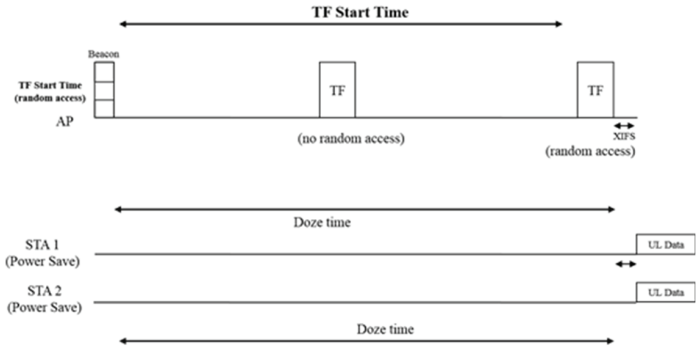


Figure 25-4 - Illustration of Trigger frame (TF) Start Time in Beacon frame for power save operation with random access operation

When an HE STA receives a Beacon with the value of Trigger frame start time for random access, it may enter the doze state till the expiration of the value indicated in the Beacon.

If random acces is enabled by a sequence of Trigger frames, then all the Trigger frames in the sequence shall have the Cascade Indication field set to 1, except for the last Trigger frame in the sequence that shall have the Cascade Indication field set to 0.

An HE STA may use the value indicated in the Cascade Indication field in a Trigger frame to enter the doze state. If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 0, it may enter the doze state immediately. If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 1, it may remain awake for random access in the cascaded Trigger frame.

26High Efficiency (HE) PHY specification

26.1 Introduction

26.1.1 Introduction to the HE PHY

Clause 26 specifies the PHY entity for a high efficiency (HE) orthogonal frequency division multiplexing (OFDM) system. In addition to the requirements in Clause 26, an HE STA shall be capable of transmitting and receiving PPDUs that are compliant with the mandatory PHY specifications defined in Clause 20 and Clause 22.

The HE PHY is based on the VHT PHY defined in Clause 22, which in turn is based on the HT PHY defined in Clause 20, which in turn is further based on the OFDM PHY defined in Clause 18. The HE PHY extends the maximum number of users supported for downlink multi-user MIMO (MU-MIMO) transmissions to eight and provides support for downlink and uplink orthogonal frequency divisional multiple access (OFDMA) as well as for uplink MU-MIMO. Both downlink and uplink MU-MIMO transmissions are supported on portions of the PPDU bandwidth (on resource units greater than or equal to 106 tones) and in an MU-MIMO resource unit, there is support for up to eight users with up to four space-time streams per user with the total number of space-time streams not exceeding eight.

NOTE—An HE SU PPDU includes individually addressed and group addressed transmissions.

The HE PHY provides support for 20 MHz, 40 MHz, 80 MHz and 160 MHz contiguous channel widths and support for 80+80 MHz non-contiguous channel width. Tones of one or more secondary channels in 80 MHz and 160 (80+80) MHz could be nulled when using OFDMA PPDU transmission. The modes of non-contiguous channel bonding are TBD. The non-contiguous channels within primary or secondary 80 MHz only exists at AP side.

The HE PHY provides support for 800 ns, 1600 ns, and 3200 ns guard interval durations.

The HE PHY provides support for 3.2 μs (1x LTF), 6.4 μs (2x LTF), and 12.8 μs (4x LTF) LTF symbol durations (symbol duration not including the guard interval).

The HE PHY data subcarriers are modulated using binary phase shift keying (BPSK), quadrature phase shift keying (QPSK), 16-quadrature amplitude modulation (16-QAM), 64-QAM, 256-QAM and 1024-QAM. Forward error correction (FEC) coding (convolutional or LDPC coding) is used with coding rates of 1/2, 2/3, 3/4 and 5/6.

An HE STA shall support the following Clause 26 features:

- Binary convolutional coding for RU sizes less than or equal to 242 tones (transmit and receive)
- LDPC as the only coding scheme for RU sizes of 484 tones, 996 tones (transmit and receive)
- LDPC when declaring support for at least one of HE 80/160/80+80 SU-PPDU bandwidths, or declaring support for more than 4 spatial streams (transmit and receive)
- A combination of 2x LTF with 0.8 μs GI duration on both LTF and data
- A combination of 2x LTF with 1.6 μs GI duration on both LTF and data
- A combination of 4x LTF with 3.2 μs GI duration on both LTF and data

An HE STA may support the following Clause 26 features:

- Other combinations of LTF durations and GI durations
- LDPC (transmit and receive) for RU sizes less than or equal to 242 tones
- LDPC (transmit and receive) when declaring support for less than or equal to 4 spatial streams
- Dual carrier modulation (transmit and receive)

NOTE--Once mandatory vs optional TBDs are decided, above text will have additions.

26.1.2 Scope

The services provided to the MAC by the HE PHY consist of the following protocol functions:

a) A function that defines a method of mapping the PSDUs into a framing format (PPDU) suitable for sending and receiving PSDUs between two or more STAs.

b) A function that defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more STAs. Depending on the PPDU format, these STAs support a mixture of HE, Clause 22 (Very High Throughput (VHT) PHY specification), Clause 20 (High Throughput (HT) PHY specification) and Clause 18 (Orthogonal frequency division multiplexing (OFDM) PHY specification) PHYs.

26.1.3 HE PHY functions

26.1.3.1 General

The HE PHY contains two functional entities: the PHY function, and the physical layer management function (i.e., the PLME). Both of these functions are described in detail in 26.3 (HE PHY) and 26.4 (HE PLME). The HE PHY service is provided to the MAC through the PHY service primitives defined in Clause 7 (PHY service specification). The HE PHY service interface is described in 26.2 (HE PHY service interface).

26.1.3.2 PHY management entity (PLME)

The PLME performs management of the local PHY functions in conjunction with the MLME.

26.1.3.3 Service specification method

The models represented by figures and state diagrams are intended to be illustrations of the functions provided. It is important to distinguish between a model and a real implementation. The models are optimized for simplicity and clarity of presentation; the actual method of implementation is left to the discretion of the HE-PHY-compliant developer.

The service of a layer is the set of capabilities that it offers to a user in the next higher layer. Abstract services are specified here by describing the service primitives and parameters that characterize each service. This definition is independent of any particular implementation.

26.1.4 HE PPDU formats

The structure of the PPDU transmitted by an HE STA is determined by the TXVECTOR parameters as defined in Table 25-1 (TXVECTOR and RXVECTOR parameters).

The FORMAT parameter determines the overall structure of the PPDU:

— HE SU PPDU format (HE_SU) carries a single PSDU. With this format the HE-SIG-A field is not repeated. Support for the HE SU PPDU format is mandatory.

— HE MU PPDU format (HE_MU) carries one or more PSDUs to one or more users. It is similar to the SU format, except that an HE-SIG-B field is present. Support for the HE MU PPDU format is mandatory.

— HE extended range SU PPDU format (HE_EXT_SU) carries a single PSDU. It is similar to the SU format, except that the HE-SIG-A field is repeated. Support for the HE extended range SU PPDU format is TBD (mandatory or optional).

— HE trigger-based PPDU format (HE_TRIG) carries a single PSDU and is sent in response to a PPDU that carries a Trigger frame. The preamble format prior to the HE-STF field is identical to the HE SU PPDU. Support for the HE trigger-based PPDU format is TBD (mandatory or optional).

26.2 HE PHY service interace

26.2.1 Introduction

26.2.2 TXVECTOR and RXVECTOR parameters

The parameters in Table 26-1 (TXVECTOR and RXVECTOR parameters) are defined as part of the TXVECTOR parameter list in the PHY-TXSTART.request primitive and/or as part of the RXVECTOR parameter list in the PHY-RXSTART.indication primitive.

Table 26-1 - TXVECTOR and RXVECTOR parameters

Parameter	Condition	Value	TXVECTOR	RXVECTOR
FORMAT		Determines the format of the PPDU. Enumerated type: NON_HT indicates Clause 18 (Orthogonal frequency division multiplexing (OFDM) PHY specification) or non-HT duplicate PPDU format. In this case, the modulation is determined by the NON_HT_MODULATION parameter. HT_MF indicates HT-mixed format. HT_GF indicates HT-greenfield format. VHT indicates VHT format. HE_SU indicates HE SU PPDU format. HE_MU indicates HE MU PPDU format HE_EXT_SU indicates HE extended range SU PPDU format HE_TRIG indicates HE trigger-based PPDU format	Y	Y
PE_DURATION	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG.	Determines the duration of PE field in an HE PPDU. Possible values are 0 μs, 4 μs, 8 μs, 12 μs and 16 μs.		
BEAM_CHANGE	FORMAT is HE_SU	Indicates beam change between pre-HE and HE modulated fields. 1 indicates that the beam is changed between the two portions. NOTE—BEAM_CHANGE shall be set to 1 if $N_{SS} > 2$ or the PPDU is the first PPDU in a TXOP.		
	Otherwise	Set to 1		

	(To be added)			
BSS_COLOR	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG.	Set to a value of the AP's choosing within the range 0 to *TBD* (see 25.11 (STA ID, Uplink Flag and BSS Color in HE PPDUs)).	Y	Y
	Otherwise	Not present	N	N
UPLINK_FLAG	FORMAT is HE_SU or HE_MU or HE_EXT_SU	Set to 1 if the HE PPDU is addressed to an AP Set to 0 otherwise (see 25.11 (STA ID, Uplink Flag and BSS Color in HE PPDUs)).	Y	Y
	Otherwise	Not present	N	N
STA_ID_LIST	FORMAT is HE_MU	Indicates the list of STA IDs for an HE MU PPDU (see 25.11 (STA ID, Uplink Flag and BSS Color in HE PPDUs)).	M U	Y
	Otherwise	Not present	N	N

NOTE 1—In the "TXVECTOR" and "RXVECTOR" columns, the following apply:

Y = Present;

N = Not present;

O = Optional;

MU indicates that the parameter is present once for an HE SU PPDU, HE extended range SU PPDU and HE trigger-based PPDU and present per user for an HE MU PPDU. Parameters specified to be present per user are conceptually supplied as an array of values indexed by *u*, where *u* takes values 0 to NUM_USERS-1.

26.3 HE PHY

26.3.1 Introduction

26.3.2 HE PPDU formats

Four HE PPDU formats are defined: HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU.

The format of the HE SU PPDU is defined as in Figure 26-1. This PPDU is used for SU transmission and in this format the HE-SIG-A field is not repeated.

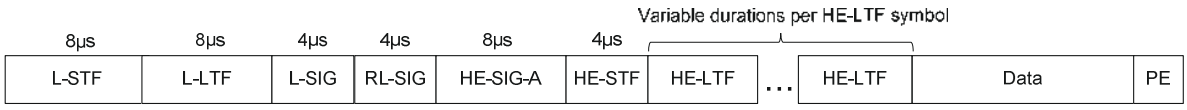


Figure 26-1 - HE SU PPDU format

The format of the HE MU PPDU is defined as in Figure 26-2. This format is used for MU transmission that is not a response of a Trigger frame. An HE-SIG-B field is present in this format.

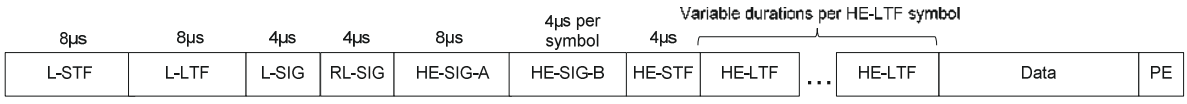


Figure 26-2 - HE MU PPDU format

The format of the HE extended range SU PPDU is defined as in Figure 26-3. This format is used for SU transmission and in this format the HE-SIG-A field is repeated.

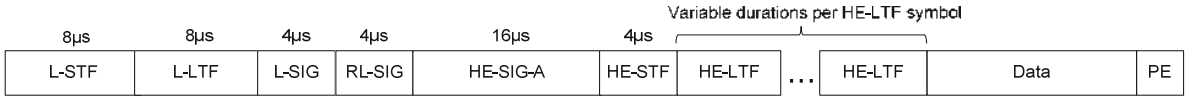


Figure 26-3 - HE extended range SU PPDU format

The format of the HE trigger-based PPDU is defined as in Figure 26-4. This format is used for a transmission that is a response to a Trigger frame. The HE trigger-based PPDU format is identical to the HE SU PPDU format for the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A fields. The duration of the HE-STF field is 8 µs.

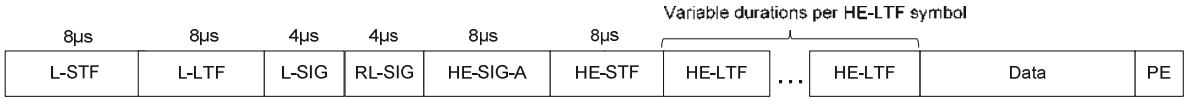


Figure 26-4 - HE trigger-based PPDU format

The fields of the HE PPDU formats are summarized in Table 26-2.

Table 26-2 - HE PPDU fields

Field	Description
L-STF	Non-HT Short Training field
L-LTF	Non-HT Long Training field
L-SIG	Non-HT SIGNAL field
RL-SIG	Repeated Non-HT SIGNAL field
HE-SIG-A	HE Signal A field
HE-SIG-B	HE Signal B field
HT-STF	HE Short Training field
HE-LTF	HE Long Training field
Data	The Data field carrying the PSDU(s)
PE	Packet Extension field

The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, HE-LTF, and PE fields exist only in HE PPDUs. In the HE NDP PPDU the Data field is not present. The number of OFDM symbols in the HE-LTF field, $N_{HE\text{-}LTF}$, is 1, 2, 4, 6, or 8 and the duration of each symbol in the HE-LTF field is 3.2 µs, 6.4 µs, or 12.8 µs plus the GI duration. The HE-SIG-B field is present only in the HE MU PPDU. The duration of the PE field is determined by the TXVECTOR parameter PE_DURATION.

DL HE NDP is one DL HE sounding format.

The format of a HE NDP PPDU is shown in Figure 26-5.



Figure 26-5 - HE NDP PPDU format

NOTE 1—The number of HE-LTF OFDM symbols, $N_{HE\text{-}LTF}$ in the NDP is a function of the total number of space-time streams N_{STS} as shown in Table 26-6.

NOTE 2—The combination of HE-LTF modes and GI duration is indicated in HE-SIG-A field.

NOTE 3—The duration of each HE-LTF OFDM symbol, $T_{HE\text{-}LTF}$, is defined in Table 26-3.

NOTE 4—The presence and duration of PE are TBD.

The HE NDP PPDU has the following properties:

— It uses the HE SU PPDU format but without the Data field
— is an HE SU PPDU as implied by the value of L-Length field in L-SIG field

26.3.3 Transmitter block diagram

The generation of each field in a HE PPDU uses many of the following blocks:

a) pre-FEC PHY padding
b) Scrambler
c) FEC (BCC or LDPC) encoders
d) post-FEC PHY padding
e) Stream parser
f) Segment parser (for contiguous 160 MHz and noncontiguous 80+80 MHz transmissions)
g) BCC interleaver
h) Constellation mapper
i) DCM tone mapper
j) Pilot insertion
k) Replicate over multiple 20 MHz (if BW > 20 MHz)
l) Multiply by 1st column of P_{VHTLTF}
m) LDPC tone mapper
n) Segment deparser
o) Space time block code (STBC) encoder
p) Cyclic shift diversity (CSD) per STS insertion
q) Spatial mapper
r) Inverse discrete Fourier transform (IDFT)
s) Cyclic shift diversity (CSD) per chain insertion
t) Guard interval (GI) insertion
u) Windowing

Figure 26-6 to Figure 26-13 show example transmitter block diagrams. The actual structure of the transmitter is implementation dependent.

In particular, Figure 26-6 shows the transmit process for the L-SIG, RL-SIG, and HE-SIG-A fields of a HE PPDU using one frequency segment, when the Beam Change subfield in HE-SIG-A field is set to 1. These

transmit blocks are also used to generate the other pre-HE-SIG-B fields of the HE PPDU when the Beam Change subfield in HE-SIG-A field is set to 1, with the following exceptions applied:

— The BCC encoder and interleaver are not used when generating the L-STF and L-LTF fields.

— The BCC interleaver is not applied in the repeated HE-SIG-A symbols (i.e. the 2nd and the 4th OFDM symbols of HE-SIG-A field) in the HE extended range SU PPDU.

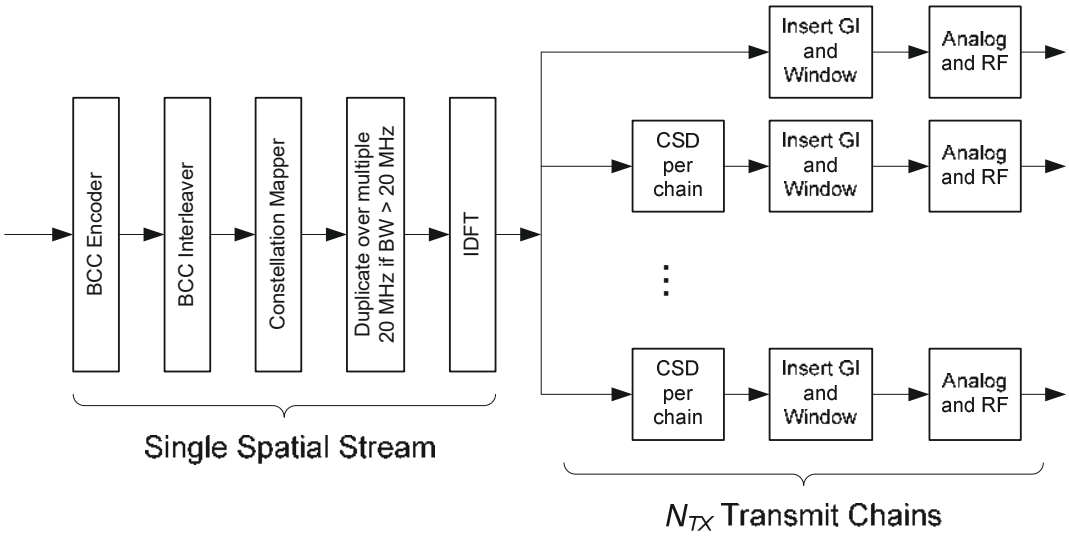


Figure 26-6 - Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields when the Beam Change field is 1

Figure 26-7 shows the transmit process for the L-SIG, RL-SIG, and HE-SIG-A fields of a HE PPDU using one frequency segment, when the Beam Change subfield in HE-SIG-A field is set to 0. These transmit blocks are also used to generate the other pre-HE-SIG-B fields of the HE PPDU when the Beam Change subfield in HE-SIG-A field is set to 0, with the following exceptions:

— The BCC encoder and interleaver are not used when generating the L-STF and L-LTF fields.

— The BCC interleaver is not applied in the repeated HE-SIG-A field OFDM symbols (i.e., the 2nd and the 4th OFDM symbols of HE-SIG-A field) in the HE extended range SU PPDU.

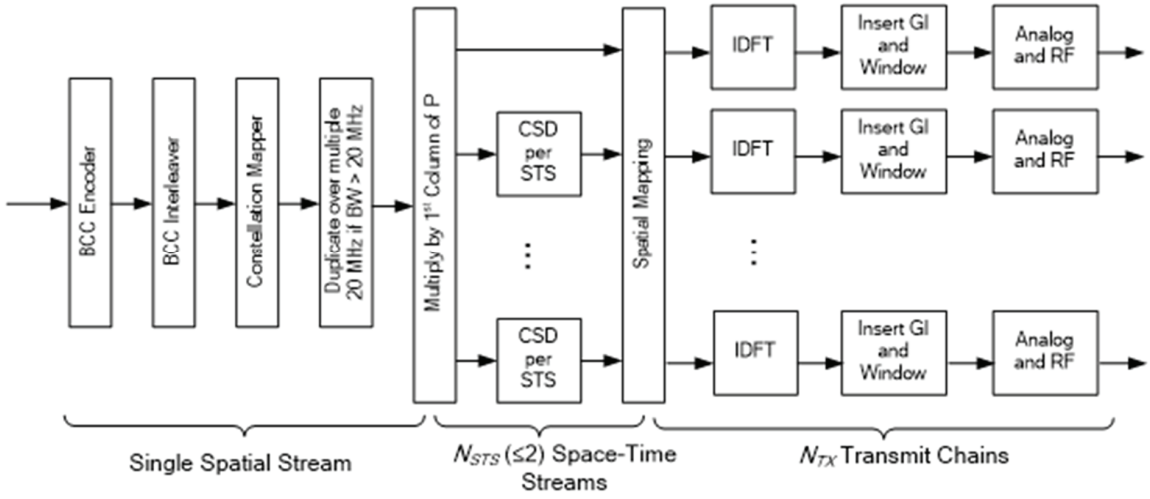


Figure 26-7 – Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields when the Beam Change field is 0

Figure 26-8 shows the transmit process for the HE-SIG-B field of an HE MU PPDU using one frequency segment. This block diagram is for transmitting HE-SIG-B in one 20 MHz subchannel. Refer to 26.3.9.8.1 for the methods of transmitting HE-SIG-B in 40 MHz, 80 MHz and 160 MHz. The DCM tone mapper is applied only if the DCM indication in HE-SIG-A field is set to 1. (TBD: MCS0-DCM)

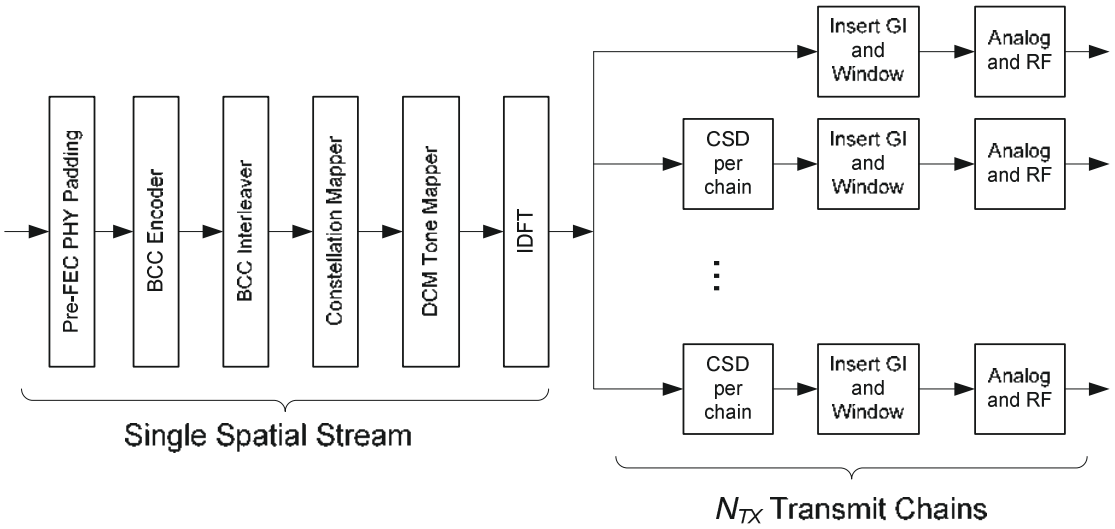


Figure 26-8 - Transmitter block diagram for the HE-SIG-B field

Figure 26-9 shows the transmitter blocks used to generate the Data field of a single user HE transmission within a 26-, 52-, 106-, or 242-RU with BCC encoding for a single frequency segment when the number of spatial stream is less than or equal to 4. This also includes the SU transmission in an RU that is part of a downlink or uplink OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU. The STBC block may be applied only for single spatial stream and only when DCM is not applied. The DCM tone mapper is applied only when the DCM indication for the RU is set to 1. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the HE-LTF fields. This is illustrated in Figure 26-29. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the HE-STF field. (TBD: MCS0-DCM). This figure also applies to the data field with BCC encoding in a HE trigger-based PPDU.

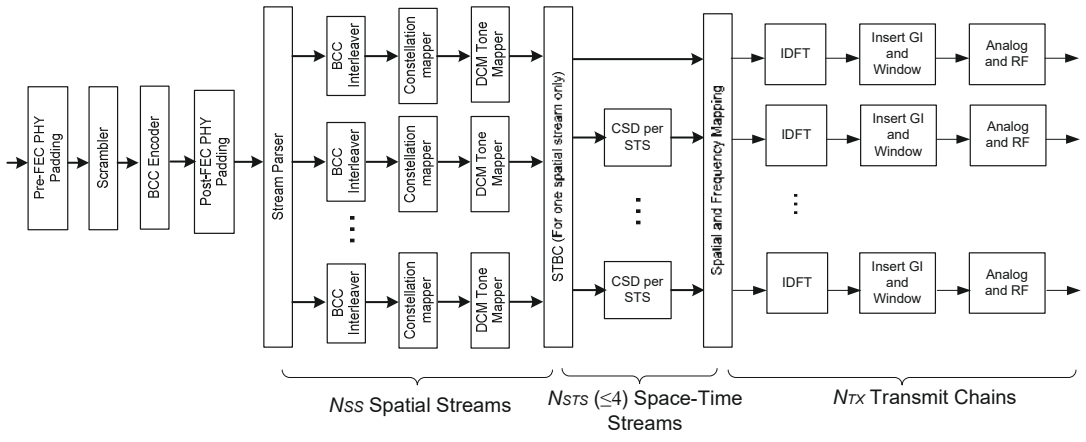


Figure 26-9 - Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-RU with BCC encoding

Figure 26-10 shows the transmitter blocks used to generate the Data field of a single user HE transmission within a 26-, 52-, 106-, 242-, 484-, or 996-RU with LDPC encoding for a single frequency segment. This also includes the SU transmission in an RU that is part of a downlink or uplink OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU. The STBC block may be applied only for single spatial stream and only when DCM is not applied. The DCM tone Mapper is applied only when the DCM indication for the RU is set to 1. (TBD: MCS0-DCM) This figure also applies to the data field with LDPC encoding in a HE trigger-based PPDU.

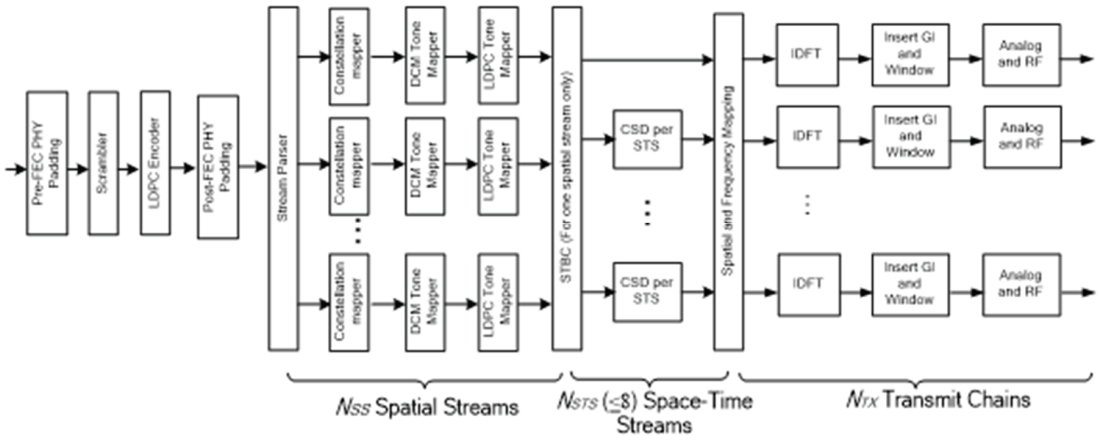


Figure 26-10 - Transmitter block diagram for the Data field of an HE SU transmission in 26-, 52-, 106-, 242-, 484- or 996-RU with LDPC encoding

Figure 26-11 shows the transmitter blocks used to generate the Data field of a HE downlink MU-MIMO transmission within a 106-, 242-, 484-, or 996-RU with LDPC encoding. This also includes the downlink MU-MIMO transmission in an RU that is part of a downlink or uplink OFDMA PPDU.

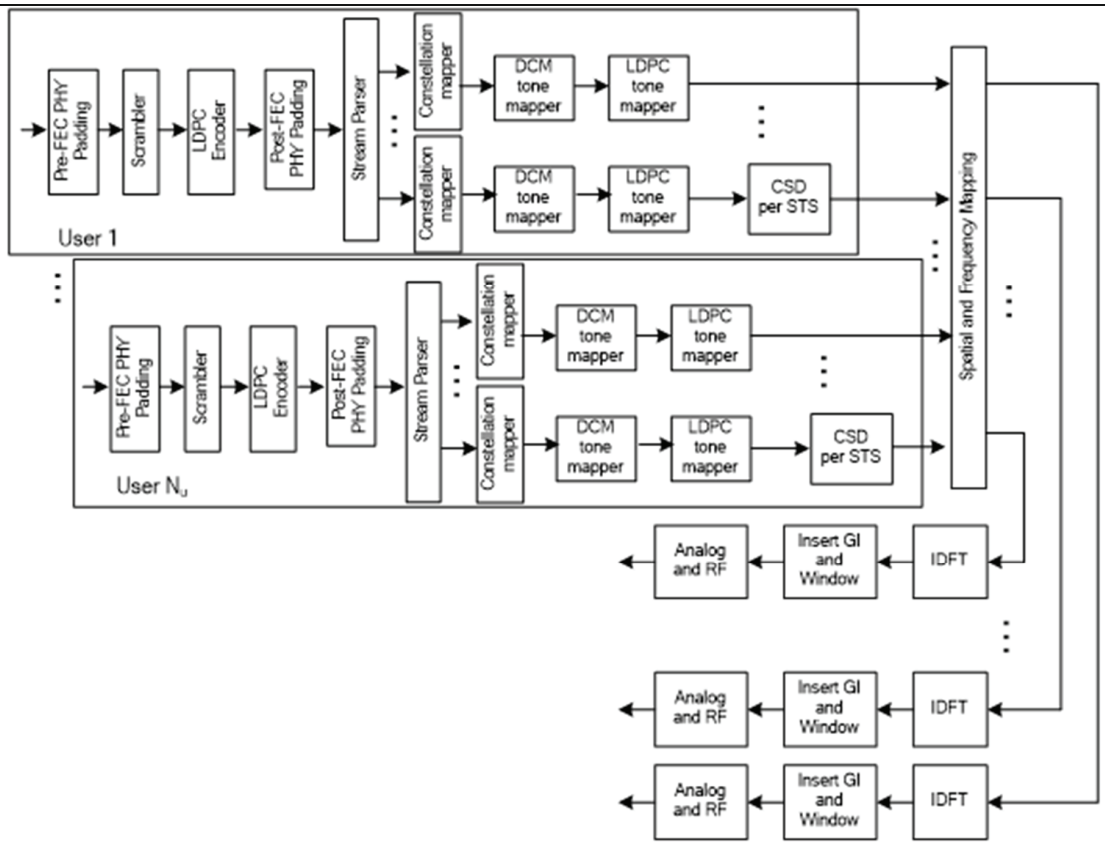


Figure 26-11 - Transmitter block diagram for the Data field of an HE downlink MU-MIMO transmission in 106-, 242-, 484- or 996-RU with LDPC encoding

Figure 26-12 shows the transmitter blocks used to generate the Data field of a single-user HE transmission in 160 MHz with LDPC encoding.

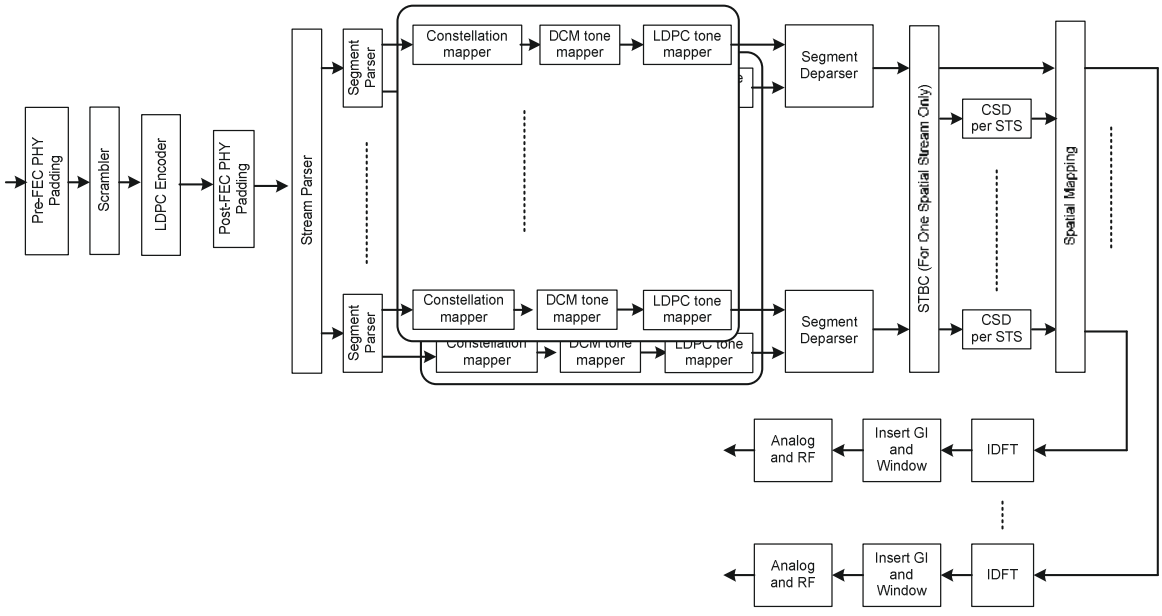


Figure 26-12 - Transmitter block diagram for the Data field of an HE SU PPDU in 160 MHz with LDPC encoding

Figure 26-13 shows the transmitter blocks used to generate the Data field of a single-user HE transmission in 80+80 MHz with LDPC encoding.

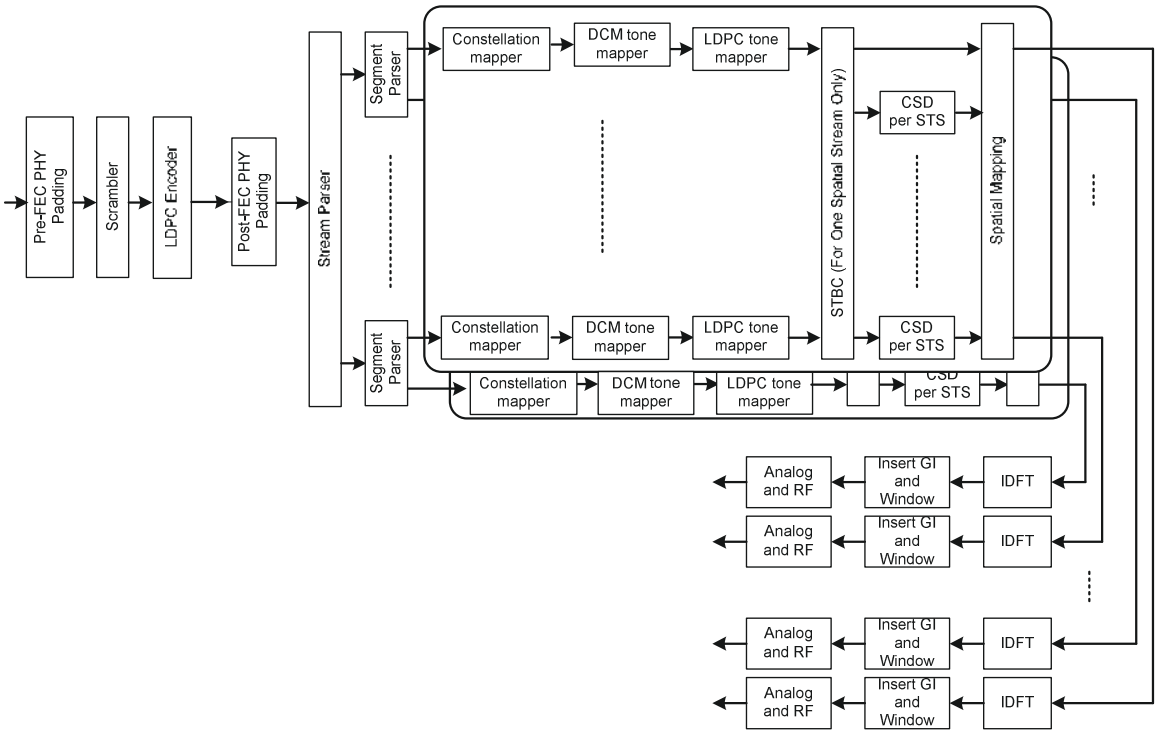


Figure 26-13 - Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding

26.3.4 Overview of the PPDU encoding process

26.3.5 HE modulation and coding schemes (HE-MCSs)

The HE-MCS is a value that determines the modulation and coding used in the HE-SIG-B field and the Data field of the PPDU. It is a compact representation that is carried in the HE-SIG-A field for the HE-SIG-B field in an HE MU PPDU and for the Data field in an HE SU PPDU and HE extended range SU PPDU and carried in the HE-SIG-B field for the Data field in an HE MU PPDU. Rate-dependent parameters for the full set of HE-MCSs are shown in Table 25-x (HE-MCSs for TBD mandatory/optional 26-tone RU, NSS = 1) to Table 25-y (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8) (in 26.5 (Parameters for HE-MCSs)). These tables give rate-dependent parameters for HE-MCSs with indices 0 to 11, with number of spatial streams from 1 to 8, RU options of 26-tone, 52-tone, 106-tone, 242-tone, 484-tone and 996-tone, and bandwidth options of 20 MHz, 40 MHz, 80 MHz, and either 160 MHz or 80+80 MHz. HE-MCSs with indices 10 and 11 (1024-QAM) are optionally applied to the Data field of an HE PPDU with RUs equal to or larger than 242-tone. The HE extended range SU PPDU can only be transmitted with MCS0, MCS1, MCS2 and only with 1 spatial stream on the primary 20 MHz channel.

DCM is an optional modulation scheme used for the HE-SIG-B field and the Data field in an HE PPDU. It is indicated in the HE-SIG-A field for the HE-SIG-B field in an HE MU PPDU and for the Data field in HE SU PPDU, HE trigger-based PPDU and HE extended range SU PPDU and indicated in the HE-SIG-B field for the Data field in an HE MU PPDU. It is only applied for the HE-MCSs with indices 0, 1, 3 and 4.

26.3.6 Timing related parameters

Refer to Table 20-6 and Table 22-5 (Timing-related constants) for timing-related parameters for non-HE PPDU formats.

Table 26-3 defines the timing-related parameters for HE PPDU formats.

Table 26-3 – Timing related constants

Parameter	Values	Description
$\Delta_{F,\text{Pre-HE}}$	312.5 kHz	Subcarrier frequency spacing for the pre-HE portion.
$\Delta_{F,\text{HE}}$	78.125 kHz	Subcarrier frequency spacing for the HE portion.
$T_{DFT,Pre\text{-}HE}$	3.2 μs	IDFT/DFT period for the pre-HE portion.
$T_{DFT,HE}$	12.8 μs	IDFT/DFT period for the HE portion.
$T_{GI,Pre\text{-}HE}$	0.8 μs	Guard interval duration for the legacy preamble, RL-SIG, HE-SIG-A and HE-SIG-B
$T_{GI,HE\text{-}LTF}$	$T_{GI1,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$ depending on the GI used for data	Guard interval duration for the HE-LTF field, same as $T_{GI,Data}$
$T_{GI,Data}$	$T_{GI1,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$ depending on the GI used for data	Guard interval duration for the HE-Data field
$T_{GI1,Data}$	0.8 μs	Base guard interval duration for the HE-Data field.
$T_{GI2,Data}$	1.6 μs	Double guard interval duration for the HE-Data field.
$T_{GI4,Data}$	3.2 μs	Quadruple guard interval duration for the HE-Data field.
T_{SYM1}	13.6 μs = $T_{DFT,HE} + T_{GI1,Data} = 1.0625 \times T_{DFT,HE}$	Normal GI symbol interval
T_{SYM2}	14.4 μs = $T_{DFT,HE} + T_{GI2,Data} = 1.125 \times T_{DFT,HE}$	Double GI symbol interval
T_{SYM4}	16 μs = $T_{DFT,HE} + T_{GI4,Data} = 1.25 \times T_{DFT,HE}$	Quadruple GI symbol interval
T_{SYM}	T_{SYM1}, T_{SYM2}, or T_{SYM4} depending on the GI used (see Table xx-x (Tone scaling factor and guard interval duration values for PHY fields))	Symbol interval
$T_{L\text{-}STF}$	8 μs = 10 x $T_{DFT,\ Pre\text{-}HE}$ /4	Non-HT Short Training field duration
$T_{L\text{-}LTF}$	8 μs = 2 x $T_{DFT,Pre\text{-}HE} + T_{GI2,Data}$	Non-HT Long Training field duration
$T_{L\text{-}SIG}$	4 μs	Non-HT SIGNAL field duration
$T_{RL\text{-}SIG}$	4 μs	Repeated non-HT SIGNAL field duration
$T_{HE\text{-}SIG\text{-}A}$	8 μs = 2 × 4 μs	HE-SIG-Afield duration in an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU
$T_{HE\text{-}SIG\text{-}A\text{-}R}$	8 μs or 16 μs (TBD)	HE-SIG-A field duration in an HE extended range SU PPDU
$T_{HE\text{-}STF\text{-}T}$	8 μs = 5 × 1.6 μs	HE-STF field duration for an HE trigger-based PPDU
$T_{HE\text{-}STF\text{-}NT}$	4 μs = 5 × 0.8 μs	HE-STF field duration for an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU
$T_{HE\text{-}LTF}$	$T_{HE\text{-}LTF\text{-}1X}$, $T_{HE\text{-}LTF\text{-}2X}$ or $T_{HE\text{-}LTF\text{-}4X}$ depending upon the LTF duration used	Duration of each HE-LTF field OFDM symbol without GI
$T_{HE\text{-}LTF\text{-}1X}$	3.2 μs	Duration of each 1x HE-LTF OFDM symbol without GI
$T_{HE\text{-}LTF\text{-}2X}$	6.4 μs	Duration of each 2x HE-LTF OFDM symbol without GI
$T_{HE\text{-}LTF\text{-}4X}$	12.8 μs	Duration of each 4x HE-LTF OFDM symbol without GI
$T_{HE\text{-}LTF,SYM}$	sum of $T_{HE\text{-}LTF}$ and $T_{GI,HE\text{-}LTF}$	Duration of each HE-LTF OFDM symbol including GI
$T_{HE\text{-}SIG\text{-}B}$	4 μs = $T_{DFT,Pre\text{-}HE} + T_{GI,Pre\text{-}HE}$	Duration of each HE-SIG-B field OFDM symbol
T_{PE}	0, 4 μs, 8 μs, 12 μs, 16 μs depending on actual extension duration used	Duration of the Packet Extension field
$N_{service}$	16	Number of bits in the SERVICE field
N_{tail}	6	Number of tail bits per BCC encoder
T_{SYML}	4 μs	Symbol duration including GI prior to the HE-STF field

Table 26-4 defines tone allocation related parameters for a non-OFDMA HE PPDU.

Table 26-4 - Tone allocation related constants for Data field in a non-OFDMA HE PPDU

Parameter	CBW20	CBW40	CBW80	CBW80+80	CBW160	Description
N_{SD}	234	468	980	980	1960	Number of complex data numbers per frequency segment
N_{SP}	8	16	16	16	32	Number of pilot values per frequency segment
N_{ST}	242	484	996	996	1992	Total number of subcarriers per frequency segment
N_{SR}	122	244	500	500	1012	Highest data subcarrier index per frequency segment
N_{Seg}	1	1	1	2	1	Number of frequency segments
N_{DC}	3	5	5	5	23	Number of null tones at DC per segment

Parameter	CBW20	CBW40	CBW80	CBW80+80	CBW160	Description
$N_{Guard,Left}$	6	12	12	12	12	Number of guard tones at the lower side of the spectrum
$N_{Guard,Right}$	5	11	11	11	11	Number of guard tones at the higher end of the spectrum
NOTE: $N_{ST} = N_{SD} + N_{SP}$						

Table 26-5 defines tone allocation related parameters for an OFDMA HE PPDU.

Table 26-5 - Tone allocation related constants for RUs in an OFDMA HE PPDU

Parameter	RU Size (Tones)						Description
	26	52	106	242	484	996	
N_{SD}	24	48	102	234	468	980	Number of complex data numbers per RU
N_{SP}	2	4	4	8	16	16	Number of pilot values per RU
N_{ST}	26	52	106	242	484	996	Total number of subcarriers per RU
NOTE: $N_{ST} = N_{SD} + N_{SP}$							

Table 26-6 defines parameters used frequently in Clause 26.

Table 26-6 - Frequently used parameters

Symbol	Explanation
N_{CBPS}, $N_{CBPS,r,u}$	Number of coded bits per symbol at r-th RU for user u, r = 0, …, N_{RU} – 1, u = 0, ..., $N_{user,r}$ – 1. For an HE SU PPDU, $N_{CBPS} = N_{CBPS,0,0}$ For an HE MU PPDU, N_{CBPS} is undefined
N_{CBPSS}, $N_{CBPSS,r,u}$	Number of coded bits per symbol per spatial stream. For the Data field, $N_{CBPSS,r,u}$ equals the number of coded bits per symbol per spatial stream at r-th RU for user u, r = 0, …, N_{RU}-1, u = 0, ..., $N_{user,r}$–1. For the Data field of an HE SU PPDU, $N_{CBPSS} = N_{CBPSS,0,0}$ For the Data field of an HE MU PPDU, N_{CBPSS} is undefined
N_{DBPS}, $N_{DBPS,r,u}$	Number of data bits per symbol at r-th RU for user u, r = 0, …, N_{RU} – 1, u = 0, ..., $N_{user,r}$ – 1. For an HE SU PPDU, $N_{DBPS} = N_{DBPS,0,0}$ For an HE MU PPDU, N_{DBPS} is undefined
N_{BPSCS}, $N_{BPSCS,r,u}$	Number of coded bits per subcarrier per spatial stream at r-th RU for user u, r = 0, …, N_{RU} – 1, u = 0, ..., $N_{user,r}$ – 1. For an HE SU PPDU, $N_{BPSCS} = N_{BPSCS,0,0}$ For an HE MU PPDU, N_{BPSCS} is undefined
N_{RX}	Number of receive chains
N_{RU}	For pre-HE modulated fields, N_{RU} = 1. For HE modulated fields, N_{RU} represents the number of RUs in the transmission (equal to the TXVECTOR parameter NUM_RUS).
$N_{user,r}$	For pre-HE modulated fields, $N_{user,r}$ = 1. For HE modulated fields, $N_{user,r}$ represents the number of users at r-th RU in the transmission (summing over all RUs equals to the TXVECTOR parameter NUM_USERS_TOTAL).
N_{user_total}	For pre-HE modulated fields, N_{user_total} = 1. For HE modulated fields, N_{user_total} represents the number of users in the transmission (equal to the TXVECTOR parameter NUM_USERS_TOTAL).
N_{STS}, $N_{STS,r,u}$	For pre-HE modulated fields, $N_{STS,r,u}$ = 1 (see NOTE 2). For HE modulated fields, $N_{STS,r,u}$ the number of space-time streams at r-th RU for user u, u = 0,…, $N_{user,r}$ – 1. In case of STBC, $N_{STS,r,u}$ = 2 For an HE SU PPDU, $N_{STS} = N_{STS,0,0}$

	For an HE MU PPDU, $N_{STS} = max_{r=0}^{N_{RU}-1} N_{STS,r,total}$
$N_{STS,r,total}$	For HE modulated fields, $N_{STS,r,total}$ is the total number of space-time streams at the r-th RU in a PPDU. $N_{STS,r,total} = \sum_{u=0}^{N_{user,r}-1} N_{STS,r,u}$ For pre-HE modulated fields, $N_{STS,r,total}$ is undefined. Note that $N_{STS,r,total} = N_{STS}$ for an HE SU PPDU.
N_{SS}, $N_{SS,r,u}$	Number of spatial streams. For the Data field, NSS,r,u is the number of spatial streams at r-th RU for user u, $u = 0,\ldots,N_{user,r} - 1$ For the Data field of an HE SU PPDU, $N_{SS} = N_{SS,0,0}$ For the Data field of an HE MU PPDU, $N_{SS} = max_{r=0}^{N_{RU}-1} N_{SS,r,total}$
$N_{SS,r,total}$	For HE modulated fields, $N_{SS,r,total}$ is the total number of spatial streams at r-th RU in a PPDU. $N_{SS,r,total} = \sum_{u=0}^{N_{user,r}-1} N_{SS,r,u}$ For pre-HE modulated fields, $N_{SS,r,total}$ is undefined. Note that $N_{SS,r,total} = N_{SS}$ for an HE SU PPDU.
N_{TX}	Number of transmit chains
N_{ES}, $N_{ES,r,u}$	The number of BCC encoders. This parameter should be 1 in all BCC cases in 11ax. For a Data field encoded using BCC, $N_{ES,r,u}$ is the number of BCC encoders at r-th RU for user u, $u = 0, \ldots, N_{user,r} - 1$. For the Data field encoded using LDPC, $N_{ES} = 1$ for an HE SU PPDU and $N_{ES,r,u} = 1$ for an HE MU PPDU at r-th RU for user u, $u = 0, \ldots N_{user,r} - 1$. For the Data field of an HE SU PPDU, $N_{ES} = N_{ES,0,0}$ For the Data field of an HE MU PPDU, N_{ES} is undefined.
$N_{HE\text{-}LTF}$	The number of OFDM symbols in the HE-LTF field (see 26.3.9.10 (HE-LTF))
$N_{HE\text{-}SIG\text{-}B}$	The number of OFDM symbols in the HE-SIG-B field
K_r	Set of subcarrier indices in the r-th RU
R, $R_{r,u}$	$R_{r,u}$ is the coding rate at r-th RU for user u, $u = 0, \ldots, N_{user} - 1$. For an HE SU PPDU, $R = R_{0,0}$ For an HE MU PPDU, R is undefined
$M_{r,u}$	For pre-HE modulated fields, $M_{r,u} = 0$. For HE modulated fields, $M_{r,0} = 0$ for $u = 0$ and $M_{r,u} = \sum_{u'=0}^{u-1} N_{STS,r,u'}$ for $u = 1, \ldots N_{user,r} - 1$.
NOTE 1—Pre-HE modulated fields refer to the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, HE-SIG-A-R, and HE-SIG-B fields, while HE modulated fields refer to the HE-STF, HE-LTF, and Data fields (see Timing boundaries for HE PPDU fields). NOTE 2—For pre-HE modulated fields, u and r are zeros only since $N_{user,r} = 1$ and $N_{RU} = 1$.	

1

26.3.7 OFDMA and SU tone allocation

Orthogonal Frequency Division Multiple Access (OFDMA) is the multi-user variant of the OFDM scheme where multiple-access is achieved by assigning subsets of subcarriers to different users, allowing simultaneous data transmission by several users. In OFDMA, the resources are allocated in two dimensional regions over time and frequency. In HE, the time region covers the entire data portion of an HE PPDU, and the frequency region includes a number of contiguous subcarriers with the exception of the RUs which straddle DC where nulls are placed in the middle of the band. The difference between OFDM and OFDMA is illustrated in Figure 26-14. Similar to OFDM, OFDMA employs multiple subcarriers, but the subcarriers are divided into several groups of subcarriers where each group is denoted as a resource unit (RU). The grouping of subcarriers into groups of resource units is referred to as subchannelization. In HE, the subcarriers that form a RU are physically adjacent (contiguous except at the middle of the band where nulls are placed at DC).

Subchannelization defines subchannels that can be allocated to stations depending on their channel conditions and service requirements. Using subchannelization, an OFDMA system can potentially allocate different transmit powers to different allocations.

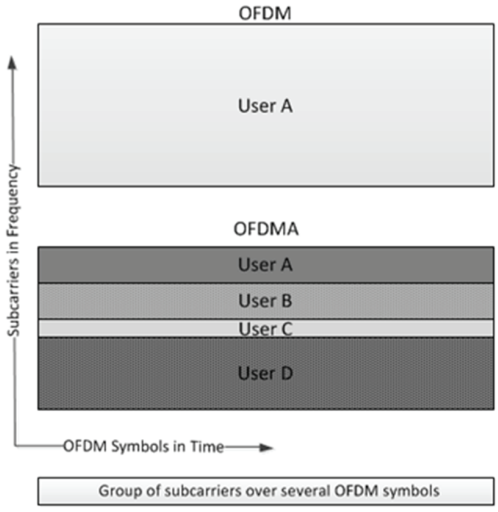


Figure 26-14 - Illustration of OFDM and OFDMA Concepts

OFDMA is a method to add multiple access in OFDM systems and has been adopted by other wireless standards, and the HE amendment introduces OFDMA into 802.11 WLAN networks. The OFDMA parameters in HE satisfy general design criteria for OFDM systems as follows:

$$T_{CP} \geq \tau_{RMS} \quad \text{(to prevent ISI due to delay spread)} \qquad \textbf{(26-1)}$$
$$T_{CP}\Delta f \gg 1 \quad \text{(for spectral efficiency improvement)}$$

In OFDMA, an OFDM symbol is constructed of subcarriers, the number of which is a function of the FFT size. There are several subcarrier types: 1) Data subcarriers which are used for data transmission; defined in section 25.3.7.1, 2) Pilot subcarriers which are utilized for phase information and parameter tracking; defined in section 25.3.7.3, and 3) unused subcarriers which are not used for data/pilot transmission. The unused subcarriers are the DC subcarrier (defined in section 23.3.7.1), the Guard band subcarriers at the band edges (defined in section 23.3.7.1), and the Null subcarriers (defined in section 25.3.7.2).

26.3.7.1 Resource unit, edge and DC tones

The OFDMA structure consists of a 26-subcarrier resource unit (RU), 52-subcarrier RU, 106-subcarrier RU, 242-subcarrier RU, 484-subcarrier RU and 996-subcarrier RU. Resource allocations for single user (SU) consist of a 242 subcarrier RU, 484-subcarrier RU, 996-subcarrier RU and 2x996-subcarrier RU.

The 26-subcarrier RU and 52-subcarrier RU are used in the 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz OFDMA HE PPDU formats. The 106-subcarrier RU is used in the 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz OFDMA and MU-MIMO HE PPDU formats. The 242-subcarrier RU is used in the 40 MHz, 80 MHz, 160 MHz and 80+80 MHz OFDMA and MU-MIMO HE PPDU formats. The 484-subcarrier RU is used in the 80 MHz, 160 MHz and 80+80 MHz OFDMA and MU-MIMO HE PPDU formats. The 996-subcarrier RU is used in the 160 MHz and 80+80 MHz OFDMA and MU-MIMO HE PPDU formats.

The 242-subcarrier and larger RUs are used in the HE SU PPDU and non-OFDMA, MU-MIMO HE PPDU formats. The 242-subcarrier RU is used in the 20 MHz HE SU PPDU and MU-MIMO HE PPDU formats. The 484-subcarrier RU is used in the 40 MHz HE SU PPDU and MU-MIMO HE PPDU formats. The 996-subcarrier RU is used in the 80 MHz HE SU PPDU and MU-MIMO HE PPDU formats. The 2x996-subcarrier RU is used in the 160 MHz and 80+80 MHz HE SU PPDU and MU-MIMO HE PPDUs.

The maximum numbers of RUs in the 20 MHz, 40 MHz, 80 MHz, 160 MHZ and 80+80 MHz HE PPDU formats are defined in Table 26-7. Cases of 1 RU indicate the HE SU and a HE MU-MIMO PPDU allocation.

Table 26-7 - Total number of RUs for BWs

RU type	CBW20	CBW40	CBW80	CBW160 and CBW80+80
26-subcarrier RU	9	18	37	74
52-subcarrier RU	4	8	16	32
106-subcarrier RU	2	4	8	16
242-subcarrier RU	1-SU/MU-MIMO	2	4	8
484-subcarrier RU	N/A	1-SU/MU-MIMO	2	4
996-subcarrier RU	N/A	N/A	1-SU/MU-MIMO	2
2x996 subcarrier RU	N/A	N/A	N/A	1-SU/MU-MIMO

An OFDMA HE PPDU can carry a mixture of 26-subcarrier, 52-subcarrier and 106-subcarrier RUs within any of the 242-subcarrier RU boundaries.

Table 26-8 - Subcarrier indices for RUs in a 20 MHz HE PPDU

RU type					
26-subcarrier	RU 1 [-121 : -96]	RU 2 [-95 : -70]	RU 3 [-68 : -43]	RU 4 [-42 : -17]	RU 5 [-16 : -4, 4 : 16]
	RU 6 [17 : 42]	RU 7 [43 : 68]	RU 8 [70 : 95]	RU 9 [96 : 121]	-
52-subcarrier	RU 1 [-121 : -70]	RU 2 [-68 : -17]	RU 3 [17: 68]	RU 4 [70 : 121]	-
106-subcarrier	RU 1 [-122 : -17]		RU 2 [17: 122]		-
242-subcarrier	RU 1 [-122 : -2, 2:122]				

Table 26-9 - Subcarrier indices for RUs in a 40 MHz HE PPDU

RU type					
26-subcarrier	RU 1 [-243 : -218]	RU 2 [-217 : -192]	RU 3 [-189 : -164]	RU 4 [-163 : -138]	RU 5 [-136 : -111]
	RU 6 [-109 : -84]	RU 7 [-83 : -58]	RU 8 [-55 : -30]	RU 9 [-29 : -4]	-

	RU 10 [4 : 29]	RU 11 [30 : 55]	RU 12 [58 : 83]	RU 13 [84: 109]	RU 14 [111 : 136]
	RU 15 [138 : 163]	RU 16 [164 : 189]	RU 17 [192 : 217]	RU 18 [218 : 243]	-
52-subcarrier	RU 1 [-243 : -192]	RU 2 [-189 : -138]	RU 3 [-109: -58]	RU 4 [-55: -4]	-
	RU 5 [4 : 55]	RU 6 [58 : 109]	RU 7 [138 : 189]	RU 8 [192 : 243]	-
106-subcarrier	RU 1 [-243:-138]	RU 2 [-109 : -4]	RU 3 [4 : 109]	RU 4 [138 : 243]	-
242-subcarrier	RU 1 [-244 : -3]			RU2 [3 : 244]	
484-subcarrier	RU 1 [-244 : -3, 3 : 244]				

Table 26-10 - Subcarrier indices for RUs in a 80 MHz HE PPDU

RU type					
26-subcarrier	RU 1 [-499 : -474]	RU 2 [-473 : -448]	RU 3 [-445 : -420]	RU 4 [-419 : -394]	RU 5 [-392 : -367]
	RU 6 [-365 : -340]	RU 7 [-339 : -314]	RU 8 [-311 : -286]	RU 9 [-285 : -260]	-
	RU 10 [-257 : -232]	RU 11 [-231 : -206]	RU 12 [-203 : -178]	RU 13 [-177 : -152]	RU 14 [-150 : -125]
	RU 15 [-123 : -98]	RU 16 [-97 : -72]	RU 17 [-69 : -44]	RU 18 [-43 : -18]	RU 19 [-16 : -4, 4:16]
	RU 20 [18 : 43]	RU 21 [44 : 69]	RU 22 [72 : 97]	RU 23 [98 : 123]	RU 24 [125 : 150]
	RU 25 [152 : 177]	RU 26 [178 : 203]	RU 27 [206 : 231]	RU28 [232 : 257]	-
	RU 29 [260 : 285]	RU 30 [286 : 311]	RU 31 [314 : 339]	RU 32 [340 : 365]	RU 33 [367 : 392]
	RU 34 [394 : 419]	RU 35 [420 : 445]	RU 36 [448 : 473]	RU37 [474 : 499]	-
52-subcarrier	RU 1 [-499: -448]	RU 2 [-445: -394]	RU 3 [-365: -314]	RU 4 [-311: -260]	-
	RU 5 [-257: -206]	RU 6 [-203: -152]	RU 7 [-123 : -72]	RU 8 [-69: -18]	-
	RU 9 [18: 69]	RU 10 [72: 123]	RU 11 [152: 203]	RU 12 [206: 257]	
	RU 13 [260: 311]	RU 14 [314: 365]	RU 15 [394: 445]	RU 16 [448: 499]	
106-subcarrier	RU 1 [-499 : -394]	RU 2 [-365 : -260]	RU 3 [-257 : -152]	RU 4 [-123 : -18]	-
	RU 5 [18 : 123]	RU 6 [152 : 257]	RU 7 [260 : 365]	RU 8 [394 : 499]	
242-subcarrier	RU 1 [-500: -259]	RU 2 [-258: -17]		RU 3 [17: 258]	RU 4 [259: 500]
484-subcarrier	RU 1 [-500 : -17]			RU 2 [17 , 500]	
996-subcarrier	RU 1 [-500 : -3 , 3: 500]				

A 26-subcarrier RU consists of 24 data subcarriers and 2 pilot subcarriers. The position of the pilots for the 26-subcarrier RU is defined in 26.3.7.3. The location of the 26-subcarrier RUs are fixed as defined in Table 26-8 and shown in Figure 26-15, Figure 26-16 and Figure 26-17 for the 20 MHz, 40 MHz and 80 MHz OFDMA HE PPDU formats, respectively. The same structure as used for the 80 MHz OFDMA HE PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU. The

center 26-subcarrier RU in the 20 MHz and 80 MHz OFDMA HE PPDU (Figure 26-15 and Figure 26-17) is located on subcarriers [-16:-4, 4:16].

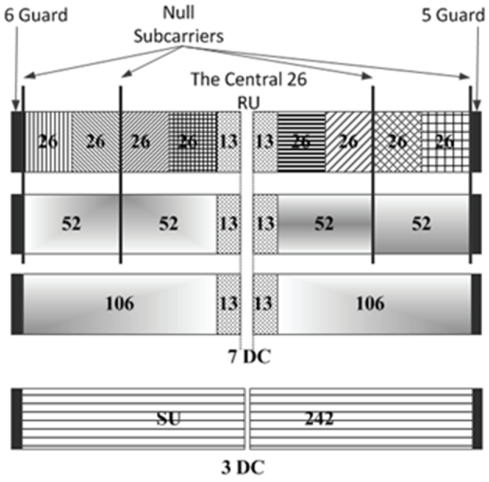


Figure 26-15 - RU locations in a 20 MHz HE PPDU

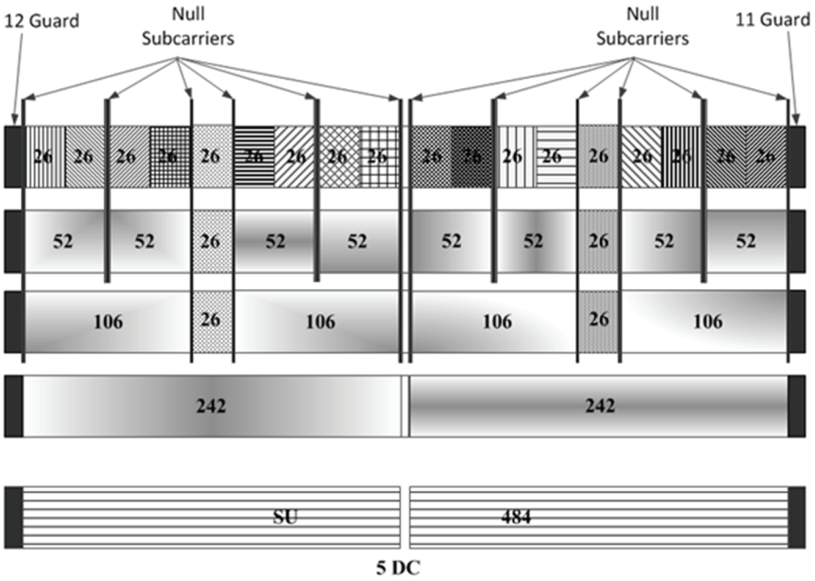


Figure 26-16 - RU locations in a 40 MHz HE PPDU

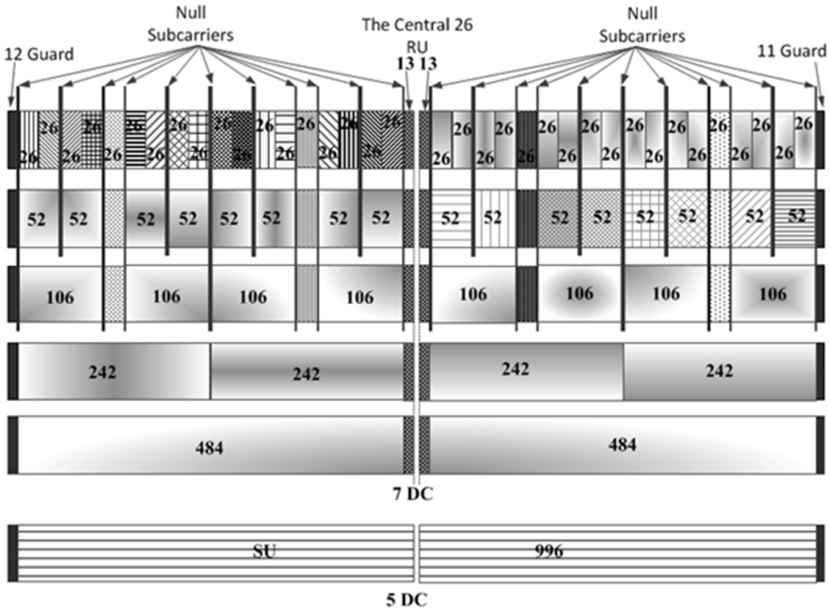


Figure 26-17 - RU locations in an 80 MHz HE PPDU

A 52-subcarrier RU consists of 48 data subcarriers and 4 pilot subcarriers. The position of the pilots for the 52-subcarrier RU is defined in 25.3.7.3. The locations of the 52-subcarrier RUs are fixed as defined in Table 26-8, Table 26-9 and Table 26-10 and illustrated in Figure 26-15, Figure 26-16 and Figure 26-17 for the 20 MHz, 40 MHz and 80 MHz OFDMA HE PPDU formats, respectively. The same structure as used in the 80 MHz OFDMA HE PPDU format is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU formats.

A 106-subcarrier RU consists of 102 data subcarriers and 4 pilot subcarriers. The position of the pilots for the 106-subcarrier RU is defined in 25.3.7.3. The locations of the 106-subcarrier RUs are fixed as defined in Table 26-8, Table 26-9 and Table 26-10 and illustrated in Figure 26-15, Figure 26-16 and Figure 26-17 for the 20 MHz, 40 MHz and 80 MHz OFDMA HE PPDU formats, respectively. The same structure as used in the 80 MHz OFDMA HE PPDU formats is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU formats.

A 242-subcarrier RU consists of 234 data subcarriers and 8 pilot subcarriers. The position of pilots for the 242-subcarrier RU is defined in 25.3.7.3. The locations of the 242-subcarrier RUs are fixed as defined in Table 26-9 and Table 26-10 and illustrated in Figure 26-16 and Figure 26-17 for the 40 MHz, 80 MHz OFDMA HE PPDU formats, respectively. The same structure as used in the 80 MHz OFDMA HE PPDU formats is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU formats. A 20 MHz HE SU PPDU and MU-MIMO HE PPDU with a 242-subcarrier RU is shown in Figure 26-15.

A 484-subcarrier RU consists of 468 data subcarriers and 16 pilot subcarriers. The position of the pilots for the 484-subcarrier RU is defined in 25.3.7.3. The locations of the 484-subcarrier RUs are fixed as defined in Table 26-10 and illustrated in Figure 26-17 for the 80 MHz HE PPDU. The same structure as used for the 80 MHz OFDMA HE PPDU is used for for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU. The 40 MHz HE SU PPDU and MU-MIMO HE PPDU with a 484-subcarrier RU is shown in Figure 26-16.

A 996-subcarrier RU consists of 980 data subcarriers and 16 pilot subcarriers. The position of the pilots for the 996-subcarrier RU is defined in 25.3.7.3. The locations of the 996-subcarrier RUs are fixed and located on subcarrier [-1012:-515, -509:-12] and [12:509, 515:1012] for each half of the BW, respectively, for 160/80+80 MHz HE OFDMA PPDUs.

The 20 MHz OFDMA HE PPDU has 7 DC subcarriers located at [-3:3]. The 20 MHz HE SU PPDU and 20 MHz MU-MIMO HE PPDU with a 242 subcarrier RU has 3 DC subcarriers located at [-1:1]. The 40 MHz OFDMA HE PPDU, HE SU PPDU and a HE MU-MIMO PPDU with 484 subcarries have 5 DC subcarriers located at [-2:2]. An 80 MHz HE OFDMA PPDU has 7 DC subcarriers located at [-3:3]. The 80 MHz HE SU PPDU and 80 MHz HE MU-MIMO PPDU with 996 a subcarrier allocation have 5 DC subcarriers located at [-2:2]. The same structure as used in the 80 MHz OFDMA HE PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU. The DC tones are located on subcarriers [-11:11]. The same structure as used in the 80 MHz HE SU PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU.

The 20 MHz HE PPDU format has 11 guard subcarriers (6, 5) located at [-128:-123] and [123:127] as shown in Figure 26-15. The 40 MHz HE PPDU has 23 guard subcarriers (12, 11) located at [-256:-245] and [245:255] as shown in Figure 26-16. The 80 MHz HE PPDU has 23 guard subcarriers (12, 11) located at [-512:-501] and [501:511] as shown in Figure 26-17. For 160 MHz and 80+80 MHz HE PPDUs, the same number of leftmost and rightmost guard subcarriers as 80 MHz are defined at each edge of the 160 MHz.

26.3.7.2 Null subcarriers

There are null subcarriers between the 26-, 52- and 106-subcarrier RU locations as illustrated in Figure 26-15, Figure 26-16 and Figure 26-17. The null subcarriers have zero energy. The indices of the null subcarrier are enumerated in Table 26-11.

Table 26-11 – Null subcarrier indices

Channel Width	RU size	Null Subcarrier Indices
20 MHz	26, 52	±69, ±122
	106	none
	242	none
40 MHz	26, 52	±3, ±56, ±57, ±110, ±137, ±190, ±191, ±244
	106	±3, ±110, ±137, ±244
	242, 484	none
80 MHz	26, 52	±17, ±70, ±71, ±124, ±151, ±204, ±205, ±258, ±259, ±312, ±313, ±366, ±393, ±446, ±447, ±500
	106	±17, ±124, ±151, ±258, ±259, ±366, ±393, ±500
	242, 484	none
	996	none

26.3.7.3 Pilot tones

If pilot tones are present in the HE-LTF field, the pilot tone locations in the HE-LTF field and Data field shall be the same. The pilot tone locations for 20 MHz, 40 MHz and 80 MHz bandwidth are as shown in Figure 26-18, Figure 26-19 and Figure 26-20, respectively. All pilot tones are at the even indices enumerated in Table 26-12.

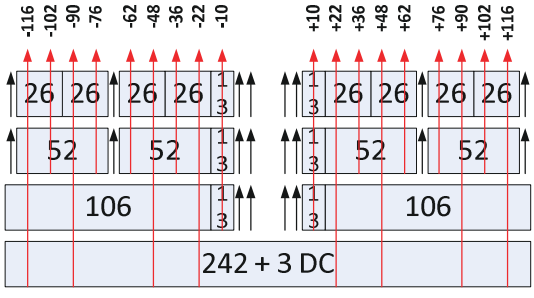


Figure 26-18 - Pilot tone locations for 20 MHz

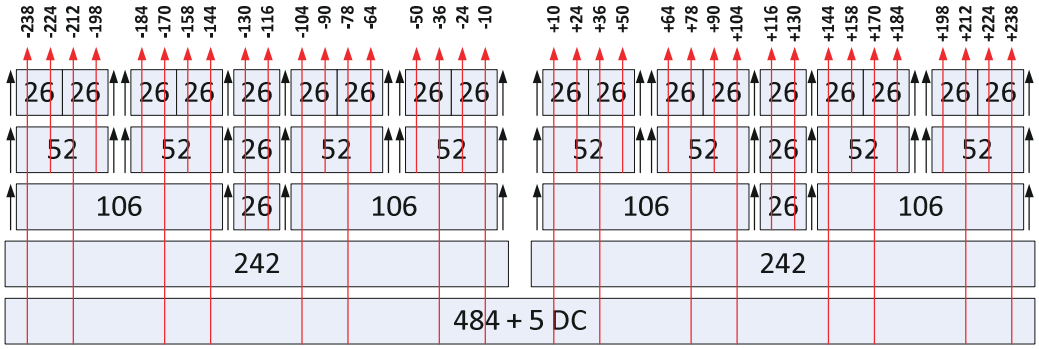


Figure 26-19 - Pilot tone locations for 40 MHz

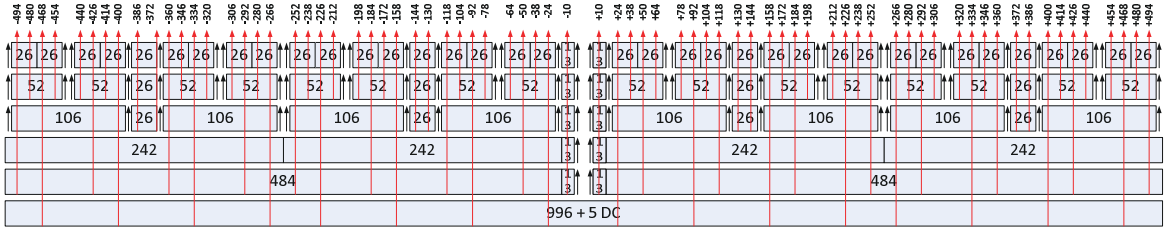


Figure 26-20 - Pilot tone locations for 80 MHz

Table 26-12 - Pilot tone indices

Channel Width	RU size	Pilot Tone Indices
20 MHz	26, 52	±10, ±22, ±36, ±48, ±62, ±76, ±90, ±102, ±116
	106, 242	±22, ±48, ±90, ±116
40 MHz	26, 52	±10, ±24, ±36, ±50, ±64, ±78, ±90, ±104, ±116, ±130, ±144, ±158, ±170, ±184, ±198, ±212, ±224, ±238
	106, 242, 484	±10, ±36, ±78, ±104, ±144, ±170, ±212, ±238
80 MHz	26, 52	±10, ±24, ±38, ±50, ±64, ±78, ±92, ±104, ±118, ±130, ±144, ±158, ±172, ±184, ±198, ±212, ±226, ±238, ±252, ±266, ±280, ±292, ±306, ±320, ±334, ±346, ±360, ±372, ±386, ±400, ±414, ±426, ±440, ±454, ±468, ±480, ±494
	106, 242, 484	±24, ±50, ±92, ±118, ±158, ±184, ±226, ±252, ±266, ±292, ±334, ±360, ±400, ±426, ±468, ±494
	996	±24, ±92, ±158, ±226, ±266, ±334, ±400, ±468

The pilot tones locations for 160 MHz or 80+80 MHz shall use the same 80 MHz locations for both 80 MHz.

26.3.8 Mathematical description of the signals

For a description of the conventions used for the mathematical description of the signals, see 18.3.2.5 (Mathematical conventions in the signal descriptions). In addition, the following notational conventions are used in Clause 25 (High Efficiency (HE) PHY specification):

$[Q]_{m,n}$ indicates the element in row m and column n of matrix , where $1 \le m \le N_{row}$, $1 \le n \le N_{col}$

N_{row} and N_{col} are the number of rows and columns, respectively, of the matrix Q.

$[Q]_{M:N}$ indicates a matrix consisting of columns M to N of matrix Q.

For a description on subcarrier indices over which the signal is transmitted for non-HT, HT and VHT PPDUs, see 22.3.7 (Mathematical description of signals).

For a 20 MHz HE Non-OFDMA PPDU transmission, the 20 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –2 and 2 to 122, with 0 being the center (DC) subcarrier.

For a 20 MHz HE OFDMA PPDU transmission, the 20 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –4 and 4 to 122, with 0 being the center (DC) subcarrier.

For a 40 MHz HE Non-OFDMA or OFDMA PPDU transmission, the 40 MHz is divided into 512 subcarriers. The signal is transmitted on subcarriers –244 to –3 and 3 to 244.

For an 80 MHz HE Non-OFDMA PPDU transmission, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers –500 to –3 and 3 to 500.

For an 80 MHz HE OFDMA PPDU transmission, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers –500 to –4 and 4 to 500.

For a 160 MHz HE PPDU transmission or a noncontiguous 80+80 MHz transmission, and each half 80 MHz bandwidth is divided into 1024 subcarriers, and the subcarriers on which the signal is transmitted in each 80 MHz bandwidth is identical to a 80 MHz HE PPDU transmission, depending on Non-OFDMA or OFDMA transmission within the correspond 80 MHz.

The transmitted signal is described in complex baseband signal notation. The actual transmitted signal is related to the complex baseband signal by the relation shown in Equation (26-2).

$$r_{RF}^{(i_{Seg},i_{TX})}(t) = \mathrm{Re}\left\{ \frac{1}{\sqrt{N_{Seg}}} r_{PPDU}^{(i_{Seg},i_{TX})}(t) \exp\left(j2\pi f_c^{(i_{Seg})} t \right) \right\}, \quad i_{Seg} = 0,\ldots,N_{Seg}-1;\ i_{TX} = 1,\ldots,N_{TX} \tag{26-2}$$

where

N_{Seg} represents the number of frequency segments in the transmit signal, as defined in Table 26-3;

$r_{PPDU}^{(i_{Seg},i_{TX})}$ represents the complex baseband signal of frequency segment i_{Seg} and transmit chain i_{TX};

$f_c^{(i_{Seg})}$ represents the center frequency of the portion of the PPDU transmitted in frequency segment i_{Seg}.

The transmitted RF signal is derived by up-converting the complex baseband signal, which consists of several fields. The timing boundaries for the various fields are shown in Figure 26-21, where $N_{HE\text{-}LTF}$ is the number of HE-LTF symbols and is defined in Table 26-6, $N_{HE\text{-}SIG\text{-}B}$ is the number of symbols in the HE-SIG-B field, and N_{SYM} is the number of symbols in the Data field.

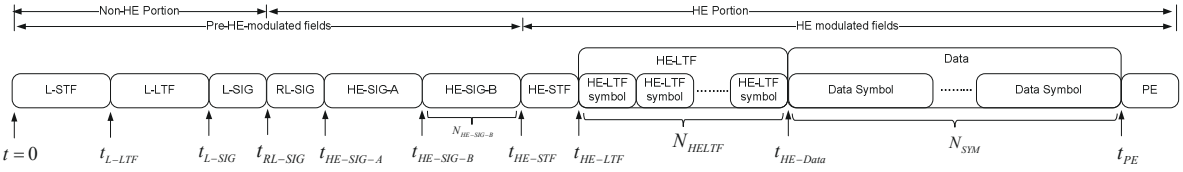


Figure 26-21 - TIming boundaries for HE PPDU fields

The time offset, t_{Field} , determines the starting time of the corresponding field relative to the start of L-STF (t = 0).

The signal transmitted on frequenct segment i_{Seg} of transmit chain i_{TX} shall be as shown in Equation (26-3).

$$
\begin{aligned}
r_{\text{PPDU}}^{(i_{Seg},i_{\text{TX}})}(t) = {} & r_{\text{L-STF}}^{(i_{Seg},i_{\text{TX}})}(t) + r_{\text{L-LTF}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{L-LTF}}) \\
& + r_{\text{L-SIG}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{L-SIG}}) + r_{\text{RL-SIG}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{RL-SIG}}) \\
& + r_{\text{HE-SIG-A}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-SIG-A}}) + r_{\text{HE-SIG-B}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-SIG-B}}) \\
& + r_{\text{HE-STF}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-STF}}) + r_{\text{HE-LTF}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-LTF}}) \\
& + r_{\text{HE-Data}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-Data}}) + r_{\text{HE-PE}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-PE}})
\end{aligned}
\qquad \textbf{(26-3)}
$$

where

$0 \le i_{Seg} \le N_{Seg} - 1$

$1 \le i_{TX} \le N_{TX}$

$t_{L\text{-}LTF} = T_{L\text{-}STF}$

$t_{L\text{-}SIG} = t_{L\text{-}LTF} + T_{L\text{-}LTF}$

$t_{RL\text{-}SIG} = t_{L\text{-}SIG} + T_{L\text{-}SIG}$

$t_{HE\text{-}SIG\text{-}A} = t_{RL\text{-}SIG} + T_{RL\text{-}SIG}$

$$t_{HE\text{-}SIG\text{-}B} = \begin{cases} t_{HE\text{-}SIG\text{-}A} + T_{HE\text{-}SIG\text{-}A}, & \text{for an HE MU PPDU} \\ undefined, & \text{otherwise} \end{cases}$$

$$t_{HE\text{-}STF} = \begin{cases} t_{HE\text{-}SIG\text{-}A} + T_{HE\text{-}SIG\text{-}A}, & \text{for an HE SU PPDU and HE trigger-based PPDU} \\ t_{HE\text{-}SIG\text{-}A} + T_{HE\text{-}SIG\text{-}A\text{-}R}, & \text{for an HE extended range SU PPDU} \\ t_{HE\text{-}SIG\text{-}B} + N_{HE\text{-}SIG\text{-}B} T_{HE\text{-}SIG\text{-}B}, & \text{for an HE MU PPDU} \end{cases}$$

where $N_{HE\text{-}SIG\text{-}B}$ is the number of OFDM symbols in the HE-SIG-B field

$$t_{HE\text{-}LTF} = \begin{cases} t_{HE\text{-}STF} + T_{HE\text{-}STF\text{-}T}, & \text{for an HE trigger-based PPDU} \\ \mathrm{t}_{HE\text{-}STF} + T_{HE\text{-}STF\text{-}NT}, & \text{otherwise} \end{cases}$$

$$t_{HE\text{-}Data} = \begin{cases} t_{HE\text{-}LTF} + N_{HELTF}.\left(T_{HE\text{-}LTF\text{-}1X} + T_{GI,HE\text{-}LTF}\right), & \text{for 1x HE-LTF} \\ t_{HE\text{-}LTF} + N_{HELTF}.\left(T_{HE\text{-}LTF\text{-}2X} + T_{GI,HE\text{-}LTF}\right), & \text{for 2x HE-LTF} \\ t_{HE\text{-}LTF} + N_{HELTF}.\left(T_{HE\text{-}LTF\text{-}4X} + T_{GI,HE\text{-}LTF}\right), & \text{for 4x HE-LTF} \end{cases}$$

$t_{PE} = t_{HE\text{-}Data} + N_{SYM}.T_{SYM}$

In an HE SU PPDU, HE MU PPDU and HE extended range SU PPDU, each field, $r_{Field}^{(i_{Seg},i_{\text{TX}})}(t)$, is defined as the summation of one or more subfields, where each subfield is defined to be an inverse discrete Fourier transform as specified in Equation (26-4).

$$
\begin{aligned}
r_{\text{Field}}^{(i_{Seg},i_{\text{TX}})}(t) = \eta_{\text{Field}} w_{T_{\text{Field}}}(t) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r \beta_r}{\sqrt{N_{Norm,r}}} \sum_{k \in K_r} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left[Q_k^{(i_{Seg})} \right]_{i_{TX},(M_{r,u}+m)} \Upsilon_{k,\text{BW}} X_{k,r,u}^{(i_{Seg},m)} \\
\exp\left(j2\pi k \Delta_{F,\text{Field}} (t - T_{GI,Field} - T_{CS,HE}(M_{r,u}+m)) \right)
\end{aligned}
\qquad \textbf{(26-4)}
$$

In an HE trigger-based PPDU, transmitted by user-*u* in the *r*-th RU, each field, $r_{Field}^{(i_{Seg},i_{TX})}(t)$, is defined in Equation (26-5).

$$r_{\text{Field}}^{(i_{Seg},i_{TX})}(t)=\frac{\eta_{\text{Field}}\alpha_r\beta_r}{\sqrt{N_{Norm,r}}}w_{T_{\text{Field}}}(t)\sum_{k\in K_r}\sum_{m=1}^{N_{STS,r,u}}\left[Q_k^{(i_{Seg})}\right]_{i_{TX},(M_{r,u}+m)}\Upsilon_{k,\text{BW}}X_{k,r,u}^{(i_{Seg},m)}$$
$$\exp\left(j2\pi k\Delta_{F,\text{Field}}(t-T_{GI,Field}-T_{CS,HE}(M_{r,u}+m))\right) \quad \textbf{(26-5)}$$

In the remainder of this subclause, pre-HE modulated fields refer to the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, and HE-SIG-B fields, while HE modulated fields refer to the HE-STF, HE-LTF, Data, and PE fields, as shown in Figure 26-21. The total power of the time domain HE modulated field signals summed over all transmit chains should not exceed the total power of the time domain pre-HE modulated field signals summed over all transmit chains. For notational simplicity, the parameter BW is omitted from some bandwidth dependent terms.

In Equation (26-4) the following notions are used:

N_{Field}^{Tone} Table 26-13 summarizes the various values of N_{Field}^{Tone} as a function of bandwidth per frequency segment. In the case of an HE OFDMA PPDU, the N_{Field}^{Tone} value of HE-STF, HE-LTF and HE-Data fields is variable, and is determined by which RUs of the current full bandwidth are transmitted in the PPDU.

Table 26-13 - Tone scaling factor and guard interval duration values for HE PPDU fields

Field	N_{Field}^{Tone} as a function of bandwidth, and RU size per frequency segment				Guard interval duration
	20 MHz	40 MHz	80 MHz	160 MHz	
L-STF	12	24	48	96	-
L-LTF	52	104	208	416	$T_{GI2,Data}$
L-SIG	56	112	224	448	$T_{GI,LegacyPreamble}$
RL-SIG	56	112	224	448	$T_{GI,LegacyPreamble}$
HE-SIG-A	56	112	224	448	$T_{GI,LegacyPreamble}$
HE-SIG-B	56	112	224	448	$T_{GI,LegacyPreamble}$
HE-STF not in HE_TRIG	14	30	62	126	-
HE-STF in HE_TRIG	30	60	124	248	-
HE-LTF 1x Duration	60	122	250	500	$T_{GI,HE-LTF1}$
HE-LTF 2x Duration	122	242	498	996	$T_{GI,HE-LTF2}$
HE-LTF 4x Duration	242	484	996	1992	$T_{GI,HE-LTF4}$
HE-Data	242	484	996	1992	$T_{GI,Data}$ or $T_{GI2,Data}$ or $T_{GI4,Data}$

NON_HT_DUP_OFDM-Data	56	112	224	448	$T_{GI,LegacyPreamble}$
NOTE--in the case of an HE OFDMA PPDU, the N_{Field}^{Tone} value of HE-STF, HE-LTF and HE-Data fields is variable, and is determined by which RUs of the current full bandwidth are transmitted in the PPDU.					

$N_{\text{Norm},r}$ If the TXVECTOR parameter BEAM_CHANGE is 1, then for pre-HE modulated fields, $N_{\text{Norm},r} = N_{TX}$. If the TXVECTOR parameter BEAM_CHANGE is 0, then for pre-HE modulated fields $N_{\text{Norm},r} = N_{STS,r,total}$, where $N_{STS,r,total}$ is given in Table 26-6. For HE modulated fields $N_{\text{Norm},r} = N_{STS,r,total}$.

$w_{T_{\text{Field}}}(t)$ is a windowing function. An example function, $w_{T_{\text{Field}}}(t)$, is given in 18.3.2.5 (Mathematical conventions in the signal descriptions).

K_r For pre-HE modulated fields, K_r is the set of subcarriers indices from $-N_{SR}$ to N_{SR}. For HE modulated fields in a non-OFDMA HE PPDU, K_r is the set of subcarriers indices from $-N_{SR}$ to N_{SR}. For HE modulated fields in an OFDMA HE PPDU, K_r is the set of subcarrier indices for the tones in the r-th RU.

η_{Field} is the power boost factor per OFDM symbol, which is $\sqrt{2}$ for the L-STF and L-LTF fields in the HE extended range SU PPDU, and 1 otherwise.

α_r is the power boost factor for the r-th RU, where $\alpha_r \in [TBD_1, TBD_2]$

β_r is the per-RU power normalization factor and is defined in Equation (26-6)

$$\beta_r = \begin{cases} \dfrac{1}{\sqrt{N_{Field}^{Tone}}}, \text{ Pre-HE modulated Fields when BEAM\_CHANGE=1} \\ \sqrt{\dfrac{|K_r|}{|K_r^{Field}|}} \Big/ \sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|}, \text{ otherwise} \end{cases} \quad \textbf{(26-6)}$$

$|K_r|$ is the cardinality of the set of subcarriers K_r

K_r^{Field} is the set of subcarriers that have non-zero values within K_r in the HE-STF and Data fields, and defined in Equation (26-7) for the HE-LTF field.

$$K_r^{HELTF} = \begin{cases} |K_r|/4 & \text{for 1x HE-LTF} \\ |K_r|/2 & \text{for 2x HE-LTF} \\ |K_r| & \text{for 4x HE-LTF} \end{cases} \quad \textbf{(26-7)}$$

$Q_k^{(i_{Seg})}$ is the spatial mapping matrix for the subcarrier k in frequency segment i_{Seg}. For HE modulated fields, $Q_k^{(i_{Seg})}$ is a matrix with N_{TX} rows and $N_{STS,total}$ columns. If the TXVECTOR parameter BEAM_CHANGE is 1, then for pre-HE modulated fields $Q_k^{(i_{Seg})}$ is a column vector with N_{TX} elements with element i_{TX} being $exp\left(-j2\pi k\Delta_{F,Pre-HE}T_{CS}^{i_{TX}}\right)$, where $T_{CS}^{i_{TX}}$ represents the cyclic shift for the transmitter chain whose values are TBD; otherwise it is identical to the spatial mapping $Q_k^{(i_{Seg})}$ for HE modulation fields.

$\Delta_{F,\text{Field}}$ is the subcarrier frequency spacing. For pre-HE modulated fields, $\Delta_{F,\text{Field}} = \Delta_{F,\text{Pre-HE}}$ given in Table 26-3. For HE modulated fields, $\Delta_{F,\text{Field}} = \Delta_{F,\text{HE}}$ given in Table 26-3.

$X_{k,r,u}^{(i_{Seg},m)}$ is the frequency-domain symbol in subcarrier k of user u in the r-th RU for frequency segment i_{Seg} of space-time stream m. Some of the $X_{k,u}^{(i_{Seg},m)}$ within $-N_{\text{SR}} \le k \le N_{\text{SR}}$ have a value of zero. Examples of such cases include the DC tones, guard tones on each side of the transmit spectrum, the leftover tones in an HE OFDMA PPDU, as well as the unmodulated tones of L-STF, HE-STF, and HE-LTF fields. Note that the multiplication matrices A_{HE-LTF}^{k} are included in the calculation of $X_{k,r,u}^{(i_{Seg},m)}$ for the HE-STF and HE-LTF fields. When the TXVECTOR parameter BEAM_CHANGE is 0, the first column of the multiplication matrices A_{HE-LTF}^{k} are included in the calculation of $X_{k,r,u}^{(i_{Seg},m)}$ for the pre-HE modulated fields.

$T_{GI,Field}$ is the guard interval duration used for each OFDM symbol in the field. The value for each field is as defined in Table 25-2 (Tone scaling factor and guard interval duration values for PHY fields).

$T_{CS,HE}(l)$ For pre-HE modulated fields, $T_{CS,HE}(l) = 0$. For HE modulated fields, $T_{CS,HE}(l)$ represents the cyclic shift per space-time stream, whose value is defined in Table 25-xx (Cyclic shift values for the HE modulated fields of a PPDU).

$\Upsilon_{k,\text{BW}}$ is used to represent a rotation of the tones. In HE modulated fields, $\Upsilon_{k,\text{BW}} = 1$ in all the subcarriers. In pre-HE modulated fields, BW in $\Upsilon_{k,\text{BW}}$ is determined by the TXVECTOR parameter CH_BANDWIDTH as defined in Table 26-14.

Table 26-14 - CH_BANDWIDTH and $\Upsilon_{k,\text{BW}}$ for pre-HE modulated fields

CH_BANDWIDTH	$\Upsilon_{k,\text{BW}}$
CBW20	$\Upsilon_{k,20}$
CBW40	$\Upsilon_{k,40}$
CBW80	$\Upsilon_{k,80}$
CBW160	$\Upsilon_{k,160}$
CBW80+80	$\Upsilon_{k,80}$ per frequency segments

For a 20 MHz PPDU transmission,

$$\Upsilon_{k,20} = 1 \quad \text{(26-8)}$$

For a 40 MHz PPDU transmission,

$$\Upsilon_{k,40} = \text{TBD} \quad \text{(26-9)}$$

For an 80 MHz PPDU transmission,

$$\Upsilon_{k,80} = \text{TBD} \quad \text{(26-10)}$$

For a noncontiguous 80+80 MHz PPDU transmission, each 80 MHz frequency segment shall use the phase rotation for 80 MHz PPDU transmissions as defined in Equation (26-10).

For a contiguous 160 MHz PPDU transmission,

$$\Upsilon_{k,160} = \text{TBD} \quad \text{(26-11)}$$

26.3.9 HE preamble

26.3.9.1 Introduction

The HE portion of HE format preamble consists of pre-HE modulated fields and HE modulated fields. The HE modulated fields consist of HE-STF and HE-LTF fields. The pre-HE modulated fields depend on the structure of the PPDU and consist of the following:

— RL-SIG and HE-SIG-A fields of an HE SU PPDU

— RL-SIG, HE-SIG-A and HE-SIG-B fields of an HE MU PPDU

— RL-SIG, HE-SIG-A and repeated HE-SIG-A fields of an HE Extended Range SU PPDU

— RL-SIG and HE-SIG-A fields of an HE Trigger-based PPDU

26.3.9.2 Cyclic shift for Pre-HE modulated fields

26.3.9.3 L-STF

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain representation of the L-STF field shall be as specified in Equation (26-12). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-STF}}^{(i_{seg},i_{TX})}(t) = \frac{\eta}{\sqrt{N_{\text{TX}} \cdot N_{\text{L-STF}}^{\text{Tone}}}} w_{\text{T}_{\text{L-STF}}}(t) \sum_{i_{BW}=0}^{N_{20MHz}-1} \sum_{k=-26}^{26} \left(\begin{array}{l} \Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}} S_{k,20} \\ \cdot \exp\left(j2\pi \left(k - K_{\text{Shift}}(i_{\text{BW}}) \right) \Delta_{F,\text{Pre-HE}} \left(t - T_{GI,\text{LegacyPreamble}} - T_{CS}^{i_{TX}} \right) \right) \end{array} \right) \quad \text{(26-12)}$$

where

η is an PPDU format dependent scaling factor, with the following value

$$\eta = \begin{cases} \sqrt{2}, & \text{HE extended range PPDU} \\ 1, & \text{otherwise} \end{cases} \quad \text{(26-13)}$$

N_{20MHz} is defined in 22.3.8.3.4 (L-SIG definition)

$K_{\text{Shift}}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32$

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} with a value given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields).

$\Gamma_{k,\text{BW}}$ is defined by Equation (22-14), Equation (22-15), Equation (22-16) and Equation (22-17).

$N_{\text{L-STF}}^{\text{Tone}}$ has the value given in Table 22-8 (Tone scaling factor and guard interval duration values for PHY fields(11ac)).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain representation of the L-STF field of contiguous 20 MHz, 40 MHz, 80 MHz and 160 MHz transmission shall be as specified in Equation (26-14). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-STF}}^{(i_{seg},i_{TX})}(t) = \frac{\eta}{\sqrt{N_{\text{TX}} \cdot N_{\text{L-STF}}^{\text{Tone}}}} w_{\text{T}_{\text{L-STF}}}(t) \sum_{i_{BW}=0}^{N_{20MHz}-1} \sum_{k=-26}^{26} \sum_{m=0}^{N_{STS,total}-1} \left(\begin{array}{l} \Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}} \left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})} \right]_{i_{TX},m} \left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,1} S_{k,20} \\ \cdot \exp\left(j2\pi \left(k - K_{\text{Shift}}(i_{\text{BW}}) \right) \Delta_{F,\text{Pre-HE}} \left(t - T_{GI,\text{LegacyPreamble}} - T_{CS}^{i_{TX}} \right) \right) \end{array} \right) \quad \textbf{(26-14)}$$

where

$T_{CS,\text{HE}}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields).

$Q_k^{(i_{seg})}$ is defined in **Error! Reference source not found.**

A_{HELTF}^k is defined in Equation (26-57)

26.3.9.4 L-LTF

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain representation of the L-LTF field shall be as specified in Equation (26-15). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-LTF}}^{(i_{seg},i_{TX})}(t) = \frac{\eta}{\sqrt{N_{\text{TX}} \cdot N_{\text{L-LTF}}^{\text{Tone}}}} w_{\text{T}_{\text{L-LTF}}}(t) \sum_{i_{BW}=0}^{N_{20MHz}-1} \sum_{k=-26}^{26} \left(\begin{array}{l} \Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}} L_{k,20} \\ \cdot \exp\left(j2\pi \left(k - K_{\text{Shift}}(i_{\text{BW}}) \right) \Delta_{F,\text{Pre-HE}} \left(t - T_{GI,\text{LegacyPreamble}} - T_{CS}^{i_{TX}} \right) \right) \end{array} \right) \quad \textbf{(26-15)}$$

where

η is an PPDU format dependent scaling factor, as defined in Equation (26-13).

$N_{20MHz}$is defined in 21.3.7.3 (Channel frequencies)

$K_{\text{Shift}}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32$

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} with a value given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields).

$\Gamma_{k,\text{BW}}$ is defined by Equation (22-14), Equation (22-15), Equation (22-16) and Equation (22-17).

$N_{\text{L-LTF}}^{\text{Tone}}$ has the value given in Table 22-8 (Tone scaling factor and guard interval duration values for PHY ields(11ac)).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain representation of the L-LTF field of contiguous 20 MHz, 40 MHz, 80 MHz and 160 MHz transmission shall be as specified in Equation (26-16). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-LTF}}^{(i_{seg},i_{TX})}(t)=\frac{\eta}{\sqrt{N_{\text{TX}}\cdot N_{\text{L-LTF}}^{\text{Tone}}}}w_{\text{T}_{\text{L-LTF}}}(t)$$
$$\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-26}^{26}\sum_{m=0}^{N_{STS,total}-1}\left(\begin{array}{l}\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})}\right]_{i_{TX},m}\left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,1}L_{k,20}\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}\left(i_{\text{BW}}\right)\right)\Delta_{F,\text{Pre-HE}}\left(t-T_{GI,\text{LegacyPreamble}}-T_{CS}^{i_{TX}}\right)\right)\end{array}\right) \quad \textbf{(26-16)}$$

where

$T_{CS,\text{HE}}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields).

$Q_k^{(i_{seg})}$ is defined in **Error! Reference source not found.**

A_{HELTF}^{k} is defined in Equation (26-57)

26.3.9.5 L-SIG

The L-SIG field is used to communicate rate and length information. The structure of the L-SIG field is defined in Figure 18-5 (SIGNAL field bit assignment).

In a HE PPDU, the RATE field shall be set to the value representing 6 Mb/s in the 20 MHz channel spacing column of Table 18-6 (Contents of the SIGNAL field). In a non-HT duplicate PPDU, the RATE field is defined in 18.3.4.2 (RATE field) using the L_DATARATE parameter in the TXVECTOR.

The LENGTH field shall be set to the value given by Equation (26-17).

$$\text{Length}=\frac{\text{TXTIME}-20}{4}\times 3-3-m \quad \textbf{(26-17)}$$

where

TXTIME (in μs) is defined in 26.4.3 (TXTIME and PSDU_LENGTH calculation).

m is 1 for an HE MU PPDU and HE extended range SU PPDU, and 2 otherwise.

The LSB of the binary expression of the Length value shall be mapped to B5. In a non-HT duplicate PPDU, the LENGTH field is defined in 18.3.4.3 (LENGTH field) using the L_LENGTH parameter in the TXVECTOR.

The Reserved (R) field shall be set to 0.

The Parity (P) field has the even parity of bits 0-16.

The SIGNAL TAIL field shall be set to 0.

The L-SIG field shall be encoded, interleaved, and mapped following the steps described in 18.3.5.6 (Convolutional encoder), 18.3.5.7 (Data interleaving), and 18.3.5.8 (Subcarrier modulation mapping). The stream of 48 complex numbers generated by these steps is denoted by $d_k, k=0,\cdots,47$. Pilots shall be inserted as described in 18.3.5.9 (Pilot subcarriers). Extra 4 BPSK modulated tones are added, two at each edge of the subcarriers used by data and pilot tones. The 4 extra tones [-28, -27, 27, 28] of L-SIG in 20 MHz HE PPDU is [-1, -1, -1, 1].

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform of the L-SIG field shall be as given by Equation (26-18).

$$r_{\text{L-SIG}}^{(i_{Seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{L-SIG}^{\text{Tone}}N_{TX}}}w_{T_{L-SIG}}(t)\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\left(\begin{array}{l}\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}}\left(D_{k,20}+p_0P_k\right)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}\left(i_{\text{BW}}\right)\right)\Delta_{F,\text{Pre-HE}}\left(t-T_{GI,\text{LegacyPreamble}}-T_{CS}^{i_{TX}}\right)\right)\end{array}\right) \quad \textbf{(26-18)}$$

where

N_{20MHz} is defined in 21.3.7.3 (Channel frequencies)

$K_{\text{Shift}}(i) = (N_{20\text{MHz}} - 1 - 2i)\cdot 32$

$$D_{k,20}=\begin{cases}0, k=0,\pm7,\pm21\\ \pm1(TBD), k=\pm27,\pm28\\ d_{M_{20}^r(k)}, \text{otherwise}\end{cases}$$

$$M_{20}^r(k) = \begin{cases}k+26, -26\le k\le -22\\ k+25, -20\le k\le -8\\ k+24, -6\le k\le -1\\ k+23, 1\le k\le 6\\ k+22, 8\le k\le 20\\ k+21, 22\le k\le 26\end{cases}$$

P_k is defined in 18.3.5.10 (OFDM modulation)

p_0 is the first pilot value in the sequence defined in 18.3.5.10 (OFDM modulation)

$N_{\text{L-SIG}}^{\text{Tone}}$ has the value given in **Error! Reference source not found.**

$\Upsilon_{k,\text{BW}}$ is defined in Equation (26-8), Equation (26-9), Equation (26-10) and Equation (26-11).

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} with a value given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

NOTE— $M_{20}^r(k)$ is a "reverse" function of the function M(k) defined in 18.3.5.10 (OFDM modulation).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the L-SIG field shall be as given by Equation (26-19).

$$r_{L-SIG}^{(i_{seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{\text{L-SIG}}^{\text{Tone}}N_{STS,total}}}w_{T_{L-SIG}}(t)\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\sum_{m=0}^{N_{STS,total}-1}\left(\begin{array}{l}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})}\right]_{i_{TX},m}\left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,1}\left(D_{k,20}+p_0P_k\right)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}\left(i_{BW}\right)\right)\Delta_{F,\text{Pre-HE}}\left(t-T_{GI,\text{LegacyPreamble}}-T_{CS,HE}(m)\right)\right)\end{array}\right) \quad \textbf{(26-19)}$$

where

$T_{CS,\text{HE}}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$Q_k^{(i_{seg})}$ is defined in **Error! Reference source not found.**

A^{k}_{HELTF} is defined in **Error! Reference source not found.**

26.3.9.6 RL-SIG

The RL-SIG field is used to identify a HE PPDU.

The time domain waveform of the RL-SIG field is generated by repeating the time domain waveform of the L-SIG field, as defined in (26-20).

$$r^{(i_{Seg},i_{TX})}_{RL-SIG}(t) = r^{(i_{Seg},i_{TX})}_{L-SIG}(t) \quad \text{(26-20)}$$

26.3.9.7 HE-SIG-A

26.3.9.7.1 General

The HE-SIG-A field carries information required to interpret HE PPDUs. The structure of the HE-SIG-A field for the first part (HE-SIG-A1) and for the second part (HE-SIG-A2) is TBD.

26.3.9.7.2 Content

The HE-SIG-A field for an HE SU PPDU or an HE extended range SU PPDU contains the fields listed in Table 26-15.

Table 26-15 - Fields in the HE-SIG-A for an HE SU PPDU and HE extended range SU PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
TBD	TBD	DL/UL	1	Indicates whether the PPDU is sent UL or DL. This field indicates DL for TDLS. NOTE—The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the MPDU.
	TBD	Format	1	Differentiate between an HE SU PPDU and an HE trigger-based PPDU or between an HE extended range SU PPDU and an HE trigger-based PPDU
	TBD	BSS Color	6	The BSS Color field is an identifier of the BSS
	TBD	Spatial Reuse	TBD	TBD
	TBD	TXOP Duration	TBD	Indicates the remaining time in the current TXOP. Details TBD.
	TBD	Bandwidth	2	Set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, 3 for 160 MHz and 80+80 MHz
	TBD	MCS	4	HE-MCS index
	TBD	CP+LTF Size	3	To indicate the CP length and HE-LTF size, the current combinations are 1x HE-LTF + 0.8 μs, 2x HE-LTF + 0.8 μs, 2x HE-LTF + 1.6 μs and 4x HE-LTF + 3.2 μs. Other combinations are TBD.
	TBD	Coding	2	Indication of BCC/LDPC and presence of the extra OFDM symbol for LDPC. Detailed indication is TBD.
	TBD	Nsts	3	Indicates the number of spatial streams: Set to 0 for 1 space time stream Set to 1 for 2 space time streams Set to 2 for 3 space time streams Set to 3 for 4 space time streams Set to 4 for 5 space time streams Set to 5 for 6 space time streams Set to 6 for 7 space time streams Set to 7 for 8 space time streams
	TBD	STBC	1	Set to 1 if space time block coding is used and set to 0 otherwise.

	TBD	TxBF	1	Set to 1 if a Beamforming steering matrix is applied to the waveform in an SU transmission, set to 0 otherwise.
	TBD	DCM	1	Set to 1 indicates that the payload of the SU PPDU is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual sub-carrier modulation for the MCS.
	TBD	Packet Extension	3	The first two bits indicate the "*a-factor*" and the third bit indicates the PE-Disambiguity.
	TBD	Beam Change	1	Set to 1 indicates that the pre-HE-STF portion of the SU PPDU is spatially mapped differently from HE-LTF1. Set to 0 indicates that the pre-HE-STF portion of the SU PPDU is spatially mapped the same way as HE-LTF1 on each tone.
	TBD	CRC	4	CRC of bits 0–41 in HT-SIG-A. See 22.3.9.7.1 (CRC calculation for HE-SIG-A). The first bit to be transmitted is bit C3 as explained in 20.3.9.7.1 (CRC calculation for HE-SIG).
	TBD	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

NOTE—The HE-SIG-A field contents for the HE extended range SU PPDU may be subject to change.

The HE-SIG-A field of an HE MU PPDU contains the fields listed in Table 26-16.

Table 26-16 - Fields in the HE-SIG-A for a HE MU PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of Bits	Description
TBD	TBD	DL/UL	1	Indicates whether the HE MU PPDU is UL or DL. This field indicates DL for TDLS. NOTE—The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the 11ax MPDU.
	TBD	BSS Color	6	The BSS Color field is an identifier of the BSS
	TBD	Spatial Reuse	TBD	TBD
	TBD	TXOP Duration	TBD	Indicates the remaining time in the current TXOP. Details TBD.
	TBD	Bandwidth	≥ 2	Set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, 3 for 160 MHz and 80+80 MHz
	TBD	SIGB MCS	3	Indication the MCS of HE-SIG-B. Set to 0 for MCS0 Set to 1 for MCS1 Set to 2 for MCS2 Set to 3 for MCS3 Set to 4 for MCS4 Set to 5 for MCS5
	TBD	SIGB DCM	1	Set to 1 indicates that the HE-SIG-B is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the HE-SIB-B is not modulated with dual sub-carrier modulation for the MCS.
	TBD	SIGB Number Of Symbols	4	Indciates the number of HE-SIG-B symbols.
	TBD	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.
	TBD	Number of HE-LTF Symbols	3	Indicates the number of HE-LTF symbols.

	TBD	CP+LTF Size	3	To indicate the CP length and HE-LTF size, the current combinations are 1x HE-LTF + 0.8 μs, 2x HE-LTF + 0.8 μs, 2x HE-LTF + 1.6 μs and 4x HE-LTF + 3.2 μS. Other combinations are TBD.
	TBD	LPDC Extra Symbol	1	Indication of the presence of the extra OFDM symbol for LDPC.
	TBD	Packet Extension	3	The first two bits indicate the "a-factor" and the third bit indicates the PE-Disambiguity.
	TBD	CRC	4	CRC of bits 0–41 in HT-SIG-A. See 22.3.9.7.1 (CRC calculation for HE-SIG-A). The first bit to be transmitted is bit C3 as explained in 20.3.9.7.1 (CRC calculation for HE-SIG).
	TBD	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

The HE-SIG-A field for an HE trigger-based PPDU contains the fields listed in Table 26-17.

Table 26-17 - HE Fields in the HE-SIG-A for a HE trigger-based PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of Bits	Description
TBD	TBD	Format	1	Set to 0 for an HE SU PPDU Set to 1 for an HE trigger-based PPDU
	TBD	BSS Color	6	The BSS Color field is an identifier of the BSS
	TBD	Spatial Reuse	TBD	TBD
	TBD	TXOP Duration	TBD	Indicates the remaining time in the current TXOP. Details TBD.
	TBD	Bandwidth	TBD	TBD
	TBD	Reserved	TBD	TBD
	TBD	CRC	4	CRC of bits 0–41 in HT-SIG-A. See 22.3.9.7.1 (CRC calculation for HE-SIG-A). The first bit to be transmitted is bit C3 as explained in 20.3.9.7.1 (CRC calculation for HE-SIG).
	TBD	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

26.3.9.7.3 CRC computation

The CRC computation defined in this subclause applies to HE-SIG-A, the Common field of HE-SIG-B and the User Specific field of HE-SIG-B.

The CRC protects bits 0–L of the HE-SIG (L=41 for HE-SIG-A, or L=x for each HE-SIG-B common block fields, or L=x for HE-SIG-B user specific fields). The value of the CRC field shall be the 1s complement of

$$crc(D) = \big(M(D) + I(D)\big)D^8 \; mod \; G(D)$$

where

$$M(D) = \sum_{i=0}^{L} m_{L-i} D^i$$

where

m_i is bit i in the field

$$I(D) = \sum_{i=L-7}^{L} D^i$$

G(D) and *crc(D)* are defined in Equation (20-18).

The CRC field is transmitted from c_5 to c_7 with c_7 first.

Figure 20-8 (HT-SIG CRC calculation) shows the operation of the CRC, where the serial input are from m_L to m_0, and the output is stopped at c_4.

26.3.9.7.4 Encoding and modulation

For an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU, the HE-SIG-A field is composed of two parts, HE-SIG-A1 and HE-SIG-A2, each containing 26 data bits. HE-SIG-A1 is transmitted before HE-SIG-A2. The HE-SIG-A symbols shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted following the steps described in 18.3.5.6 (Convolutional encoder), 18.3.5.7 (Data interleaving), 18.3.5.8 (Subcarrier modulation mapping), and 18.3.5.9 (Pilot subcarriers), respectively. The constellation mappings of HE-SIG-A in HE SU PPDU, HE MU PPDU and HE trigger-based PPDU are shown in Figure 26-22. The first and second half of the stream of 104 complex numbers generated by these steps (before pilot insertion) is divided into two groups of 52 complex numbers, where respectively, the first 52 complex numbers form the first symbol of HE-SIG-A and the second 52 complex numbers form the second symbol of HE-SIG-A. If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform for the HE-SIG-A field of an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU shall be as specified in Equation (26-21).

$$r_{\text{HE-SIG-A}}^{(i_{Seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{HE-SIG-A}^{\text{Tone}}N_{TX}}}\sum_{n=0}^{1}w_{T_{SYML}}\left(t-nT_{SYML}\right)\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\left(\begin{array}{l}\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}}\left(D_{k,n,BW}+p_{n+2}P_k\right)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}\left(i_{\text{BW}}\right)\right)\Delta_{F,\text{Pre-HE}}\left(t-nT_{SYML}-T_{GI,LEgacy\,\text{Pr}eamble}-T_{CS}^{i_{TX}}\right)\right)\end{array}\right) \quad \textbf{(26-21)}$$

where

N_{20MHz} is defined in 21.3.7.3 (Channel frequencies)

$K_{\text{Shift}}(i) = (N_{20\text{MHz}} - 1 - 2i)\cdot 32$

$$D_{k,n,20}=\begin{cases}0, k=0,\pm7,\pm21\\ d_{M_{20}^{r'}(k),n}, \text{otherwise}\end{cases}$$

$$M_{20}^{r'}(k)=\begin{cases}k+28, -28\le k\le -22\\ k+25, -20\le k\le -8\\ k+24, -6\le k\le -1\\ k+23, 1\le k\le 6\\ k+22, 8\le k\le 20\\ k+21, 22\le k\le 28\end{cases}$$

P_k and p_n are defined in 18.3.5.10 (OFDM modulation).

$N_{HE-SIG-A}^{Tone}$ has the value given in **Error! Reference source not found.**

$\Upsilon_{k,\text{BW}}$ is defined in Equation (26-8), Equation (26-9), Equation (26-10) and Equation (26-11).

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} with a value given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the HE-SIG-A field shall be as given by Equation (26-22).

$$r_{HE-SIG-A}^{(i_{seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{\text{HE-SIG-A}}^{\text{Tone}}N_{STS,total}}}\sum_{n=0}^{1}w_{T_{SYML}}(t-nT_{SYML})$$
$$\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\sum_{m=0}^{N_{STS,total}-1}\left(\begin{array}{l}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})}\right]_{i_{TX},m}\left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,1}(D_{k,20}+p_{n+2}P_k)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}(i_{BW})\right)\Delta_{F,\text{Pre-HE}}\left(t-nT_{SYML}-T_{GI,\text{LegacyPreamble}}-T_{CS,HE}(m)\right)\right)\end{array}\right) \quad \textbf{(26-22)}$$

where

$T_{CS,\text{HE}}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$Q_k^{(i_{seg})}$ is defined in **Error! Reference source not found.**

A_{HELTF}^{k} is defined in Equation (26-57)

For an HE extended range SU PPDU, the HE-SIG-A field is composed of four parts, i.e. HE-SIG-A1, HE-SIG-A2, HE-SIG-A3 and HE-SIG-A4, each part containing 26 data bits. These four parts are transmitted sequentially from HE-SIG-A1 to HE-SIG-A4. HE-SIG-A1 and HE-SIG-A2 have the same data bits. HE-SIG-A3 and HE-SIG-A4 have same data bits. The data bits of HE-SIG-A1 and HE-SIG-A3 shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted. HE-SIG-A2 shall be BCC encoded at rate, R=1/2, mapped to a QBPSK constellation and have pilots inserted. The constellation mappings of the HE-SIG-A field in an HE extended range SU PPDU is shown in Figure 26-22. QBPSK constellation on HE-SIG-A2 is used to differentiate between an HE extended range SU PPDU and an HE MU PPDU. HE-SIG-A4 shall be BCC encoded at rate, R=1/2, mapped to a BPSK constellation and have pilots inserted. BCC encoding, Data interleaving, constellation mapping and pilot insertion follow the steps described in 18.3.5.6 (Convolutional encoder), 18.3.5.7 (Data interleaving), 18.3.5.8 (Subcarrier modulation mapping), and 18.3.5.9 (Pilot subcarriers), respectively.

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform for the HE-SIG-A field in an HE extended range SU PPDU, shall be as specified in Equation (26-23).

$$r_{\text{HE-SIG-A}}^{(i_{Seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{HE-SIG-A}^{\text{Tone}}N_{TX}}}\sum_{n=0}^{3}w_{T_{SYML}}(t-nT_{SYML})$$
$$\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\left(\begin{array}{l}\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}}(R_nD_{k,n,BW}+p_{n+2}P_k)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}(i_{\text{BW}})\right)\Delta_{F,\text{Pre-HE}}\left(t-nT_{SYML}-T_{GI,LEgacy\,\text{Pr}eamble}-T_{CS}^{i_{TX}}\right)\right)\end{array}\right) \quad \textbf{(26-23)}$$

where

R is a phase rotation vector defined as $[1, j, 1, 1]$.

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform for the HE-SIG-A field in an HE extended range SU PPDU, shall be as specified in Equation (26-24).

$$r_{HE-SIG-A}^{(i_{seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{\text{HE-SIG-A}}^{\text{Tone}}N_{STS,total}}}\sum_{n=0}^{3}w_{T_{SYML}}(t-nT_{SYML})$$
$$\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\sum_{m=0}^{N_{STS,total}-1}\left(\begin{array}{l}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})}\right]_{i_{TX},m}\left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,1}(R_nD_{k,20}+p_{n+2}P_k)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}(i_{BW})\right)\Delta_{F,\text{Pre-HE}}\left(t-nT_{SYML}-T_{GI,\text{LegacyPreamble}}-T_{CS,HE}(m)\right)\right)\end{array}\right) \quad \textbf{(26-24)}$$

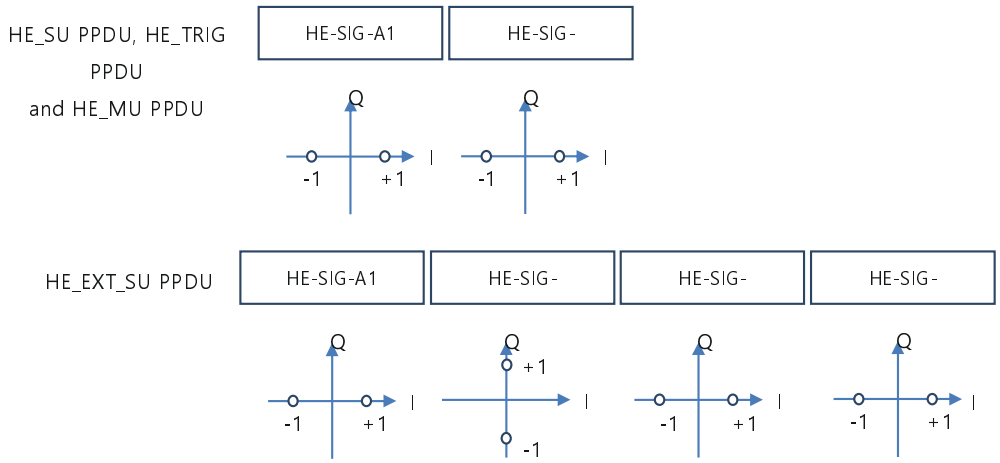


Figure 26-22 - Data tone constellation of HE-SIG-A symbols

26.3.9.8 HE-SIG-B

26.3.9.8.1 Encoding and modulation

The HE-SIG-B field is separately encoded on each 20 MHz band. The encoding structure in one such 20 MHz band is shown in Figure 26-23. It consists of a Common Block field followed by a User Specific field.

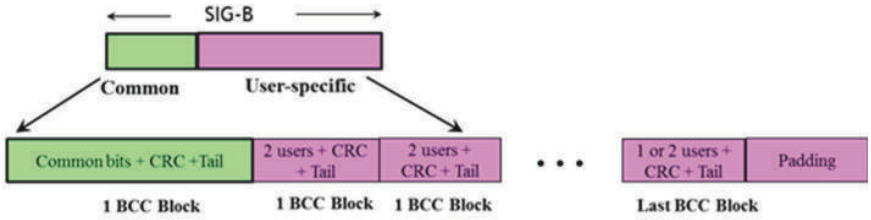


Figure 26-23 – HE-SIG-B field encoding structure in each 20 MHz

The Common Block field contains information regarding the resource unit allocation such as the RU arrangement in frequency domain, the RUs allocated for MU-MIMO and the number of users in MU-MIMO allocations. The Common Block field is described in detail in 25.3.9.2.5.2

The User Specific field consists of multiple User Block fields. Each User Block field contains information for two STAs to decode their payloads. The last User Block field may contain information for only one STA, if the number of user fields indicated by the RU allocation signaling in the common block is odd. See 25.3.9.2.5.3 for a description of the contents of the User Block field.

26.3.9.8.1.1 Frequency domain mapping

For 20 MHz and 40 MHz PPDUs, the Common Block field and the User field for a STA are transmitted in the same 20 MHz band as the STA's data as shown in Figure 26-24 and Figure 26-25.



Figure 26-24 HE-SIG-B content channel for a 20 MHz PPDU

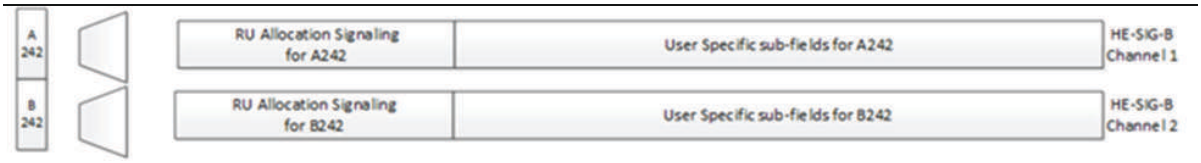


Figure 26-25 - HE-SIG-B content channels for a 40 MHz PPDU

For an 80 MHz PPDU, the default frequency mapping of the Common Block field and User Specific fields is shown in Figure 26-26. The HE-SIG-B field content in the 1st and 3rd 20 MHz bands from the top are identical. The information carried in either of these bands is called HE-SIG-B content channel 1. HE-SIG-B content channel 1 carries signaling information for all STAs whose payloads occupy some tones in A242 or C242. Similarly, the HE-SIG-B contents on the 2nd and 4th 20 MHz bands are identical. The information carried in either of these bands is called HE-SIG-B content channel 2. HE-SIG-B content channel 2 carries signaling information for all STAs whose payloads occupy some tones in B242 or D242.

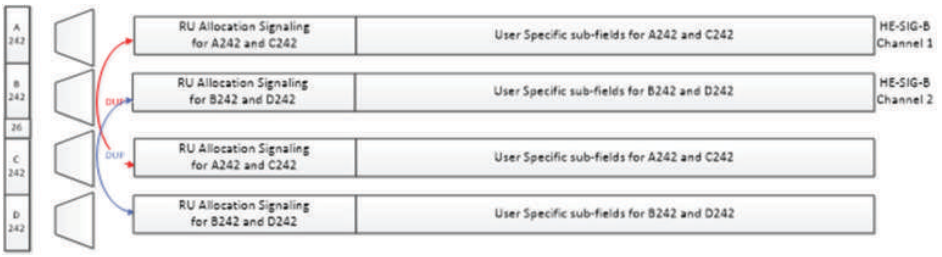


Figure 26-26 - Default mapping of the two HE-SIG-B channels and their duplication in an 80 MHz PPDU

For a 160 MHz PPDU, the default frequency mapping of the Common Block field and User Specific fields is shown in Figure 26-27. The HE-SIG-B content in the 1st, 3rd, 5th and 7th 20 MHz bands from top are all identical. The information carried in any of these bands is called HE-SIG-B content channel 1. HE-SIG-B content channel 1 carries signaling information for all STAs whose payloads occupy some tones in A1-242 or C1-242 or A2-242 or C2-242. Similarly, the HE-SIG-B contents in the 2nd, 4th, 6th and 8th 20 MHz bands from top are identical. The information carried in any of these bands is called HE-SIG-B content channel 2. HE-SIG-B content channel 2 carries signaling information for all STAs whose payloads occupy some tones in B1-242 or D1-242 or B2-242 or D2-242.

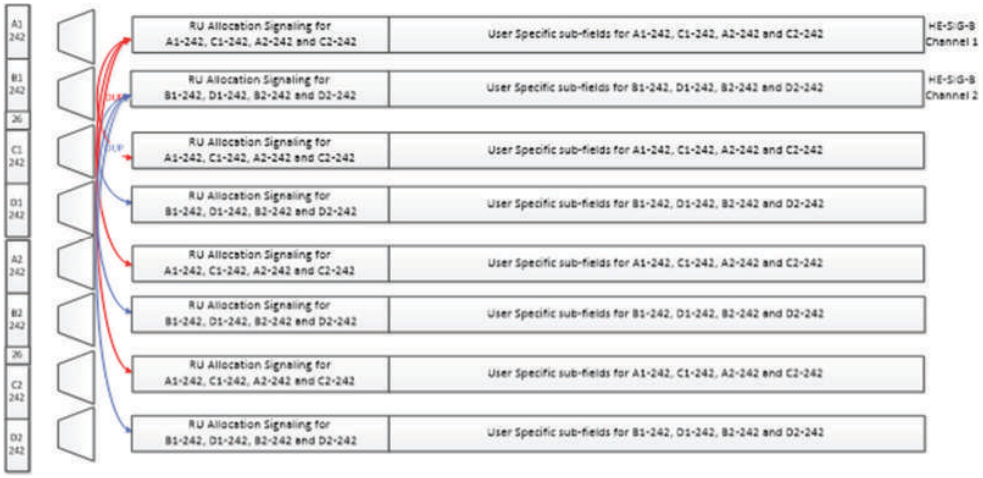


Figure 26-27 - Default mapping of the two HE-SIG-B channels and their duplication in a 160 MHz PPDU

For MU-MIMO allocation of RU size > 20 MHz, the User Block subfields are dynamically split between the two HE-SIG-B content channels (1/2) and the split is decided by the AP (on a per case basis). See 25.3.9.2.5.2 and 25.3.9.2.5.3 for more details.

26.3.9.8.1.2 Time domain encoding

In each 20 MHz band, the bits in the Common Block field shall have CRC and tail bits added and then be BCC encoded at rate R = ½. Padding bits are not added after the common block.

In the User Specific field, in any 20 MHz band, the bits corresponding to two STAs (i.e. two User fields) are encoded together. Specifically, the STAs scheduled in the HE-MU-PPDU are split into groups of two. Each group of two User fields shall have CRC and tail bits added and then BCC encoded at rate R = ½ using the encoder described in 18.3.5.6. If the number of users is even, padding bits are added to round up the number of symbols to the nearest integer. If the number of users is odd, the User Block field corresponding to the last user, who is not grouped, is encoded after adding tail and CRC bits and only then are any padding bits added. The padding bits added ensure that both content channels have the same number of symbols. The specific method of generating padding bits is TBD. When the code rate is not equal to ½, the convolutional encoder output bits for each field (including padding bits) are concatenated, then the concatenated bit streams are punctured continuously as described in 18.3.5.6 (Convolutional encoder).

The number of data tones in each symbol is N_{SD} = 52. The coded bits are interleaved as in 22.3.10.8, with the parameter N_{col} = 13 (as in Table 22-17, for 20 MHz). The interleaved bits are mapped to constellation points from the MCS specified in HE-SIG-A and have pilots inserted following the steps described in 18.3.5.7 (Data Interleaving), 18.3.5.8 (Subcarrier modulation mapping) and 18.3.5.9 (Pilot subcarriers) respectively.

The cyclic prefix used for HE-SIG-B shall be 0.8 μs. The number of symbols in HE-SIG-B, denoted by $N_{SYM,HE\text{-}SIG\text{-}B}$, shall be signaled in HE-SIG-A in the default mode (see Section 25.3.9.2.4). For the cth content channel (c = 1 or 2), denote the sample on the kth subcarrier of the nth symbol by $d_{k,n,c}$. The time domain waveform for the HE-SIG-B follows Equation (26-25).

$$r_{HE-SIG-B}^{(i_{Seg},i_{Tx})}(t)=\frac{1}{\sqrt{N_{HE-SIG-B}^{Tone}N_{Tx}}}\sum_{n=0}^{N_{sym,HE-SIG-B}}w_{T_{HE-SIG-B}}(t-nT_{SYML})\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-N_{SR}}^{N_{SR}}\Upsilon_{(k-K_{shift}(i_{BW})),BW}\left(D^{i_{Seg}}{}_{k,n,i_{BW}}+p_{n+4}P_k\right)\exp\left(j2\pi(k-K_{shift}(i_{BW}))\Delta_{F,Pre-HE}(t-nT_{SYML}-T_{GI,LEgacy\,Preamble}-T_{CS}^{i_{TX}})\right) \quad \textbf{(26-25)}$$

where

N_{20MHz} and $K_{shift}(i)$ are defined in 22.3.8.2.4 (L-SIG definition)

$$D_{k,n,i_{BW}}^{i_{Seg}}=\begin{cases}0,k=0,\pm7,\pm21\\ d_{M_{20}^{r}(k),n,(i_{BW}\bmod 2)+1},otherwise\end{cases}$$

$$M_{20}^{r}(k)=\begin{cases}k+28,-28\le k\le-22\\ k+27,-20\le k\le-8\\ k+26,-6\le k\le-1\\ k+25,1\le k\le6\\ k+24,8\le k\le20\\ k+23,22\le k\le28\end{cases}$$

P_k and p_n are defined in 18.3.5.10 (OFDM modulation)

$\Upsilon_{k,BW}$ is defined in Equation (25-4), Equation (25-7), Equation (24-7) and Equation (24-8)

$N_{sym,HE-SIG-B}$ is the number of symbols in HE-SIG-B

26.3.9.8.2 HE-SIG-B common content

The Common block field in the HE-SIG-B carries RU allocation subfields. Depending on the PPDU bandwidth, the Common block field can contain multiple RU allocation subfields.

An RU allocation subfield in the Common block field of HE-SIG-B consists of 8 bits that indicates the following for a 20 MHz PPDU BW:

— The RU arrangement in the frequency domain: indexes the size of the RUs and their placement in the frequency domain.

— Number of user fields in each RU in the HE-SIG-B content channel: the number of users multiplexed in the RUs indicated by the arrangement; for RUs of size greater than or equal to 106 tones that support MU-MIMO, it indicates the number of users multiplexed using MU-MIMO.

The mapping of the 8-bit RU allocation subfield to the RU arrangement and the number of user fields per RU is defined in the Table 26-18. In the table, the number of entries column refers to the number of 8-bit indices that refer to the same RU arrangement in the frequency domain but differ in the number of users fields per RU. The RU arrangement and the number of user fields per RU together indicate the number of user-fields in the User specific field of HE-SIG-B. Signaling for the center 26 unit in 80 MHz is [TBD].

Table 26-18 - RU allocation signalling: Arrangement and number of MU-MIMO allocations

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

NOTE: yyy' = 000~111 indicates number of STAs multiplexed in an RU. Binary vector yyy is indexed as $[y[3]y[2]y[1]]$ indicates $2^2 \times y[3] + 2^1 \times y[2] + y[1] + 1$ STAs multiplexed in the RU.

The definition for entries with 'x' bits is TBD.

The number of RU allocation subfields in the HE-SIG-B common block field depends on the total PPDU bandwidth

— In the default mode, for 20 MHz and 40 MHz PPDU, each HE-SIG-B content channel contains one RU allocation subfield followed by multiple user fields. The position of the user-field in the user-specific field together with the 8-bit RU allocation subfield indicates the RU assignment to the user.

— In the default mode for the 80 MHz PPDU, each HE-SIG-B content channel contains two RU allocation subfields for a total of 16 bits of RU allocation signaling, one each for the RUs in the two 20 MHz segments of the HE-SIG-B content channel. The user fields corresponding to the first RU allocation signaling field are followed by the user fields indicated by the second RU allocation signaling field in the user specific field.

In the default mode for the 160 MHz PPDU, each HE-SIG-B content channel contains four RU allocation signaling fields for a total of 32 bits of RU allocation signaling, one each for the RUs in the four 20 MHz segments of the HE-SIG-B content channel. The user fields for each of the 20 MHz segments in the content channel are arranged by the order in which their RU allocation signaling fields appear in the common field.

26.3.9.8.3 HE-SIG-B per-user content

The user-specific field consists of multiple user fields. The user fields follow the common block field of HE-SIG-B. The RU allocation subfield in the Common block field and the position of the user field in the HE-SIG-B user specific field together identify the RU used to transmit a STA's data. An example for the mapping of the 8-bit RU allocation subfield and the position of the user field to an STA's data is illustrated in Figure 26-28. The RU arrangement signaling indicates an arrangement of 106 tone RU followed by five 26-tone RUs and that the 106-tone RU contains three user-fields, i.e., the 106-tone RU supports multiplexing of three users using MU-MIMO. The eight user fields in the HE-SIG-B user-specific field thus map to the 6 RUs, with the first three user fields indicating MU-MIMO allocations in the first 106-tone RU followed by user fields corresponding to the each of the five 26-tone RUs.

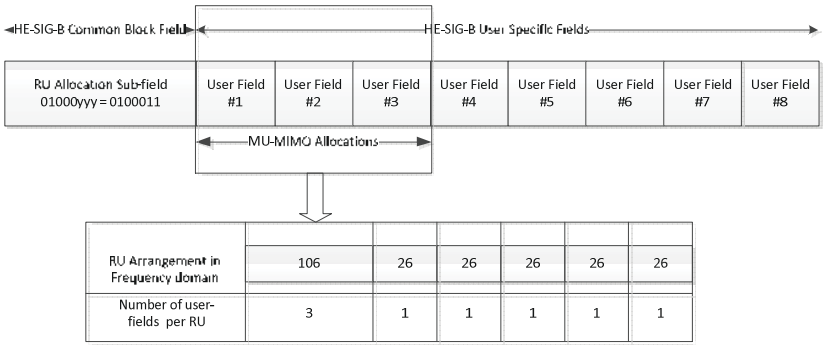


Figure 26-28 - Illustration for the mapping of the 8-bit RU allocation subfield and the position of the user-field to the STA's assignment

The contents of the user field differ based on whether the field addresses a single-STA in an RU or a STA in a MU-MIMO allocation in an RU. Irrespective of whether the allocation is for a STA in a SU or an MU-MIMO allocation, the size of the userfield is the same.

The HE-SIG-B user field for a SU allocation contain the subfields shown in Table 26-19.

Table 26-19 - Fields of the HE-SIG-B user field for a SU allocation

Bit	Subfield	Number of bits	Description
TBD	STA-ID	11	The STA identifier that addresses a STA – reference to MAC section(?). For RUs that carry a broadcast allocation: For single BSS AP, the STAID for Broadcast will be 0; For Multiple BSS AP, the STAID for Broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation; For Multiple BSS AP, the STAID for Broadcast to all BSS of the AP will have a special STAID value reserved.
TBD	NSTS	3	Number of spatial streams
TBD	Tx Beamforming	1	Use of transmit beamforming
TBD	MCS	4	Modulation and Coding Scheme
TBD	DCM	1	Indication for use of dual carrier modulation
TBD	Coding	1	Indication for use of LDPC

The HE-SIG-B user field for an STA in MU-MIMO allocation contain the subfields shown in Table 26-20.

Table 26-20 - Fields of the HE-SIG-B user field for a MU-MIMO allocation

Bit	Subfield	Number of bits	Description
TBD	STA-ID	11	The STA identifier that addresses an STA – reference to MAC section(?)
TBD	Spatial Configuration	4	Indication for the number of spatial streams for a STA in a MU-MIMO allocation. See Table 26-21.
TBD	MCS	4	Modulation and Coding Scheme
TBD	DCM	1	Use of dual carrier modulation
TBD	Coding	1	Use of LDPC

A user field for an MU-MIMO allocation includes a Spatial Configuration subfield consisting of 4 bits that indicates the number of spatial streams for each STA and the total number of spatial streams in the MU-MIMO allocation. The subfield shown in Table 26-21 is constructed by using the entries corresponding to the value of number of users (Nuser) multiplexed using MU-MIMO in an RU. When MU-MIMO is used in an RU of size ≤ 20 MHz, the number of users (Nuser) in an MU-MIMO allocation is equal to the number of user-fields per RU signalled for the RU in the RU allocation subfield of an HE-SIG-B Common block field. When MU-MIMO is used in RUs of size 20 MHz or greater, the number of users (Nuser) in an MU-MIMO allocation is computed as the sum of the number of user-fields per RU indicated for the RU by the 8-bit RU allocation subfield in each HE-SIG-B content channel. For a given value of Nuser, the four bits of the spatial configuration subfield are used as follows: A STA with a STA-ID that matches the 11-bit ID signalled in the user field for an MU-MIMO allocation derives the number of spatial streams allocated to it using the row corresponding to the signalled 4-bit spatial configuration subfield and the column corresponding to the position of the user-field in the user-specific field. The starting stream index for the STA is computed by summing the Nsts in the columns prior to the column indicated by the STA's user-field position. In the case of load balancing for RUs of size > 20 MHz where user fields corresponding to the same MU-MIMO allocations are split into two HE-SIG-B content channels, the user-field positions are logically continuous with the user-field in the second HE-SIG-B content channel updating its position (and therefore, column index) from that of the last user-field in the first HE-SIG-B content channel.

Table 26-21 - Spatial Configuration subfield encoding

Nuser	B0…B3	Nsts [1]	Nsts [2]	Nsts [3]	Nsts [4]	Nsts [5]	Nsts [6]	Nsts [7]	Nsts [8]	Total Nsts	Number of Entries
2	0000~0011	1~4	1							2~5	10
	0100~0110	2~4	2							4~6	
	0111~1000	3~4	3							6~7	

	1001	4	4							8	
3	0000~0011	1~4	1	1						3~6	13
	0100~0110	2~4	2	1						5~7	
	0111~1000	3~4	3	1						7~8	
	1001~1011	2~4	2	2						6~8	
	1100	3	3	2						8	
4	0000~0011	1~4	1	1	1					4~7	11
	0100~0110	2~4	2	1	1					6~8	
	0111	3	3	1	1					8	
	1000~1001	2~3	2	2	1					7~8	
	1010	2	2	2	2					8	
5	0000~0011	1~4	1	1	1	1				5~8	6
	0100~0101	2~3	2	1	1	1				7~8	
6	0000~0010	1~3	1	1	1	1	1			6~8	4
	0011	2	2	1	1	1	1			8	
7	0000~0001	1~2	1	1	1	1	1	1		7~8	2
8	0000	1	1	1	1	1	1	1	1	8	1

26.3.9.9 HE-STF

The main purpose of the HE-STF field is to improve automatic gain control estimation in a MIMO transmission. The duration of the HE-STF field for HE PPDUs except HE trigger-based PPDUs is $T_{HE\text{-}STF\text{-}NT}$ (peridiocity of 0.8 μs with 5 periods) and the duration of the HE-STF field for an HE trigger-based PPDU is $T_{HE\text{-}STF\text{-}T}$ (peridiocity of 1.6 μs with 5 periods). The tone indices for HE-STF field for HE PPDUs except HE trigger-based PPDUs is defined in Equation (26-26).

$$i_{STF} \bmod 16 = 0, \quad \lfloor N_{DC}/2 \rfloor < |i_{STF}| \le N_{SR} \qquad (25-1) \qquad \textbf{(26-26)}$$

i_{STF} : HE-STF tone index

The tone indices for HE-STF fields for an HE trigger-based PPDU are defined in Equation (26-27).

$$i_{STF} \bmod 8 = 0, \quad \lfloor N_{DC}/2 \rfloor < |i_{STF}| \le N_{SR} \qquad (25-2) \qquad \textbf{(26-27)}$$

i_{STF} : HE-STF tone index

For the HE-STF field, the M sequence is defined by Equation (26-28).

$$M = \{-1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1, -1, 1\} \qquad \textbf{(26-28)}$$

The HE-STF field is constructed from the M sequence(s) by multiplying integer coefficient(s) to each 20 MHz subchannel and inserting appropriate coefficients into tone indices which are null after mapping M sequences.

For a 20 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (26-29).

$$HES_{-112:16:112} = \{M\} \cdot (1+j)/\sqrt{2} \qquad (25-3)$$
$$HES_0 = 0 \qquad \textbf{(26-29)}$$

where $HES_{a:b:c}$ means coefficients of the HE-STF on every b tone indices from a to c tone indices and coefficients on other tone indices are set to zero.

For a 40 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (26-30).

$$HES_{-240:16:240} = \{M, 0, -M\} \cdot (1+j)/\sqrt{2} \qquad (25-4) \qquad \textbf{(26-30)}$$

For an 80 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (26-31).

$$HES_{-496:16:496} = \{M, 1, -M, 0, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \qquad (25-5) \qquad \textbf{(26-31)}$$

For a 20 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (26-32).

$$HES_{-120:8:120} = \{M, 0, -M\} \cdot (1+j)/\sqrt{2} \qquad (25-6) \qquad \textbf{(26-32)}$$

For a 40 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (26-33).

$$HES_{-248:8:248} = \{M, -1, -M, 0, M, -1, M\} \cdot (1+j)/\sqrt{2} \qquad (25-7)$$
$$HES_{\pm 248} = 0 \qquad \textbf{(26-33)}$$

For an 80 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (26-34).

$$HES_{-504:8:504} = \{M, -1, M, -1, -M, -1, M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \qquad \textbf{(26-34)}$$
$$HES_{\pm 504} = 0 \qquad (25-8)$$

For an OFDMA transmission, the coefficients in Equation (25-3) to (25-8) are set to zero if those values are corresponding to tone indices on which no RUs defined in 25.3.7.1 are assigned.

The time domain representation of the signal for HE PPDUs except HE trigger-based PPDUs on frequency segment i_{Seg} of transmit chain i_{TX} shall be as specified in Equation (26-35).

$$r_{\text{HE-STF}}^{(i_{Seg}, i_{TX})}(t) = w_{T_{\text{HE-STF-NT}}}(t) \cdot \eta_{EXT} \cdot \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r \beta_r}{\sqrt{N_{STS,r,total}}} \cdot \sum_{k \in K_r} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left(\begin{array}{l} \left[Q_k^{(i_{Seg})} \right]_{i_{TX}, (M_{r,u}+m)} HES_k \\ \cdot \exp\left(j2\pi k \Delta_{F,\text{HE}} \left(t - T_{\text{CS,HE}} \left(M_{r,u} + m \right) \right) \right) \end{array} \right) \qquad \textbf{(26-35)}$$

where

α_r is the power boost factor for the r-th RU, where $\alpha_r \in [TBD_1, TBD_2]$

η_{EXT} is an PPDU format dependent scaling factor, with the following value

$$\eta_{EXT} = \begin{cases} \sqrt{2}, & \text{HE extended range SU PPDU} \\ 1, & \text{otherwise} \end{cases}$$

β_r is the per-RU power normalization factor and defined by

$$\beta_r = \sqrt{\frac{\left|K_r\right|}{\left|K_r^{\text{HE-STF}}\right|}} \Bigg/ \sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 \left|K_r\right|}$$

$\left|K_r\right|$ is the cardinality of the set of subcarriers K_r

$K_r^{\text{HE-STF}}$ is the set of subcarriers that have non-zero values within K_r in the HE-STF field

$T_{\text{CS,HE}}\left(n\right)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$Q_k^{\left(i_{Seg}\right)}$ is defined in 25.3.10.10.x (Transmission in HE format)

$w_{T_{\text{HE-STF-NT}}}\left(t\right)$ is the windowing function for HE-STF field in the non-HE trigger-based PPDU.

The time domain representation of the signal for HE trigger-based PPDUs on frequency segment i_{Seg} of transmit chain i_{TX} shall be as specified in Equation (26-36).

$$r_{\text{HE-STF}}^{\left(i_{Seg},i_{TX}\right)}\left(t\right) = \frac{\alpha_r \beta_r}{\sqrt{N_{STS,r,total}}} w_{T_{\text{HE-STF-T}}}\left(t\right) \cdot \sum_{k\in K_r} \sum_{m=1}^{N_{STS,r,u}} \left(\begin{array}{l} \left[Q_k^{\left(i_{Seg}\right)}\right]_{i_{TX},\left(M_{r,u}+m\right)} HES_k \\ \cdot \exp\left(j2\pi k \Delta_{F,\text{HE}}\left(t - T_{\text{CS,HE}}\left(M_{r,u}+m\right)\right)\right) \end{array} \right) \quad \textbf{(26-36)}$$

where

$w_{T_{\text{HE-STF-T}}}\left(t\right)$ is the windowing function for HE-STF field in the HE trigger-based PPDU.

26.3.9.10 HE-LTF

The HE Long Training field (HE-LTF) field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU, HE MU PPDU or HE extended range SU PPDU, the transmitter provides training for $N_{STS,r,total}$ space-time streams (spatial mapper inputs) used for the transmission of the PSDU(s) in the r-th RU; in an HE trigger-based PPDU, the transmitter of user-u in the r-th RU provides training for $N_{STS,r,u}$ space-time streams used for the transmission of the PSDU. For each tone in the r-th RU, the MIMO channel that can be estimated is an $N_{RX} \times N_{STS,r,total}$ matrix. A HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix $P_{HE\text{-}LTF}$, to enable channel estimation at the receiver. The pilot tones of each HE-LTF symbol are multiplied by the entries of a matrix $R_{HE\text{-}LTF}$ defined in the following text. The multiplication of the pilot tones in the HE-LTF symbol by the $R_{HE\text{-}LTF}$ matrix instead of the $P_{HE\text{-}LTF}$ matrix allows receivers to track phase and frequency offset during MIMO channel estimation using the HE-LTF. In an HE SU PPDU and HE extended range SU PPDU, the number of HE-LTF symbols, $N_{HE\text{-}LTF}$, is a function of the total number of space-time streams N_{STS} as shown in **Error! Reference source not found.**. In an HE trigger-based PPDU, $N_{HE\text{-}LTF}$ is indicated in the Trigger frame that triggers the transmission of the PPDU. In an HE MU PPDU, $N_{HE\text{-}LTF}$ is indicated in the HE-SIG-A field. In an HE MU PPDU and HE trigger-based PPDU, $N_{HE\text{-}LTF}$ is selected to be not smaller than the maximum value of the functions for each $N_{STS,r,total}$. As a result the HE-LTF field consists of one, two, four, six or eight symbols.

A HE PPDU supports 3 HE-LTF modes, which are 1x HE-LTF, 2x HE-LTF, and 4x HE-LTF. It is optional to support 1x HE-LTF in an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU. In an HE SU PPDU, HE MU PPDU or HE extended range SU PPDU, the combination of HE-LTF modes and GI duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the combination of HE-LTF modes and GI duration is indicated in the Trigger frame that triggers the transmission of the PPDU. The mandatory combinations of HE-LTF modes and GI duration are:

— *2x HE-LTF,* $T_{GI,Data}$
— *2x HE-LTF,* $T_{GI,Data2}$
— *4x HE-LTF,* $T_{GI,Data4}$

The optional combinations of HE-LTF mode and GI duration are:

— *1x HE-LTF,* $T_{GI,Data}$ in a HE SU PPDU or HE extended SU PPDU
— *1x HE-LTF,* $T_{GI,Data}$ in a non-OFDMA, MU-MIMO HE MU PPDU
— *1x HE-LTF,* $T_{GI,Data2}$ in a non-OFDMA, MU-MIMO HE trigger-based PPDU

The duration of each HE-LTF symbol is $T_{HE\text{-}LTF}$ is defined in Equation (26-37). In an HE SU PPDU, HE MU PPDU or HE extended range SU PPDU, the HE-LTF symbol duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the HE-LTF symbol duration is indicated in the Trigger frame that triggers the transmission of the PPDU.

$$T_{HE-LTF} = \begin{cases} T_{HE-LTF-1X} & \text{if 1x HE-LTF} \\ T_{HE-LTF-2X} & \text{if 2x HE-LTF} \\ T_{HE-LTF-4X} & \text{if 4x HE-LTF} \end{cases} \quad (26\text{-}37)$$

where $T_{HE\text{-}LTF\text{-}1X}$, $T_{HE\text{-}LTF\text{-}2X}$, $T_{HE\text{-}LTF\text{-}4x}$ are defined in Table 26-3 (Timing related constants).

In a 20 MHz transmission, the 1x HE-LTF sequence transmitted is given by Equation **(26-38)**.

$HELTF_{-122,122}$ =

{0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,
+1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1,
0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, -1, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,
+1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1,
0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -
1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0} **(26-38)**

In a 20 MHz transmission, the 2x HE-LTF sequence transmitted is given by Equation (26-39).

$HELTF_{-122,122}$ =
{-1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1,
0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0,
-1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1,
0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -
1, 0, -1, 0, +1, 0, 0, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1,
0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0,
+1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1,
0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -
1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1} **(26-39)**

In a 20 MHz transmission, the 4x HE-LTF sequence transmitted is given by Equation (26-40).

$HELTF_{-122,\ 122}$ = **(26-40)**

{-1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -
1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, -1, +1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -
1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, -1,
-1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1,
+1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, +1, -1, -1, -1, +1, -1, +1, +1, +1, 0, 0,
0, -1, +1, -1, +1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, +1, -1, +1, -1, +1, +1, +1, -1,
+1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, -1, +1, -1, +1, -1, -1, -1, -
1, +1, -1, +1, +1, -1, -1, +1, -1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1,
+1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, +1,
+1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1}

1 In a 40 MHz transmission, the 1x HE-LTF sequence transmitted is given by Equation **(26-41)**.

$HELTF_{-244,244}$ =
{ +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,
-1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1,
0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0,
0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0,
0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0,
+1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1,
0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0,
0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, **(26-41)**
0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0,
0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0,
+1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1,
0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -
1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1,
0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1}

2 In a 40 MHz transmission, the 2x HE-LTF sequence transmitted is given by Equation (26-42).

$HELTF_{-244,244}$ =
{+1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1,
0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -
1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1,
0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -
1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0,
+1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, **(26-42)**
0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, 0, 0, 0, 0, 0, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0,
-1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1,
0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0,
-1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1,
0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0,
-1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1,
0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -
1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0,
+1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1}

3 In a 40 MHz transmission, the 4x HE-LTF sequence transmitted is given by Equation (26-43).

$HELTF_{-244,244}$ =
{+1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -
1, -1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, -1, -1, -1, -1, +1, -1, +1, +1, +1, -1, - **(26-43)**
1, +1, +1, +1, -1, -1, +1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, -1, -1, +1, -1,
+1, +1, +1, -1, -1, +1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, -1, -1, -1, -1, +1,

-1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, +1, +1,
+1, +1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1,
+1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1,
-1, -1, -1, -1, -1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, -1, -1, -1, -1, -1, -1, +1, -1, -1, +1,
+1, -1, +1, -1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1,
+1, -1, -1, +1, -1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, +1, 0, 0, 0, 0, 0,
-1, +1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, -1, -1, +1, -1, +1, +1, +1, -1, -1,
+1, +1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1,
+1, +1, -1, -1, -1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, -1, +1, +1, -1,
+1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, +1, +1, -1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1,
+1, -1, -1, -1, -1, -1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, -1, -1, +1, -1, -1,
+1, +1, -1, +1, -1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1,
+1, +1, -1, -1, +1, -1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, -1}

1 In an 80 MHz transmission, the 1x HE-LTF sequence transmitted is given by Equation Equation (26-44).

$HELTF_{-500,500}$ =

{ -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -
1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1,
0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0,
0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0,
+1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1,
0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0,
0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -
1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0,
0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,
+1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -
1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1,
0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0,
0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0,
0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0,
-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, **(26-44)**
0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0,
0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0,
+1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,
+1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1,
0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0,
0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,
0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,
+1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -
1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1,
0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0,
0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0,
0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0,
-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1,
0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1}

In an 80 MHz transmission, the 2x HE-LTF sequence transmitted is given by Equation (26-45).

$HELTF_{-500,500}$ =

{+1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0,
+1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1,
0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0,
+1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1,
0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0,
+1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1,
0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0,
+1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1,
0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -
1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1,
0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
-1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1,
0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0,
+1, 0, +1, 0, +1, 0, +1, 0, 0, 0, 0, 0, 0, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, **(26-45)**
-1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1,
0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0,
+1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0,
+1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1,
0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0,
+1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1,
0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0,
+1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1,
0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -
1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1,
0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0,
-1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1,
0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0,
+1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1,
0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0,
+1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1,
0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1}

In an 80 MHz transmission, the 4x HE-LTF sequence transmitted is given by Equation (26-46).

$HELTF_{-500,500}$ =

{+1, +1, -1, +1, -1, +1, -1, -1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1,
+1, +1, +1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, +1, +1,
+1, -1, -1, -1, -1, -1, -1, +1, +1, +1, +1, +1, +1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -
1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -
1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1,
+1, +1, -1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1,
+1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, -1,
+1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, +1, +1, +1, +1,
+1, +1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, **(26-46)**
+1, +1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -
1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1,
-1, -1, -1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1,
+1, +1, +1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1,
+1, +1, -1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1,
-1, -1, +1, -1, -1, +1, -1, +1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -
1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1,
-1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, -1, -1,
+1, +1, -1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, +1, -1, +1,

+1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -
1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, -1, +1,
-1, -1, -1, -1, +1, +1, +1, -1, -1, +1, 0, 0, 0, 0, 0, +1, -1, -1, -1, -1, -1, -1, +1, -1, +1, +1, -
1, -1, +1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, -1, +1,
+1, +1, +1, +1, +1, +1, -1, +1, -1, -1, +1, -1, -1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1,
+1, +1, -1, -1, -1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1,
+1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1,
+1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1,
+1, +1, +1, -1, +1, -1, -1, +1, -1, -1, +1, -1, +1, +1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1,
+1, +1, +1, -1, -1, +1, -1, -1, -1, +1, -1, -1, -1, -1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1,
+1, -1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1, -1, +1,
+1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1,
+1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, +1,
+1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, -1, -1, -1, -1, -1,
-1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, +1,
+1, +1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1,
-1, -1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1,
+1, -1, -1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1,
+1, -1, +1, -1, -1, +1, -1, -1, +1, -1, +1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1,
+1, -1, -1, +1, -1, -1, -1, +1, -1, -1, -1, -1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -
1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1, -1, +1, +1, -1, -1,
-1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1,
+1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1}

In a 160 MHz transmission, the 1x HE-LTF sequence transmitted is given by Equation (26-47).

$$HELTF_{-1012,1012} = \{\ 1\text{x LTF}_{80\text{MHz_primary}},\ \text{zeros}(1,23),\ 1\text{x LTF}_{80\text{MHz_secondary}}\ \} \quad \textbf{(26-47)}$$

where 1x $\text{LTF}_{80\text{MHz_primary}}$ = {L-$\text{LTF}_{80\text{MHz_1x}}$, 0, R-$\text{LTF}_{80\text{MHz_1x}}$}, 1x $\text{LTF}_{80\text{MHz_ secondary}}$ = {L-$\text{LTF}_{80\text{MHz_1x}}$, 0, (-1)*R-$\text{LTF}_{80\text{MHz_1x}}$}.

In a 160 MHz transmission, the 2x HE-LTF sequence transmitted is given by Equation (26-48).

$$HELTF_{-1012,1012} = \{\ 2\text{x LTF}_{80\text{MHz_primary}},\ \text{zeros}(1,23),\ 2\text{x LTF}_{80\text{MHz_secondary}}\ \} \quad \textbf{(26-48)}$$

where

2x $\text{LTF}_{80\text{MHz_primary}}$ =
{ {1st 242-RU}, {2nd 242-RU}, {central 26-RU}, {3rd 242-RU}, {4th 242-RU} **(26-49)**

2x $\text{LTF}_{80\text{MHz_secondary}}$ =
{ {1st 242-RU}, (-1)*{2nd 242-RU}, {central 26-RU}, {3rd 242-RU}, (-1)*{4th 242-RU} } **(26-50)**

In a 160 MHz transmission, the 4x HE-LTF sequence transmitted is given by Equation (26-51).

$$HELTF_{-1012,1012} = \{\ 4\text{x LTF}_{80\text{MHz_primary}},\ \text{zeros}(1,23),\ 4\text{x LTF}_{80\text{MHz_secondary}}\ \} \quad \textbf{(26-51)}$$

where

$$4\text{x LTF}_{80\text{MHz_primary}} = \{\text{L-LTF}_{80\text{MHz_4x}},\ 0,\ \text{R-LTF}_{80\text{MHz_4x}}\} \quad \textbf{(26-52)}$$

$$4\text{x LTF}_{80\text{MHz_ secondary}} = \{\text{L-LTF}_{80\text{MHz_4x}},\ 0,\ (-1)*\text{R-LTF}_{80\text{MHz_4x}}\} \quad \textbf{(26-53)}$$

For a noncontiguous 80+80 MHz transmission, the 1x HE-LTF sequence is given by Equation (26-54).

$$HELTF_{80+80MHz} = \{\ 1\text{x LTF}_{80\text{MHz_primary}},\ 1\text{x LTF}_{80\text{MHz_secondary}}\ \} \quad \textbf{(26-54)}$$

For a noncontiguous 80+80 MHz transmission, the 2x HE-LTF sequence is given by Equation (26-55).

$$HELTF_{80+80MHz} = \{\ 2x\ LTF_{80MHz\_primary},\ 2x\ LTF_{80MHz\_secondary}\ \} \quad \textbf{(26-55)}$$

For a noncontiguous 80+80 MHz transmission, the 4x HE-LTF sequence is given by Equation (26-56).

$$HELTF_{80+80MHz} = \{\ 4x\ LTF_{80MHz\_primary},\ 4x\ LTF_{80MHz\_secondary}\ \} \quad \textbf{(26-56)}$$

The generation of the time domain HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU, HE trigger-based PPDU using single stream pilots is shown in Figure 26-29 where A^k_{HELTF} is given by Equation (26-57).

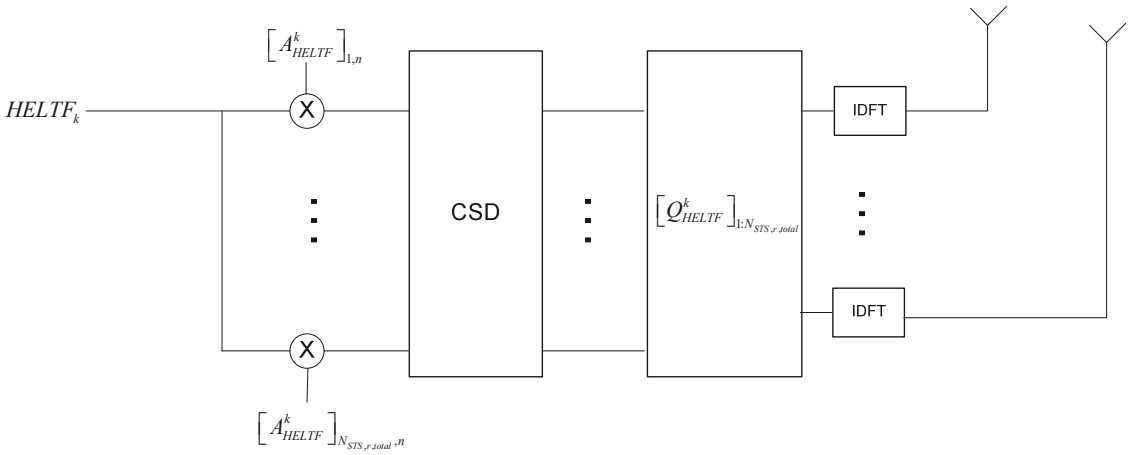


Figure 26-29 – Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU, and HE trigger-based PPDU using single stream pilots

The generation of time domain symbol of 1x HE-LTF is equivalent to modulating every 4 tones in an OFDM symbol of 12.8 μs excluding GI, and then only transmit the first ¼ of the OFDM symbol in the time domain, as shown in Figure 26-30.

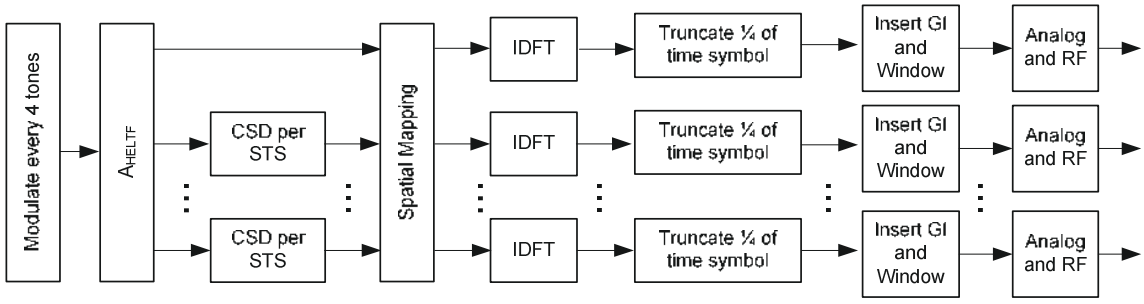


Figure 26-30 - Generation of 1x HE-LTF symbols per frequency segment

The generation of time domain symbol of 2x HE-LTF is equivalent to modulating every other tone in an OFDM symbol of 12.8 μs excluding GI, and then only transmit the first half of the OFDM symbol in time domain, as shown in Figure 26-31.

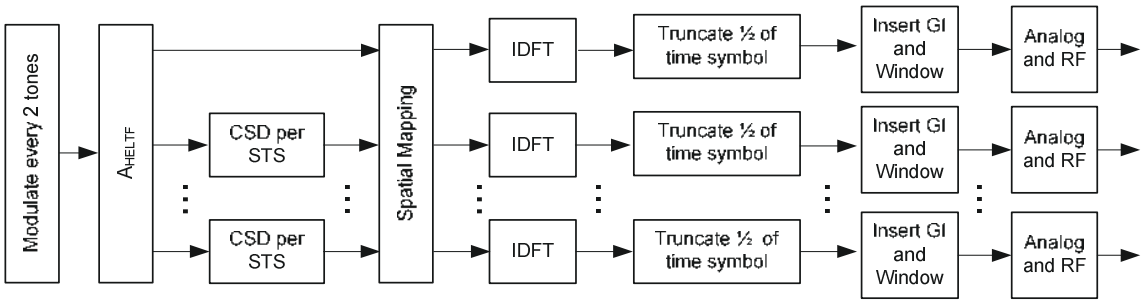


Figure 26-31 - Generation of 2x HE-LTF symbols per frequency segment

A^k_{HELTF} is given by Equation (26-57).

$$A^k_{HELTF} = \begin{cases} R_{HELTF}, & \text{if } k \in K_{\text{Pilot}} \\ P_{HELTF}, & \text{otherwise} \end{cases} \quad \textbf{(26-57)}$$

where K_{Pilot} is the set of subcarrier indices for the pilot tones as defined in 25.x (xx).

R_{HELTF} is a $N_{HELTF} \times N_{HELTF}$ matrix whose elements are defined in Equation (26-58).

$$\left[R_{HELTF}\right]_{m,n} = \left[P_{HELTF}\right]_{1,n},\ 1 \le m,n \le N_{HELTF} \quad \textbf{(26-58)}$$

P_{HELTF} is defined in (26-59).

$$P_{HELTF} = \begin{cases} P_{4\times4}, N_{HELTF} \le 4 \\ P_{6\times6}, N_{HELTF} = 6 \\ P_{8\times8}, N_{HELTF} = 8 \end{cases} \quad \textbf{(26-59)}$$

where $P_{4\times4}$ is defined in Equation (20-17), $P_{6\times6}$ is defined in Equation (22-45), and $P_{8\times8}$ is defined in Equation (22-46).

In an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU using single stream pilots, the time domain representation of the waveform transmitted on frequency segment i_{Seg} of transmit chain i_{TX} shall be as described by Equation (26-60).

$$r^{(i_{seg},i_{TX})}_{HE-LTF}(t) = \frac{\eta_{HE-LTF}\cdot\eta_{EXT}}{\sqrt{\sum_{r=1}^{N_{RU}}\alpha_r^2\left|K_r\right|}} \sum_{n=0}^{N_{HELTF}-1} w_{T_{HE-LTF}}\left(t-nT_{HE-LTF}\right) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r}{\sqrt{N_{STS,r,total}}}$$
$$\cdot \sum_{k\in K_r} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left(\begin{array}{l} \left[Q_k^{(i_{seg})}\right]_{i_{TX},(M_{r,u}+m)} \left[A^k_{HELTF}\right]_{(M_{r,u}+m),(n+1)} HELTF_k \\ \cdot \exp\left(j2\pi k\Delta_{F,HE}\left(t-nT_{HE-LTF}-T_{GI}-T_{CS,HE}\left(M_{r,u}+m\right)\right)\right) \end{array} \right) \quad \textbf{(26-60)}$$

where

α_r is the power boost factor for the r-th RU, where $\alpha_r \in [TBD_1, TBD_2]$

η_{EXT} is an PPDU format dependent scaling factor, with the following value

$$\eta_{EXT} = \begin{cases} \sqrt{2}, & \text{HE extended range SU PPDU} \\ 1, & \text{otherwise} \end{cases}$$

$N_{\text{HE-LTF}}^{\text{Tone}}$ has the value given in Table 25-xx (Tone scaling factor and guard interval duration values for PHY fields)

$T_{CS,\text{HE}}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$Q_k^{(i_{seg})}$ is defined in 25.xx (Transmission in HE format)

A_{HELTF}^k is defined in Equation (26-57)

K_r is the set of subcarrier indices for the tones in the *r*-th RU as defined in 25.x.

η_{HELTF} is the power scaling factor as defined in (25-xx)

$$\eta_{HE-LTF} = \begin{cases} 2 & \text{for 1x HE-LTF} \\ \sqrt{2} & \text{for 2x HE-LTF} \\ 1 & \text{for 4x HE-LTF} \end{cases}$$

26.3.10 Data field

26.3.10.1 General

The number of OFDM symbols in the Data field is determined by the Length field in L-SIG (see Equation (25-x)), the preamble duration and the setting of the CP+LTF Size field in HE-SIG-A (see 25.3.9.2.4.x HE-SIG-A definition). Data symbols in an HE PPDU shall use a DFT period of 12.8 μs and subcarrier spacing of 78.125 kHz. Data symbols in an HE PPDU shall support guard interval durations of 0.8 μs, 1.6 μs and 3.2 μs. HE PPDUs shall have single stream pilots in the Data field. In UL MU-MIMO transmissions, all streams use the same pilot sequence. The Data field in UL MU transmissions shall immediately follow the HE-LTF section.

When BCC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the tail bits, the post-FEC padding bits and the packet extension (bits for SU and bits for each user u in MU). When LDPC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the post-FEC padding bits and the packet extension. No tail bits are present when LDPC encoding is used.

The Data field of the HE PPDU contains data for one or more users.

26.3.10.1.1 Pre-FEC encoding process

A two-step padding process is applied on all HE PPDUs. A pre-FEC padding with both MAC and PHY padding is applied before conducting FEC coding, and a post-FEC PHY padding is applied on the FEC encoded bits.

The pre-FEC padding may pad torward 4 possible boundaries in the last one (in the case of non STBC), or two (in the case of STBC) OFDM symbols of a HE PPDU, the 4 possible boundaries participate the FEC output bit stream of the last OFDM symbol(s) into 4 symbol segments. The 4 possible boundaries are represented by a parameter *a*, called *a-factor*.

Figure 26-32 illustrates these 4 possible symbol segments in the last OFDM symbol of a non STBC case, and the general padding process assuming the desired pre-FEC padding boundary, *a-factor*, is 1. In the case of STBC, the FEC output bits and post-FEC padding bits as shown in Figure 26-33, are modulated into the last two OFDM symbols by STBC encoding, each with the same number of effective symbol segments, *a-factor,* being 1.

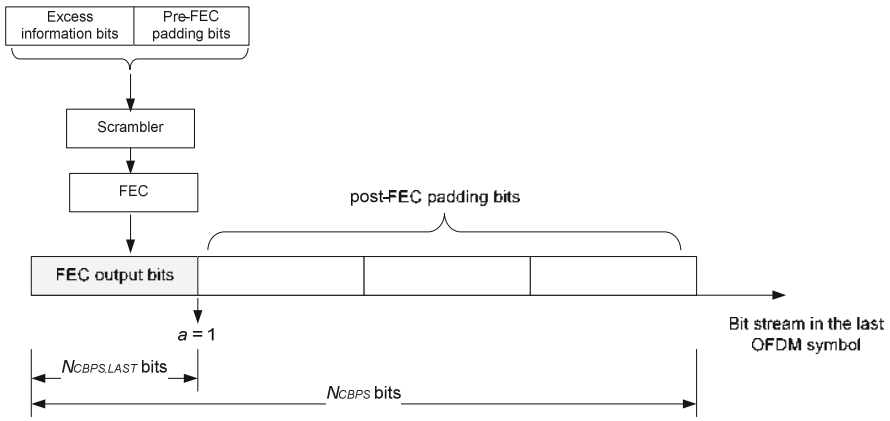


Figure 26-32 - HE PPDU padding process in the last OFDM symbol (non STBC) when *a* = 1

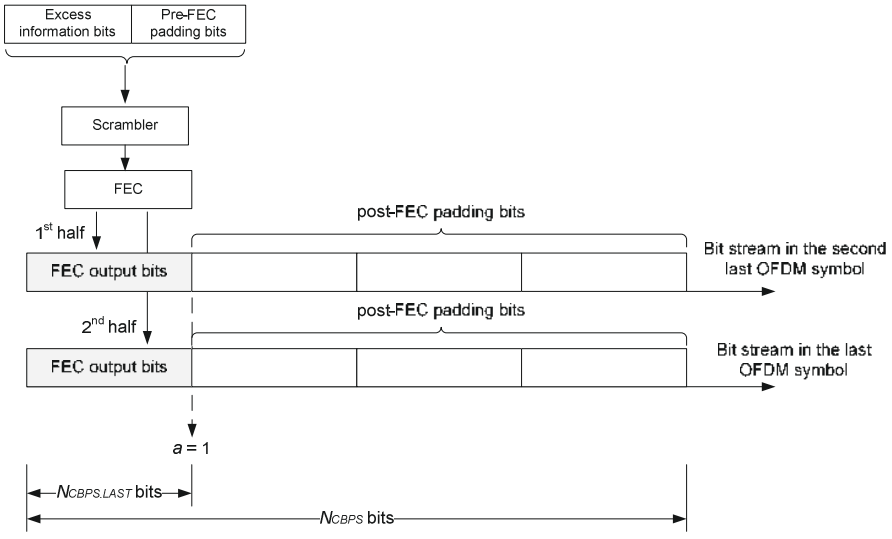


Figure 26-33 – HE PPDU padding process in the last OFDM symbol (STBC) when *a* = 1

The pre-FEC padding process is described in this subclause, and the encoding and post-FEC padding process are described in 26.3.10.3. While this subclause describes the pre-FEC padding processing of an SU transmission, its extension to MU transmission is described in 25.3.10.3.4 (Encoding Process for HE MU PPDUs).

In an HE SU PPDU transmission, the transmitter first computes the number of excess bits in the last OFDM symbol(s). Specifically, for HE SU PPDU with BCC encoding, the number of excess bits is calculated based on Equation (26-61).

$$N_{\text{Excess}} = \text{mod}\left(8.\text{APEP\_LENGTH} + N_{Tail} + N_{service},\ m_{STBC}.N_{DBPS}\right) \quad \textbf{(26-61)}$$

where

m_{STBC} is 2 when STBC is used, and 1 otherwise;

APEP_LENGTH is the TXVECTOR parameter APEP_LENGTH.

For a HE SU PPDU with LDPC encoding, the number of excess bits is calculated based on Equation (26-62):

$$N_{\text{Excess}} = \text{mod}\left(8.\text{APEP\_LENGTH} + N_{service},\ m_{STBC}.N_{DBPS}\right) \quad \textbf{(26-62)}$$

Then based on N_{Excess}, compute the initial number of symbol segments in the last OFDM symbol(s), *a-factor* value or a_{init}, as shown in Equation (26-63):

$$a_{init} = \begin{cases} 4 & \text{if } N_{\text{EXCESS}} = 0 \\ \left\lceil \dfrac{N_{\text{Excess}}}{m_{STBC} \cdot N_{DBPS,SHORT}} \right\rceil & \text{otherwise} \end{cases} \quad \textbf{(26-63)}$$

where

$N_{DBPS.SHORT} = N_{CBPS.SHORT}.R$, in which R is the coding rate, and

$N_{CBPS.SHORT} = N_{SD.SHORT}.N_{SS}.N_{BPSCS}$;

The parameter $N_{SD.SHORT}$ values for different RU sizes are as shown in Table 26-22.

Table 26-22 - $N_{SD.SHORT}$ values

RU Size	$N_{SD.SHORT}$	
	DCM = 0	***DCM = 1***
26	6	2 (TBD)
52	12	6 (TBD)
106	24	12 (TBD)
242	60	30 (TBD)
484	120	60 (TBD)
996	240	120 (TBD)
996x2	492	246 (TBD)

Given the a_{init} values, the initial number of data bits per symbol and the initial number of coded bits per symbol in the last OFDM symbol(s) are defined in Equation (26-64):

$$N_{DBPS.LAST.init} = \begin{cases} a_{init}.N_{DBPS.SHORT}, & \text{if } a_{init} < 4 \\ N_{DBPS,} & \text{if } a_{init} = 4 \end{cases}$$
$$N_{CBPS.LAST.init} = \begin{cases} a_{init}.N_{CBPS.SHORT}, & \text{if } a_{init} < 4 \\ N_{CBPS,} & \text{if } a_{init} = 4 \end{cases} \quad \textbf{(26-64)}$$

For a HE SU PPDU with BCC encoding, the number of pre-FEC pad bits is calculated using Equation (26-65).

$$N_{PAD,PRE-FEC} = (N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.Last.init} - 8.APEP\_LENGTH - N_{Tail} - N_{service} \quad \textbf{(26-65)}$$

where $N_{SYM.init}$ is defined as in Equation (26-68) for BCC encoding, and Equation (26-73) for LDPC encoding.

For a HE SU PPDU with LDPC encoding, the number of pre-FEC pad bits is calculated using Equation (26-66).

$$N_{PAD,PRE-FEC} = (N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.Last.init} - 8.APEP\_LENGTH - N_{service} \quad \textbf{(26-66)}$$

Among the pre-FEC padding bits, the MAC delivers a PSDU that fills the available octets in the Data field of the HE PPDU, toward the desired pre-FEC padding boundary, represented by a_{init} value, in the the last OFDM symbol(s). The PHY then determines the number of pad bits to add and appends them to the PSDU. The number of pre-FEC pad bits added by PHY will always be 0 to 7. The procedure is defined in Equation (26-67).

$$N_{PAD,PRE-FEC,MAC} = \left\lfloor \frac{N_{PAD,PRE-FEC}}{8} \right\rfloor \cdot 8$$
$$N_{PAD,PRE-FEC,PHY} = N_{PAD,PRE-FEC} \bmod 8 \quad \text{(26-67)}$$

26.3.10.2 SERVICE field

The SERVICE field of HE PPDU is as shown in Table 26-23.

Table 26-23 – SERVICE field

Bits	Field	Description
B0-B6	Scrambler Initialization	Set to 0
B7-B15	Reserved	Set to 0

26.3.10.3 Coding

The Data field shall be encoded using either the binary convolutional code (BCC) defined in 26.3.10.3.1 or the low density parity check (LDPC) code defined in 25.3.10.3.2 (LDPC coding). The encoder is selected by the Coding field in HE-SIG-A in an HE SU PPDU or an HE extended range SU PPDU, or HE-SIG-B per-user subfield(s) in a HE MU PPDU, as defined in 26.3.9.7 and 26.3.9.8 respectively.

When conducting BCC FEC encoding for an HE PPDU, the number of encoders is always 1.

LDPC is the only FEC coding scheme in the HE PPDU Data field for a 484-RU, a 996-RU or a 996x2-RU. Support of BCC code is limited to less than or equal to four spatial streams (per user in case of MU-MIMO), and is mandatory (for both transmit and receive) for RU sizes less than or equal to a 242-RU. Support of LDPC code (for both transmit and receive) is mandatory for HE STAs declaring support for at least one of HE 40/80/160/80+80 SU PPDU bandwidths, or for HE STAs declaring support for more than 4 spatial streams, according to HE capabilities field as defined in clause 8.4.2.1 (HE Capabilities Element). Otherwise, support of LDPC code for either transmit or receive is optional.

26.3.10.3.1 Binary convolutional coding and puncturing

The information bits and pre-FEC padding bits of user *u* are encoded by a rate R = ½ convolutional encoder defined in 18.3.5.6 (Convolutional encoder). After encoding, the encoded data is punctured by the method defined in 18.3.5.6 (Convolutional encoder) (except for rate 5/6), to achieve the rate selected by the modulation and coding scheme. In the case that rate 5/6 coding is selected, the puncturing scheme will be the same as described in 20.3.11.6 (Binary convolutional coding and puncturing).

The initial number of OFDM symbols in the Data field with BCC encoding in a HE SU PPDU is calculated as in Equation (26-68),

$$N_{SYM.init} = m_{STBC} \cdot \left\lceil \frac{8.APEP\_LENGTH + N_{Tail}.N_{ES} + N_{service}}{m_{STBC}.N_{DBPS}} \right\rceil \quad \text{(26-68)}$$

For a HE SU PPDU with BCC encoding,

$$N_{SYM} = N_{SYM.init} \quad \text{(26-69)}$$

and

$$a = a_{init} \quad \textbf{(26-70)}$$

The number of coded bits per symbol in the last OFDM symbol(s) of a HE SU PPDU is

$$N_{CBPS.LAST} = \begin{cases} a \cdot N_{CBPS.SHORT}, & \text{if } a < 4 \\ N_{CBPS,} & \text{if } a = 4 \end{cases} \quad \textbf{(26-71)}$$

26.3.10.3.2 LDPC coding

For a HE SU PPDU using LDPC coding to encode the Data field, the LDPC code and encoding process described in 20.3.11.7 (LDPC codes) shall be used with the following modifications. First, all bits in the Data field including the scrambled SERVICE, PSDU, and pre-FEC pad bits are encoded. Thus, N_{pld} for HE PPDUs shall be computed using Equation (26-72) instead of Equation (20-35).

$$N_{pld} = (N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.LAST.init} \quad \textbf{(26-72)}$$

where

$N_{SYM.init}$ is given by Equation (26-73):

$$N_{SYM.init} = m_{STBC} \cdot \left\lceil \frac{8.APEP\_LENGTH + N_{service}}{m_{STBC}.N_{DBPS}} \right\rceil \quad \textbf{(26-73)}$$

Following the calculation of N_{pld}, N_{avbits} shall be computed using (26-74) instead of Equation (20-36).

$$N_{avbits} = (N_{SYM.init} - m_{STBC}).N_{CBPS} + m_{STBC}.N_{CBPS.LAST.init} \quad \textbf{(26-74)}$$

In addition, in step d) of LDPC encoding process as described in clause 20.3.11.7.5 (LDPC PPDU encoding process) , if the following condition is met:

$\left(\left(N_{punc} > 0.1 \times N_{CW} \times L_{LDPC} \times (1-R) \right) \text{ AND } \left(N_{shrt} < 1.2 \times N_{punc} \times \frac{R}{1-R} \right) \right)$ is true OR if

$\left(N_{punc} > 0.3 \times N_{CW} \times L_{LDPC} \times (1-R) \right)$ is true,

then the LDPC Extra OFDM Symbol field of HE-SIG-A shall be set to 1, and increment *Navbits* by the following Equation (26-75) instead of Equations (20-39), followed by recomputing N_{punc} as in Equation (20-40):

$$N_{avbits} = \begin{cases} N_{avbits} + m_{STBC}.\left(N_{CBPS} - 3.N_{CBPS.SHORT}\right), & \text{if } a_{init} = 3 \\ N_{avbits} + m_{STBC}.N_{CBPS.SHORT}, & \text{otherwise} \end{cases} \quad \textbf{(26-75)}$$

and then update a and N_{SYM} values by the following Equation (26-76):

$$\begin{cases} N_{SYM} = N_{SYM.init} + m_{STBC}, \text{ and } a = 1, & \text{if } a_{init} = 4 \\ N_{SYM} = N_{SYM.init}, \text{ and } a = a_{init} + 1, & \text{otherwise} \end{cases} \quad \textbf{(26-76)}$$

If in step d) of LDPC encoding process as described in clause 20.3.11.7.5 (LDPC PPDU encoding process), the above mentioned condition is not met, then the LDPC Extra OFDM Symbol field of HE-SIG-A shall be set to 0, and:

$$a = a_{init},\ N_{SYM} = N_{SYM.init} \quad \textbf{(26-77)}$$

With the final *a-factor* value a, update the N_{CBPS} of the last symbol as:

$$N_{CBPS.LAST} = \begin{cases} a \cdot N_{CBPS.SHORT}, & \text{if } a < 4 \\ N_{CBPS,} & \text{if } a = 4 \end{cases} \quad \textbf{(26-78)}$$

LDPC codes used in HE MU PPDUs shall also follow the definitions in 20.3.11.7 (LDPC codes). Refer to 25.3.10.3.4 (Encoding process for HE MU PPDUs) for a description of the LDPC encoding process for HE MU PPDUs.

26.3.10.3.3 Post-FEC padding

The number of post-FEC padding bits in each of the last m_{STBC} symbol(s) is computed by:

$$N_{PAD,POST-FEC} = N_{CBPS} - N_{CBPS.LAST} \quad \textbf{(26-79)}$$

$N_{PAD.POST-FEC}$ bits with arbitrary 0 or 1 values (TBD) are appended after the FEC output bits in each of the last m_{STBC}OFDM symbols.

26.3.10.3.4 Encoding process for an HE MU PPDU

For an HE MU PPDU, all the users shall use a common *a-factor* value and a common N_{SYM} value. The padding process is described as follows:

First compute initial *a-factor* value ($a_{init,u}$) for each user u using Equation (26-63), and the initial number of OFDM symbols ($N_{init,u}$) for each user u using Equation (26-68) if user u is BCC encoded, or Equation (26-73) if user u is LDPC encoded. Among all the users, derive the user index with the longest encoded packet duration, as in Equation (26-80):

$$u_{\max} = \arg\max_{u=0}^{N_U-1}(N_{SYM.init.u} - m_{STBC} + 0.25.m_{STBC}.a_{init.u}) \quad \textbf{(26-80)}$$

where m_{STBC} is the common STBC setting among all the users, as described in 26.3.10.8.

Then the common a_{init} and N_{init} values among all the users are derived by Equation (26-81):

$$N_{SYM.init} = N_{SYM.init.u_{\max}} \quad \textbf{(26-81)}$$
$$a_{init} = a_{init.u_{\max}}$$

Update each user's initial number of coded bits in its last symbol as below:

$$N_{DBPS.LAST.init.u} = \begin{cases} a_{init}.N_{DBPS.SHORT.u}, & \text{if } a_{init} < 4 \\ N_{DBPS.u,} & \text{if } a_{init} = 4 \end{cases} \quad \textbf{(26-82)}$$
$$N_{CBPS.LAST.init.u} = \begin{cases} a_{init}.N_{CBPS.SHORT.u}, & \text{if } a_{init} < 4 \\ N_{CBPS.u,} & \text{if } a_{init} = 4 \end{cases}$$

For each user with LDPC encoding, the number of pre-FEC padding bits is computed as in Equation (26-83):

$$N_{PAD,PRE-FEC,u} = (N_{SYM.init} - m_{STBC}).N_{DBPS.u} + m_{STBC}.N_{DBPS.LAST.init.u} - 8APEP\_LENGTH_u - N_{service} \quad \textbf{(26-83)}$$

For each user with LDPC encoding, the parameters $N_{pld,u}$ and $N_{avbits,u}$ are computed using Equations (26-84) and (26-85) respectively:

$$N_{pld,u} = (N_{SYM.init} - m_{STBC}).N_{DBPS,u} + m_{STBC}.N_{DBPS.LAST.init,u} \quad \textbf{(26-84)}$$

$$N_{avbits,u} = (N_{SYM.init} - m_{STBC}).N_{CBPS,u} + m_{STBC}.N_{CBPS.LAST.init,u} \quad \textbf{(26-85)}$$

Each user with LDPC encoding continue LDPC encoding process as in clause 20.3.11.7.5 (LDPC PPDU encoding process) starting with the parameters $N_{pld,u}$ and $N_{avbits,u}$. If there is at least one user with LDPC encoding, where step d) of its LDPC encoding process of clause 20.3.11.7.5 (LDPC PPDU encoding process), meets the following condition:

$\left(\left(N_{punc,u} > 0.1\times N_{CW,u}\times L_{LDPC,u}\times(1-R_u)\right) \text{ AND } \left(N_{shrt,u} < 1.2\times N_{punc,u}\times\frac{R_u}{1-R_u}\right)\right)$ is true OR if $\left(N_{punc,u} > 0.3\times N_{CW,u}\times L_{LDPC,u}\times(1-R_u)\right)$ is true, where $N_{punc,u}$, $N_{CW,u}$, $L_{LDPC,u}$, $N_{shrt,u}$ are the LDPC encoding paraters for user *u*, as defined in 20.3.11.7.5 (LDPC PPDU encoding process), and R_u is the coding rate of user *u*, then the LDPC Extra symbol bit in HE-SIG-A shall be set to 1, and all the users with LDPC encoding shall increment *Navbits* and recomputed *Npunc*, by the following two equations once:

$$N_{avbits,u} = \begin{cases} N_{avbits,u} + m_{STBC}.\left(N_{CBPS,u} - 3.N_{CBPS.SHORT,u}\right), & \text{if } a_{init} = 3 \\ N_{avbits,u} + m_{STBC}.N_{CBPS.SHORT,u}, & \text{otherwise} \end{cases} \quad \textbf{(26-86)}$$

$$N_{punc,u} = \max\left(0,\ (N_{CW,u}\times L_{LDPC,u}) - N_{avbits,u} - N_{shrt,u}\right) \quad \textbf{(26-87)}$$

Update the common *a-factor* and *NSYM* values for all users by the following equation:

$$\begin{cases} N_{SYM} = N_{SYM.init} + m_{STBC}, \text{ and } a = 1, & \text{if } a_{init} = 4 \\ N_{SYM} = N_{SYM.init}, \text{ and } a = a_{init} + 1, & \text{otherwise} \end{cases} \quad \textbf{(26-88)}$$

Note that users with BCC encoding shall also use the common N_{SYM} and a parameters as in Equation (26-76).

If among all the users with LDPC encoding, in step d) of clause 20.3.11.7.5 (LDPC PPDU encoding process), the above mentioned condition is not met, or if all the users in the HE MU PPDU are BCC encoded, then the LDPC Extra symbol bit in HE-SIG-A shall be set to 0, and:

$$a = a_{init},\ N_{SYM} = N_{SYM.init} \quad \textbf{(26-89)}$$

Update the *NCBPS* and *NDBPS* of the last symbol for each user as:

$$N_{DBPS.LAST.u} = \begin{cases} a.N_{DBPS.SHORT.u}, & \text{if } a < 4 \\ N_{CBPS.u,} & \text{if } a = 4 \end{cases}$$
$$N_{CBPS.LAST.u} = \begin{cases} a.N_{CBPS.SHORT.u}, & \text{if } a < 4 \\ N_{CBPS.u,} & \text{if } a = 4 \end{cases} \quad \text{(26-90)}$$

For the users with BCC encoding, the number of pre-FEC padding bits is shown in Equation (26-91).

$$N_{PAD,PRE-FEC,u} = (N_{SYM} - m_{STBC}).N_{DBPS.u} + m_{STBC}.N_{DBPS.LAST.u} - 8APEP\_LENGTH_u - N_{Tail} - N_{service} \quad \text{(26-91)}$$

For each user with either LDPC or BCC encoding, the number of post-FEC padding bits in each of the last m_{STBC} symbol(s) is computed as in Equation (26-92):

$$N_{PAD,POST-FEC,u} = m_{STBC}.(N_{CBPS,u} - N_{CBPS.LAST,u}) \quad \text{(26-92)}$$

26.3.10.3.5 Encoding process for an HE trigger-based PPDU

The AP indicates the common N_{SYM}, *a-factor*, STBC indication and LDPC Extra Symbol in the Trigger frame.

For an HE trigger-based PPDU with BCC encoding, follow the HE SU PPDU padding and encoding process as introduced in clause 25.3.10.1.1 (pre-FEC padding process), clause 25.3.10.3.1 (Binary convolutional coding and puncturing), and 25.3.10.3.3 (Post-FEC Padding), with initial parameters setting to $N_{SYM.init} = N_{SYM}$, and $a_{init} = a$, where N_{SYM} and a are the common number of symbols and *a-factor* parameters indicated in the Trigger frame, respectively.

For an HE trigger-based PPDU with LDPC encoding, follow the HE SU PPDU padding and encoding process as introduced in 26.3.10.1.1 (pre-FEC encoding process), 26.3.10.3.2 (LDPC coding), and 26.3.10.3.3 (Post-FEC padding), with the following exceptions:

When the Trigger frame indicates LDPC Extra Symbol = 1, set the initial parameters following Equation (26-93):

$$\begin{cases} a_{init} = 4,\ N_{SYM.init} = N_{SYM} - m_{STBC}, & \text{if } a = 1 \\ a_{init} = a - 1,\ N_{SYM.init} = N_{SYM}, & \text{otherwise} \end{cases} \quad \text{(26-93)}$$

where N_{SYM} and a are the common number of symbols and *a-factor* parameters indicated in the Trigger frame respectively, and m_{STBC} is 2 if the Trigger frame indicates STBC and 1 otherwise. Then continue with the LDPC encoding process as in clause 20.3.11.7.5 (LDPC PPDU encoding process), during which in step d) of clause 20.3.11.7.5 (LDPC PPDU encoding process), always increment *Navbits* as in Equation (26-75), and always recompute N_{punc} as in Equation (20-40), followed by updating *a = ainit + 1 if* a_{init}*<4, or a=1 if* a_{init}*=4*.

When the Trigger frame indicates LDPC Extra Symbol = 0, set initial parameters to $N_{SYM.init} = N_{SYM}$, and $a_{init} = a$, where N_{SYM} and a are the common number of symbols and *a-factor* parameters indicated in the Trigger frame respectively. Then continue with the LDPC encoding process as in clause 20.3.11.7.5 (LDPC PPDU encoding process), during which in step d) of clause 20.3.11.7.5 (LDPC PPDU encoding process), *Navbits* and N_{punc} are not changed, and $a = a_{init}$.

26.3.10.4 Stream parser

After coding, puncturing and post-FEC padding, the data bit streams at the output of the FEC encoder are processed in groups of N_{CBPS} bits. Each of these groups is re-arranged into N_{SS} blocks of N_{CBPSS} bits ($N_{SS,u}$

blocks of $N_{CBPSS,u}$ bits in the case of a HE MU transmission). This operation is referred to as "stream parsing" and is described in this section.

The description is given in terms of an SU transmission. For MU transmissions, the rearrangements are carried out in the same way per user.

The number of bits assigned to a single axis (real or imaginary) in a constellation point in a spatial stream is denoted by Equation (26-94).

$$s = \max\left\{1, \frac{N_{BPSCS}}{2}\right\} \quad \textbf{(26-94)}$$

The sum of these over all streams is $S = N_{SS}.s$.

Consecutive blocks of s bits are assigned to different spatial streams in a round robin fashion.

Let

$$N_{\text{Block}} = \left\lfloor \frac{N_{CBPS}}{S} \right\rfloor \quad \textbf{(26-95)}$$

For the $N_{\text{Block}}.S$ bits of each OFDM symbol, S bits from the output of the encoder are divided among all spatial streams, s bits per stream.

Note that in all the different RU sizes, $N_{CBPS} = N_{\text{Block}}.S$, therefore the coded bits of each OFDM symbol are always evenly allocated to *Nss* spatial streams.

The following equations are an equivalent description to the above procedure. Bit i at the output of the encoder is assigned to input bit k of spatial stream i_{SS} where

$$i = (i_{SS} - 1)s + S \cdot \left\lfloor \frac{k}{s} \right\rfloor + k \bmod s, \quad k = 0,1,\ldots, N_{Block} \cdot s - 1$$

where

$i_{SS} = 1,\ 2,\ \ldots,\ N_{SS}$

$i = 0,\ 1,\ \ldots,\ N_{CBPS} - 1$

$k = 0,\ 1,\ \ldots,\ N_{CBPS} - 1$

26.3.10.5 Segment parser

For a 160 MHz and 80+80 MHz HE SU PPDU, a 160 MHz and 80+80 MHz HE MU PPDU, and a HE trigger-based PPDU with the RU spanning the entire PPDU bandwidth, the output bits of each stream parser are segment parsed as specified in 22.3.10.7.

26.3.10.6 BCC interleavers

There is some duplication here. I think we need to delete the Table 25-24 and its reference sentence.

The BCC interleaver parameters are defined in Table 26-24.

Table 26-24 - BCC interleaver and LDPC tone mapper parameters

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

For ease of explanation, the operation of the interleaver is described only for the SU case. For user *u* in the *r*-th RU of an MU transmission, the interleaver operates in the same way on the output bits for the user from the stream parser by replacing N_{SS}, N_{CBPSS}, N_{CBPSSI}, and N_{BPSCS} with $N_{SS,r,u}$, $N_{CBPSS,r,u}$, $N_{CBPSSI,r,u}$, and $N_{BPSCS,r,u}$, respectively. That is, the operation of the interleaver is the same as if the transmission were an SU one, consisting of bits from only that user.

The BCC interleaver operation is specified in 22.3.10.8 (BCC interleaver). The values of the interleaver parameters, N_{COL}, N_{ROW}, and N_{ROT} are selected based on the RU size of the user, and are given in Table 26-25.

Table 26-25 - BCC interleaver parameters

Parameter	RU Size (tones)			
	26	52	106	242
N_{COL}	8	16	17	26
N_{ROW}	$3 \times N_{BPSCS}$	$3 \times N_{BPSCS}$	$6 \times N_{BPSCS}$	$9 \times N_{BPSCS}$
N_{ROT} ($N_{SS} \leq 4$)	2	11	29	58

26.3.10.7 Constellation mapping

The mapping between the input bits of the constellation mapper and complex constellation points for BPSK, QPSK, 16-QAM, 64-QAM and 256-QAM is as defined in 22.3.10.9 (constellation mapping).

1024-QAM is used as an optional feature for SU and MU using resource units equal to or larger than 242 tones in 11ax. For 1024-QAM, the constellation mapping is TBD.

Dual sub-carrier modulation (DCM) is an optional modulation scheme for the HE-SIG-B and Data fields. DCM is only applied to BPSK, QPSK and 16-QAM modulations.

When DCM is employed, bit sequences are mapped to a pair symbols $(d_k, d_{q(k)})$ where k is in the range of $0 \leq k \leq \frac{N_{SD}}{2} - 1$ and $q(k)$ is in the range of $\frac{N_{SD}}{2} \leq k \leq N_{SD} - 1$ in order to exploit frequency diversity.

To maximize the frequency diversity, the indices of a pair of DCM subcarriers $(k, q(k))$ is $q(k) = k + \frac{N_{SD}}{2}$.

For QPSK modulation with DCM, the input stream is broken into groups of N_{CBPS} *or* $N_{CBPS,ru}$ bits $(B_0, B_1, \cdots, B_{N_{CBPS,ru}-1})$. Each pair of bits (B_{2k}, B_{2k+1}) is QPSK modulated to a symbol d_k. This generates the constellation points for the lower half the data subcarriers in the RU. For the upper half of the data sub-carriers in the RU, $d_{q(k)} = conj(d_k)$.

For BPSK and 16-QAM modulation with DCM, the constellation mapping is TBD.

26.3.10.8 Space-time block coding

This subclause defines a set of optional robust transmission techniques that are applicable only when using STBC coding. For an HE PPDU, STBC is allowed only with single spatial stream and two space-time streams, and its application is as indicated by the STBC bit in HE-SIG-A (TBD: undecided whether in HE-SIG-A for HE_MU). In an HE MU PPDU, STBC coding is used in all RUs or not used in any of the RUs. If in an RU, DL MU-MIMO is applied, STBC shall not be used in any RU in the HE MU PPDU.

The STBC encoding process is as described in clause 22.3.10.9.4 (Space-time block coding), with $N_{SS,0} = 1$ and $N_{STS,0} = 2$.

26.3.10.9 LDPC tone mapper

The LDPC tone mapper parameters are defined in Table 26-24.

The LDPC tone mapping shall be performed on all LDPC encoded streams mapped in a RU as described in this subclause. LDPC tone mapping shall not be performed on streams that are encoded using BCC. When DCM is applied to LDPC encoded streams, D_{TM_DCM} shall be applied on both the lower half data subcarriers in a RU and the upper half data subcarriers of the RU. The LDPC tone-mapping distance parameter D_{TM} and D_{TM_DCM} are constant for each RU size and the values for different RU sizes are given in Table 26-26.

Table 26-26 – LDPC tone mapping distance for each RU size

Parameter	RU Size (tones)						
	26	52	106	242	484	996	2x996
D_{TM}	1	3	6	9	12	20	20
D_{TM_DCM}	1	1	3	9	9	14	20

For an HE PPDU without DCM, the LDPC tone mapping for the LDPC encoded stream for user *u* in the *r*-th RU is done by permuting the stream of complex numbers generated by the constellation mappers (see 26.3.10.7) to

$$d''_{t(k),i,n,l,r,u} = d'_{k,i,n,l,r,u};\ \begin{aligned} &k = 0,1,...,N_{SD}-1 \text{ for a RU of 26, 52, 106, 242, 484, and 996 tones} \\ &k = 0,1,...,\frac{N_{SD}}{2}-1 \text{ for a RU of } 996\times 2 \text{ to}nes \\ &i = 1,\ldots,N_{SS,r,u} \\ &n = 0,1,\ldots,N_{SYM}-1 \\ &l = 0 \text{ for a RU of 26, 52, 106, 242, 494, and 996 tones} \\ &l = 0,1 \text{ for a RU of } 996\times 2 \text{ tones} \\ &u = 0,\ldots,N_{user,r}-1 \\ &r = 0,\ldots,N_{RU}-1 \end{aligned} \quad \textbf{(26-96)}$$

where N_{SD} *i*s the number of data tones in the *r*-th RU.

$$t(k) = \begin{cases} D_{TM}\left(k \bmod \frac{N_{SD}}{D_{TM}}\right) + \left\lfloor \frac{k \cdot D_{TM}}{N_{SD}} \right\rfloor, & \text{for a RU of 26, 52, 106, 242, 484, and 996 tones} \\ D_{TM}\left(k \bmod \frac{N_{SD}/2}{D_{TM}}\right) + \left\lfloor \frac{k \cdot D_{TM}}{N_{SD}/2} \right\rfloor, & \text{for a RU of } 996\times 2 \text{ tones} \end{cases} \quad \textbf{(26-97)}$$

For a HE PPDU with DCM, the LDPC tone mapping for the LDPC encoded stream corresponding to user *u* in the *r*-th RU is done by permuting the stream of complex numbers generated by the constellation mappers (see 25.3.10.7) to

$$d''_{t(k),i,n,l,r,u} = \begin{cases} d'_{k,i,n,l,r,u}; \\ d'_{k',i,n,l,r,u}; \end{cases} \quad \textbf{(26-98)}$$

where

$k = 0,1,...,\frac{N_{SD}}{2} - 1$

$k^{'} = k - \frac{N_{SD}}{2}, for\, k = \frac{N_{SD}}{2}, \frac{N_{SD}}{2} + 1, ..., N_{SD}\text{-}1$

$i = 1,\ldots, N_{SS,r,u}$

$n = 0,1,\ldots, N_{SYM} - 1$

$l = 0$ for a RU of 26, 52, 106, 242, 494, and 996 tones

$l = 0,1$ for a RU of 996×2 tones

$u = 0,\ldots, N_{user,r} - 1$

$r = 0,\ldots, N_{RU} - 1$

N_{SD} is the number of data tones in the r-th RU and

$$t(k) = \begin{cases} D_{TM\_DCM}\left(k \bmod \frac{N_{SD}/2}{D_{TM\_DCM}} \right) + \left\lfloor \frac{k \cdot D_{TM\_DCM}}{N_{SD}/2} \right\rfloor, & \text{for a RU of 26, 52, 106, 242, 484, and 996 tones} \\ D_{TM\_DCM}\left(k^{'} \bmod \frac{N_{SD}/2}{D_{TM\_DCM}} \right) + \left\lfloor \frac{k^{'} \cdot D_{TM\_DCM}}{N_{SD}/2} \right\rfloor + \frac{N_{SD}}{2}, & \text{for a RU of 26, 52, 106, 242, 484, and 996 tones} \\ D_{TM\_DCM}\left(k \bmod \frac{N_{SD}/2}{D_{TM\_DCM}} \right) + \left\lfloor \frac{k \cdot D_{TM\_DCM}}{N_{SD}/2} \right\rfloor, & \text{for a RU of } 996 \times 2 \text{ tones} \end{cases} \quad \textbf{(26-99)}$$

D_{TM_DCM} is the LDPC tone mapping distance for the r-th RU when DCM is applied.

NOTE—LDPC tone mapper for a 26-, 52-, 106-, 242-, 484- and 996-tone RU is defined as one segement. LDPC tone mapping is performed separately for the upper and lower 80 MHz frequency segments of a 2x996-tone RU as indicated by the frequency subblock index l in Error! Reference source not found. and Error! Reference source not found.

Since LDPC tone apping is not performed on BCC-coded streams, for BCC-coded streams, the following applies:

$$d''_{k,i,n,l,r,u} = d'_{k,i,n,l,r,u};\ k = 0,1,...,N_{SD} - 1 \text{ for a RU of 26, 52, 106, 242, 484, and 996 tones}$$
$$k = 0,1,...,\frac{N_{SD}}{2} - 1 \text{ for a RU of } 996 \times 2 \text{ to}nes$$
$$i = 1,\ldots, N_{SS,r,u}$$
$$n = 0,1,\ldots, N_{SYM} - 1 \quad \textbf{(26-100)}$$
$$l = 0 \text{ for a RU of 26, 52, 106, 242, 494, and 996 tones}$$
$$l = 0,1 \text{ for a RU of } 996 \times 2 \text{ tones}$$
$$u = 0,\ldots, N_{user,r} - 1$$
$$r = 0,\ldots, N_{RU} - 1$$

26.3.10.10 Segment deparser

In a transmission over a RU of 26, 52, 106, 242, 484 and 996 subcarriers, the segment deparsing is not performed (see Equation (22-90)).

For a 160 MHz HE SU PPDU, or a 160 MHz HE MU PPDU or HE trigger-based PPDU with the RU spanning the entire PPDU bandwidth, the two frequency subblocks at the output of the LDPC tone mapper are combined into one frequency segment as specified in Equation (22-89).

In an 80+80 MHz HE PPDU transmission, the segment deparsing is not performed (see Equation (22-91)).

26.3.10.11 Pilot subcarriers

For a user transmitting on the *i*-th 26-tone RU in a given PPDU BW, two pilot tones shall be inserted in subcarriers $k \in K_{R26_i}$, where K_{R26_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-27.

Table 26-27 - Pilot indices for 26-tone RU transmission

PPDU BW	K_{R26_i}
20 MHz, i=1:9	-116/-102, -90/-76, -62/-48, -36/-22, -10/10, 22/36, 48/62, 76/90, 102/116
40 MHz, i=1:18	-238/-224, -212/-198, -184/-170, -158/-144, -130/-116, -104/-90, -78/-64, -50/-36, -24/-10, 10/24, 36/50, 64/78, 90/104, 116/130, 144/158, 170/184, 198/212, 224/238
80 MHz, i=1:37	-494/-480, -468/-454, -440/-426, -414/-400, -386/-372, -360/-346, -334/-320, -306/-292, -280/-266, -252/-238, -226/-212, -198/-184, -172/-158, -144/-130, -118/-104, -92/-78, -64/-50, -38/-24, -10/10, 24/38, 50/64, 78/92, 104/118, 130/144, 158/172, 184/198, 212/226, 238/252, 266/280, 292/306, 320/334, 346/360, 372/386, 400/414, 426/440, 454/468, 480/494
160 MHz, i=1:74	{pilot tone indices in 80 MHz -512, pilot tone indices in 80 MHz +512}

The pilot mapping $\boldsymbol{P_n^k}$ for subcarrier *k* for symbol *n* shall be as specified in Equation (26-101).

$$P_n^{K_{\mathrm{R26}_i}} = \{\Psi_{i,n \bmod 2}, \Psi_{i,(n+1) \bmod 2}\}$$
$$P_n^{k \notin K_{\mathrm{R26}_i}} = 0 \qquad \textbf{(26-101)}$$

where

$\Psi_{i,m}$ is TBD for Pilot values for *i*-th 26-tone RU in a given PPDU BW.

For a user transmitting on the *i*-th 52-tone RU in a given PPDU BW, four pilot tones shall be inserted in subcarriers $k \in K_{R52_i}$, where K_{R52_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-28.

Table 26-28 - Pilot indices for 52-tone RU transmission

PPDU BW	K_{R52_i}
20 MHz, i=1:4	-116/-102/-90/-76, -62/-48/-36/-22, 22/36/48/62, 76/90/102/116
40 MHz, i=1:8	-238/-224/-212/-198, -184/-170/-158/-144, -104/-90/-78/-64, -50/-36/-24/-10, 10/24/36/50, 64/78/90/104, 144/158/170/184, 198/212/224/238
80 MHz, i=1:16	-494/-480/-468/-454, -440/-426/-414/-400, -360/-346/-334/-320, -306/-292/-280/-266, -252/-238/-226/-212, -198/-184/-172/-158, -118/-104/-92/-78, -64/-50/-38/-24, 24/38/50/64, 78/92/104/118, 158/172/184/198, 212/226/238/252, 266/280/292/306, 320/334/346/360, 400/414/426/440, 454/468/480/494
160 MHz, i=1:32	{pilot tone indices in 80 MHz -512, pilot tone indices in 80 MHz +512}

The pilot mapping $\boldsymbol{P_n^k}$ for subcarrier *k* for symbol *n* shall be as specified in Equation (26-102).

$$P_n^{K_{\mathrm{R52}_i}} = \{\Psi_{i,n \bmod 4}, \Psi_{i,(n+1) \bmod 4}, \Psi_{i,(n+2) \bmod 4}, \Psi_{i,(n+3) \bmod 4}\}$$
$$P_n^{k \notin K_{\mathrm{R52}_i}} = 0 \qquad \textbf{(26-102)}$$

where

$\Psi_{i,m}$ is TBD for Pilot values for *i*-th 52-tone RU in a given PPDU BW.

For a user transmitting on the *i*-th 106-tone RU in a given PPDU BW, four pilot tones shall be inserted in subcarriers $k \in K_{R106_i}$, where K_{R106_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-29.

Table 26-29 - Pilot indices for 106-tone RU transmission

PPDU BW	K_{R106_i}
20 MHz, i=1:2	-116/-90/-48/-22, 22/48/90/116
40 MHz, i=1:4	-238/-212/-170/-144, -104/-78/-36/-10, 10/36/78/104, 144/170/212/238
80 MHz, i=1:8	-494/-468/-426/-400, -360/-334/-292/-266, -252/-226/-184/-158, -118/-92/-50/-24, 24/50/92/118, 158/184/226/252, 266/292/334/360, 400/426/468/494
160 MHz, i=1:16	{pilot tone indices in 80MHz -512, pilot tone indices in 80MHz +512}

The pilot mapping $\boldsymbol{P_n^k}$ for subcarrier k for symbol n shall be as specified in Equation (26-103).

$$P_n^{K_{\mathrm{R106}_i}} = \{\Psi_{i,n \bmod 4}, \Psi_{i,(n+1) \bmod 4}, \Psi_{i,(n+2) \bmod 4}, \Psi_{i,(n+3) \bmod 4}\}\}$$
$$P_n^{k \notin K_{\mathrm{R106}_i}} = 0 \quad \textbf{(26-103)}$$

where

$\Psi_{i,m}$ is TBD for Pilot values for i-th 106-tone RU in a given PPDU BW.

For a user transmitting on the i-th 242-tone RU in a given PPDU BW, eight pilot tones shall be inserted in subcarriers $k \in K_{R242_i}$, where K_{R242_i} is given by i-th pilot index set in the row of given PPDU BW of Table 26-30.

Table 26-30 - Pilot indices for 242-tone RU transmission

PPDU BW	K_{R242_i}
20 MHz, i=1	-116/-90/-48/-22/22/48/90/116
40 MHz, i=1:2	-238/-212/-170/-144/-104/-78/-36/-10, 10/36/78/104/144/170/212/238
80 MHz, i=1:4	-494/-468/-426/-400/-360/-334/-292/-266,-252/-226/-184/-158/-118/-92/-50/-24, 24/50/92/118/158/184/226/252, 266/292/334/360/ 400/426/468/494
160 MHz, i=1:8	{pilot tone indices in 80 MHz -512, pilot tone indices in 80 MHz +512}

The pilot mapping $\boldsymbol{P_n^k}$ for subcarrier k for symbol n shall be as specified in Equation (26-104).

$$P_n^{K_{\mathrm{R242}_i}} = \{\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}\}$$
$$P_n^{k \notin K_{\mathrm{R242}_i}} = 0 \quad \textbf{(26-104)}$$

where

$\Psi_{i,m}$ is TBD for Pilot values for i-th 242-tone RU in a given PPDU BW.

For a user transmitting on the i-th 484-tone RU in a given PPDU BW, sixteen pilot tones shall be inserted in subcarriers $k \in K_{R484_i}$, where K_{R484_i} is given by i-th pilot index set in the row of given PPDU BW of Table 26-31.

Table 26-31 - Pilot indices for 484-tone RU transmission

PPDU BW	K_{R484_i}
20 MHz	N/A
40 MHz, i=1	-238/-212/-170/-144/-104/-78/-36/-10/10/36/78/104/144/170/212/238
80 MHz, i=1:2	-494/-468/-426/-400/-360/-334/-292/-266/-252/-226/-184/-158/-118/-92/-50/-24, 24/50/92/118/158/184/226/252/266/292/334/360/400/426/468/494
160 MHz, i=1:4	{pilot tone indices in 80 MHz -512, pilot tone indices in 80 MHz +512}

The pilot mapping $\boldsymbol{P_n^k}$ for subcarrier k for symbol n shall be as specified in Equation (26-105).

$$P_n^{K_{\mathrm{R484}_i}} = \{\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}, \cdots$$
$$\Psi_{i,(n+8) \bmod 8}, \Psi_{i,(n+9) \bmod 8}, \Psi_{i,(n+10) \bmod 8}, \Psi_{i,(n+11) \bmod 8}, \Psi_{i,(n+12) \bmod 8}, \Psi_{i,(n+13) \bmod 8}, \Psi_{i,(n+14) \bmod 8}, \Psi_{i,(n+15) \bmod 8}\} \quad \textbf{(26-105)}$$
$$P_n^{k \notin K_{\mathrm{R484}_i}} = 0$$

where

$\Psi_{i,m}$ is TBD for Pilot values for *i*-th 484-tone RU in a given PPDU BW.

For a user transmitting on the *i*-th 996-tone RU in a given PPDU BW, sixteen pilot tones shall be inserted in subcarriers $k \in K_{R996_i}$, where K_{R996_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-32.

Table 26-32 - Pilot indices for 996-tone RU transmission

PPDU BW	K_{R996_i}
20 MHz	N/A
40 MHz	N/A
80 MHz, i=1	-468/-400/-334/-266/-226/-158/-92/-24/24/92/158/226/266/334/400/468
160 MHz, i=1:2	{pilot tone indices in 80 MHz -512, pilot tone indices in 80 MHz +512}: -980/-912/-846/-778/-738/-670/-604/-536/-488/-420/-354/-286/-246/-178/-112/-44, 44/112/178/246/286/354/420/488/536/604/670/738/778/846/912/980

The pilot mapping $\boldsymbol{P_n^k}$ for subcarrier *k* for symbol *n* shall be as specified in Equation (26-106).

$$P_n^{K_{\mathrm{R996}_i}} = \{\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}, \cdots$$
$$\Psi_{i,(n+8) \bmod 8}, \Psi_{i,(n+9) \bmod 8}, \Psi_{i,(n+10) \bmod 8}, \Psi_{i,(n+11) \bmod 8}, \Psi_{i,(n+12) \bmod 8}, \Psi_{i,(n+13) \bmod 8}, \Psi_{i,(n+14) \bmod 8}, \Psi_{i,(n+15) \bmod 8}\} \quad \textbf{(26-106)}$$
$$P_n^{k \notin K_{\mathrm{R996}_i}} = 0$$

where

$\Psi_{i,m}$ is TBD for Pilot values for 996-tone RU in 80 MHz PPDU BW.

For a 160 MHz transmission, the 80 MHz pilot mapping is replicated in the two 80 MHz subchannels of the 160 MHz transmission. Specifically, thirty-two pilot tones shall be inserted in subcarriers $k \in K_{\mathrm{R2x996}}$, where $K_{R2\times996}$ is given by {-980, -912, -846, -778, -738, -670, -604, -536, -488, -420, -354, -286, -246, -178, -112, -44, 44, 112, 178, 246, 286, 354, 420, 488, 536, 604, 670, 738, 778, 846, 912, 980}. The pilot mapping $\boldsymbol{P_n^k}$ for subcarrier *k* for symbol *n* shall be as specified in Equation (26-107) .

$$P_n^{K_{\mathrm{R2x996}}} = \{\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}, \cdots$$
$$\Psi_{i,(n+8) \bmod 8}, \Psi_{i,(n+9) \bmod 8}, \Psi_{i,(n+10) \bmod 8}, \Psi_{i,(n+11) \bmod 8}, \Psi_{i,(n+12) \bmod 8}, \Psi_{i,(n+13) \bmod 8}, \Psi_{i,(n+14) \bmod 8}, \Psi_{i,(n+15) \bmod 8}, \cdots$$
$$\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}, \cdots$$
$$\Psi_{i,(n+8) \bmod 8}, \Psi_{i,(n+9) \bmod 8}, \Psi_{i,(n+10) \bmod 8}, \Psi_{i,(n+11) \bmod 8}, \Psi_{i,(n+12) \bmod 8}, \Psi_{i,(n+13) \bmod 8}, \Psi_{i,(n+14) \bmod 8}, \Psi_{i,(n+15) \bmod 8}\} \quad \textbf{(26-107)}$$
$$P_n^{k \notin K_{\mathrm{R2x996}}} = 0$$

where

$\Psi_{i,m}$ is TBD for Pilot values for 996-tone RU in 80 MHz PPDU BW.

For a noncontiguous 80+80 MHz transmission, each frequency segment shall follow the 80 MHz pilot tone allocation and values defined for 996-tone RU in 80 MHz transmission as specified in Equation (26-106) and TBD Pilot values for 996-tone RU in 80 MHz PPDU BW.

The above pilot mapping shall be copied to all space-time streams before the space-time stream cyclic shifts are applied.

26.3.10.12 OFDM Modulation

The time domain waveform of the Data field of an HE PPDU that is not an HE trigger-based PPDU, from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$, shall be as defined in Equation (26-108).

$$r_{\text{HE-Data}}^{(i_{seg},i_{TX})}(t) = \frac{1}{\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|}} \sum_{n=0}^{N_{SYM}-1} w_{T_{HE-Data}}(t - nT_{SYM}) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r}{\sqrt{N_{STS,r,total}}} \cdot \sum_{k \in K_r} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left(\begin{array}{l} \left[Q_k^{(i_{seg})} \right]_{i_{TX},(M_{r,u}+m)} \left(\tilde{D}_{k,m,n,r}^{(i_{Seg},u)} + p_{n+2+N_{HE-SIG-A}+N_{HE-SIG-B}} P_n^k \right) \\ \cdot \exp\left(j2\pi k \Delta_{F,HE} \left(t - nT_{SYM} - T_{\text{GI,Data}} - T_{CS,HE}(M_{r,u}+m) \right) \right) \end{array} \right) \quad \textbf{(26-108)}$$

where

p_n is defined in 18.3.5.10 (OFDM modulation)

P_n^k is defined in **Error! Reference source not found.**

$\tilde{D}_{k,m,n,BW}^{(i_{Seg},r,u)}$ is the transmitted constellation for user u in the r-th RU at subcarrier k, space-time stream m, and Data field OFDM symbol n and is defined in **Error! Reference source not found.**.

$N_{\text{HE-Data}}^{\text{Tone}}$ has the value given in **Error! Reference source not found.**

$T_{CS,HE}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$T_{\text{GI, Data}}$ is the guard interval duration as defined in Table 25-xxx (Timing related constants) of 25.3.6 (Timing related parameters).

$$\tilde{D}_{k,m,n,r}^{(i_{Seg},u)} = \begin{cases} 0, k \in K_{\text{Pilot}} \\ \tilde{d}_{M_r(k),m,n,r,u}^{(i_{Seg})}, \text{otherwise} \end{cases} \quad \textbf{(26-109)}$$

where

K_{Pilot} is the set of subcarrier indices of pilot tones, as defined in 25.3.7.3 (Pilot tones).

$M_r(k)$ is defined in Equation (26-110).

$$M_r(k) = k - K_{r,\min} - \left| \left\{ k' : K_{r,\min} \le k' < k \right\} \cap K_{\text{Pilot}} \right| \quad \textbf{(26-110)}$$

where

$K_{r,\min}$ is the minimum value of the set K_r;

$|\Phi|$ is the cardinality of a set Φ.

NOTE – $M_r(k)$ translates a subcarrier index k ($-N_{SR} \le k \le N_{SR}$) into the index of data symbols in a transmission over a RU ($0 \le M_r(k) \le N_{SD,r}$). The subcarrier index k for the data tone is first offset by the minimum value of subcarrier index $K_{r,min}$ (for the lower edge tone) in this RU, and then subtracted by the number of pilot tones falling in between the data tone and the edge tone.

In a noncontiguous 80+80 MHz transmission, each frequency segment shall follow the 80 MHz HE subcarrier mapping as specified in 26.3.7 (OFDMA and SU tone allocation).

The time domain waveform of the Data field of an HE trigger-based PPDU for user u in the r-th RU from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$ shall be as defined in Equation (26-111).

$$r_{\text{HE-Data}}^{(i_{seg},i_{TX})}(t) = \frac{\alpha_r}{\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|}} \sum_{n=0}^{N_{SYM}-1} w_{T_{HE-Data}}(t - nT_{SYM}) \frac{1}{\sqrt{N_{STS,r,total}}} \cdot \sum_{k \in K_r} \sum_{m=1}^{N_{STS,r,u}} \left(\left[Q_k^{(i_{seg})} \right]_{i_{TX},(M_{r,u}+m)} \left(\tilde{D}_{k,m,n,r}^{(i_{Seg},u)} + p_{n+4} P_n^k \right) \cdot \exp\left(j2\pi k \Delta_{F,HE} \left(t - nT_{SYM} - T_{\text{GI,Data}} - T_{CS,HE}(M_{r,u}+m) \right) \right) \right) \quad \text{(26-111)}$$

where

$Q_k^{(i_{Seg})}$ is a spatial mapping/steering matrix with N_{TX} rows and $N_{STS,r,total}$ columns for subcarrier k in frequency segment i_{Seg}. $Q_k^{(i_{Seg})}$ may be frequency dependent, and the dimension may be variant in each RU. Refer to the descriptions in 22.3.10.11.1 (Transmission in VHT format) for examples of $Q_k^{(i_{Seg})}$.

26.3.10.13 Dual carrier modulation

Dual sub-carrier modulation (DCM) modulates the same information on a pair of sub-carriers. DCM is an optional modulation scheme for the HE-SIG-B and Data fields. DCM is only applied to BPSK, QPSK and 16-QAM modulations.

The constellation mapper for DCM is defined in 25.3.10.6. The DCM tone mapper is TBD.

26.3.10.14 Packet extension

A HE PPDU may have a Packet Extension (PE) field appended at the end of the PPDU, with possible durations being 0 µs, 4 µs, 8 µs, 12 µs, or 16 µs. The PE field, when present, shall be transmitted with the same average power as the Data field, and its content is arbitrary (PE content TBD).

The PE field is applied for the recipient of the PPDU to obtain longer processing time at the end of a HE PPDU, and its duration is determined by both the *a-factor* value in the last OFDM symbol(s) of the Data field, and the maximum PE duration requested by the recipient for the signal bandwidth (or RU size), the number of spatial streams, and the constellation size of the current PPDU, which is based on the Maximum PE capabilities as defined in HE capabilities field (8.4.2.1 (HE Capabilities Element)).

For a HE PPDU, the maximum PE durations as defined by the Maximum PE capabilities in HE capabilities (8.4.2.1 (HE Capabilities Element)) are 0 µs, 8 µs and 16 µs.

— A 0 µs maximum PE duration means no PE is present.

— A 8 µs maximum PE duration means that a PE field of 0 µs, 0 µs, 4 µs, and 8 µs are appended at the end of the PPDU, corresponding to *a-factor* being 1, 2, 3 and 4, respectively, as shown in Figure 25.3.10.9-1 (PE field when maximum PE duration is 8 µs (non STBC)).

— A 16 µs maximum PE duration means that a PE field of 4 µs, 8 µs, 12 µs, and 16 µs are appended at the end of the PPDU, corresponding to *a-factor* being 1, 2, 3 and 4, respectively, as shown in Figure 25.3.10.9-2 (PE field when maximum PE duration is 16 µs (non STBC)).

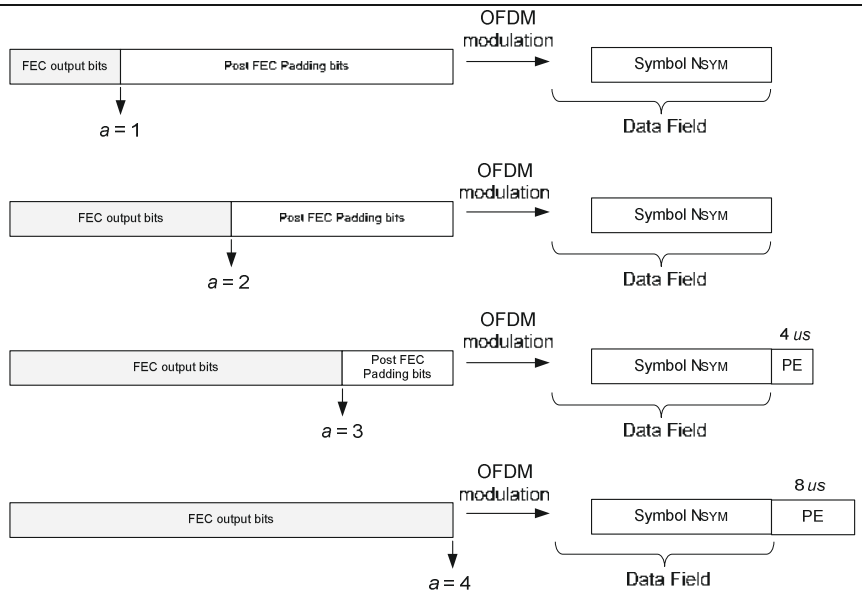


Figure 26-34 - PE field when maximum PE duration is 8 μs (non STBC)

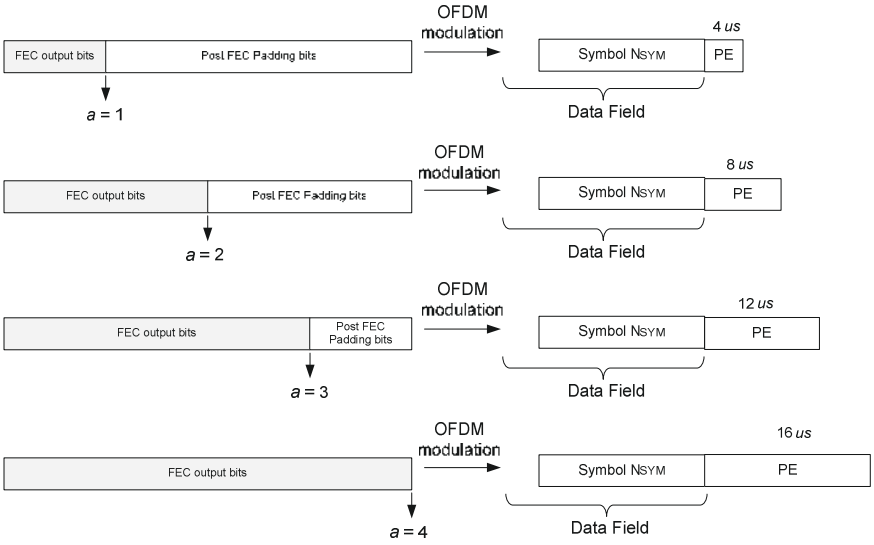


Figure 26-35 - PE field when maximum PE duration is 16 μs (non STBC)

For an HE MU PPDU, the AP computes the PE duration, $T_{PE,u}$, for each user u, according to the common *a-factor* value among all users as described in 26.3.10.3.4, the Maximum PE Duration capabilities, the RU size, the number of spatial streams and constellation size for user u. The AP shall choose the largest PE duration among all the users as the common PE duration of the current HE MU PPDU as:

$$T_{PE} = \max_{u}\left(T_{PE,u}\right) \quad \textbf{(26-112)}$$

and then append the PE field at the end of the current HE MU PPDU, with duration T_{PE}.

For an HE trigger-based PPDU, the AP indicates the common PE duration, T_{PE}, for all the users in the Trigger frame. Each user, when responding the Trigger frame with an HE trigger-based PPDU, shall append PE field at the end of the current HE trigger-based PPDU, with a duration T_{PE}. The value of T_{PE} is TBD.

Should the HE-SIG-A bits definition below be moved into 25.3.9.2.4 (HE-SIG-A)?

The 3-bit Packet Extension field in HE-SIG-A are defined as in Table 26-33.

Table 26-33 - Packet Extension field in HE-SIG-A

Name	bits	Definition
a-factor	b0-b1	Indicates a-factor value of current PPDU
PE Disambiguity	b2	Indicates PE disambiguity

The a-factor subfield of the Packet Extension field is encoded as shown in Table 26-34.

Table 26-34 - a-factor subfield encoding

a-factor value	a-factor subfield encoding
1	b01
2	b10
3	b11
4	b00

The PE Disabmbituity subfield of the Packet Extension field shall be set to 1 if the condition in Equation (26-113) is met, otherwise it shall be set to 0.

$$T_{PE} + 4 \times \left(\left\lceil \frac{TXTIME - 20}{4} \right\rceil - \left(\frac{TXTIME - 20}{4} \right) \right) \geq T_{SYM} \qquad \textbf{(26-113)}$$

where

T_{PE} is the PE field duration

T_{SYM} is the symbol duration of the Data field as defined in 26.3.6 (Timing related parameters)

TXTIME (in µs) is defined in 26.4.3.

Based on PE disambiguity field and a-factor field, the recipient shall compute N_{SYM} and T_{PE} listed in 26.3.15.

26.3.11 Non-HT Duplicate Transmission

When the TXVECTOR parameter FORMAT is NON_HT and the TXVECTOR parameter NON_HT_MODULATION is NON_HT_DUP_OFDM, the transmitted PPDU is a non-HT duplicate. Non-HT duplicate transmission is used to transmit to non-HT OFDM STAs, HT STAs, VHT STAs, HE STAs that may be present in a part of a 40 MHz, 80 MHz, or 160 MHz channel (see **Error! Reference source not found.**). The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, and HE-LTF fields are not transmitted. The L-STF, L-LTF, and L-SIG fields shall be transmitted in the same way as in the HE transmission when the TXVECTOR parameter BEAM_CHANGE is 0, with the exceptions for the Rate and Length fields which shall follow 18.3.4 (SIGNAL field).

In a 40 MHz non-HT duplicate transmission, the Data field shall be as defined by Equation (20-61).

For 80 MHz and 160 MHz non-HT duplicate transmissions, the Data field shall be as defined by **Error! Reference source not found.**.

In a noncontiguous 80+80 MHz non-HT duplicate transmission, data transmission in each frequency segment shall be as defined for an 80 MHz non-HT duplicate transmission in **Error! Reference source not found.**.

26.3.12 MU-MIMO

26.3.12.1 Introduction

DL MU MIMO is specified in 22.3.11 for full band transmission. In this amendment, MU-MIMO is also applicable on a subset of active RUs within PPDU bandwidth in both DL and UL. The non-AP STAs in the

same MU-MIMO group are allocated the same resource unit. The combination of SU-MIMO and MU-MIMO on different RU for different non-AP STA in one PPDU is supported.

26.3.12.2 Minimum RU size in MU MIMO transmission

Both DL and UL MU MIMO shall transmit on the RU of at least 106 tones.

26.3.12.3 DL MU-MIMO

26.3.12.3.1 Introduction

For DL MU-MIMO beamforming in RU r, the receive signal vector in subcarrier k (where subcarrier k is one of the subcarriers in RU r, $k \in K_r$) at beamformee u, $\boldsymbol{y}_{k,u} = \left[y_{k,0}, y_{k,1}, \cdots, y_{k,N_{RX_u}-1}\right]^T$, is shown in Equation (26-114), where $\boldsymbol{x}_k = \left[\boldsymbol{x}_{k,0}^T, \boldsymbol{x}_{k,1}^T, \cdots, \boldsymbol{x}_{k,N_{user,r}-1}^T\right]^T$ denotes the transmit signal vector in subcarrier k for all N_{user} beamformees, with $\boldsymbol{x}_{k,u} = \left[x_{k,0}, x_{k,1}, \cdots, x_{k,N_{STS,r,u}-1}\right]^T$ being the transmit signal for beamformee u.

$$\boldsymbol{y}_{k,u} = \boldsymbol{H}_{k,u} \times \left[Q_{k,0}, Q_{k,1}, \cdots, Q_{k,N_{user}-1}\right] \times \boldsymbol{x}_k + \boldsymbol{n} \quad \textbf{(26-114)}$$

where

$\boldsymbol{H}_{k,u}$ is the channel matrix from the beamformer to beamformee u in subcarrier k with dimensions $N_{RX_u} \times N_{TX}$

N_{RX_u} is the number of receive antennas at beamformee u

$Q_{k,u}$ is a steering matrix for beamformee u in subcarrier k with dimensions $N_{TX} \times N_{STS,r,u}$

$N_{user,r}$ is the number of HE MU PPDU recipients in RU r (see Table 26-6)

$\boldsymbol{n}$ is a vector of additive noise and may include interference

The DL MU-MIMO steering matrix $Q_k = \left[Q_{k,0}, Q_{k,1}, \cdots, Q_{k,N_{user,r}-1}\right]$ can be determined by the beamformer using the beamforming feedback for subcarrier k from beamformee u, where $u = 0,1,\cdots,N_{user,r}-1$. The feedback report format is TBD. The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL MU-MIMO data transmission. The beamformee group for the DL MU transmission is signaled in HE-SIG-B (see 26.3.9.8.3 and 26.3.12.3.4).

26.3.12.3.2 Beamforming feedback

TBD

26.3.12.3.3 Maximum number of total spatial streams in a VHT MU PPDU

A DL MU-MIMO capable STA shall support reception of DL MU PPDUs with the total number of space-time streams across the N_user users being less than or equal to its DL MU-MIMO STS Capability in the HE Capabilities.

26.3.12.3.4 Resource indication and STA self identification

AP shall transmit HE MU PPDU. The UL/DL field in the HE-SIG-A shall be set TBD (for DL). If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and the number of STAs on each RU for SU/MU MIMO transmission. The number of users in RU r for MU-MIMO transmission, $N_{user,r}$ is indicated together with the RU allocation as defined in Table 26-18. If the value of SIGB Compression field in HE-SIG-A is 1, there is no RU allocation signaling in HE-SIG-B common field. The number of STAs in the

MU MIMO group is indicated in the TBD field in HE-SIG-A. the number of spatial streams $N_{ss,r,u}$ is indicated by NSTS field in user specific block as defined in Table 26-19 and Table 26-20.The allocated spatial streams for a designated MU MIMO user and the total number of spatial streams on the RU are indicated in spatial configuration field of user specific block containing the STA ID of designated MU MIMO STA as defined in Table 26-21.

When processing the HE-SIG-B, a STA will look at information of each RU to find out its Membership Status, i.e., if it belongs to a beamformee group in a certain RU. If $N_{user,r}$ STAs are scheduled in RU r, there are $N_{user,r}$ user specific blocks for RU r. Each user specific block has an 11-bit field indicating the STA ID. A STA identifies itself as a member in the beamformee group in the RU, if its STA ID matches one of the STA IDs. The user position is indicated by the block index. From a multiplexing information lookup table for $N_{user,r}$, the ordered number of spatial streams for all members in the beamformee group in RU r, $N_{ss,r,u}$, u=1,…, $N_{users,u}$, could be obtained. The spatial streams of different users are ordered in accordance to user position values, i.e., the spatial streams for the user in user position 0 come first, followed by the spatial streams for the user in position 1, followed by the spatial streams for the user in position 2, and followed by the spatial streams for the user in position 3, and so on.

A STA is also able to identify the space-time streams intended for other STAs that act as interference. HE-LTF symbols in the HE DL MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, it is recommended that the STA uses the channel knowledge for all space-time streams to reduce the effect of interfering space-time streams.

If a STA finds that it is a member of the beamformee group in RU r, its corresponding $N_{STS,r,u}$ interpreted from the HE-SIG-B user specific blocks shall not be zero for the STA in the PPDU. If a STA finds that it is not a member of the beamformee group in RU r, then the STA may elect not to process RU r in the remainder of the PPDU.

26.3.12.4 UL MU-MIMO

26.3.12.4.1 Introduction

UL MU-MIMO is a technique to allow multiple STAs to transmit simultaneously over the same frequency resource to the receiver. The concept is very similar to SU-MIMO where multiple space-time streams are transmitted simultaneously over the same frequency resource utilizing spatial multiplexing through multiple antennas at the transmitter and receiver. The key difference from SU-MIMO is that in UL MU-MIMO, the transmitted streams originate at multiple transmitters.

For UL MU-MIMO transmissions, support for both single stream pilots and the masking the LTF sequence of each spatial stream by a distinct orthogonal code is mandatory at the transmitter side (non-AP STA).

26.3.12.4.2 Resource Indication and STA Self Identification

UL MU-MIMO transmissions are preceded by a Trigger frame from the AP. Similar as UL OFDMA cases, the Trigger frame indicates the transmitting STAs in the common part about when to transmit the UL MU-MIMO PPDUs, the duration of the payload, and packet-extension. The CP length for UL OFDMA/MU-MIMO transmissions shall also be explicitly indicated by AP in the Trigger frame. The value of CP length for all users addressed by the Trigger frame shall be the same. The Trigger frame shall use 1 bit to indicate whether the UL MU-MIMO transmission following it uses single stream pilots or a mask on each spatial stream of the LTF sequence by a distinct orthogonal code. When single stream pilot is used, no masking is applied to the HE LTF. The allocated RU and spatial streams are carried in the fields of RU allocation info and SS allocation of Per User Info field, where Address field is set as the AID of designated MU MIMO STA. Details TBD.

If a STA finds that there is no Per User Info field in Trigger frame carrying the STA's AID in the Address field, then the STA will not transmit in the following HE trigger-based PPDU.

26.3.12.4.3 Pre-corrections in UL MU-MIMO

Since multiple transmitters take part in an UL MU-MIMO transmission, it requires time, frequency, sampling clock and power pre-correction by the participating STAs to mitigate the synchronization related issues at the AP. Frequency and sampling clock pre-corrections are needed to prevent inter-carrier interference. Power pre-correction is done through power control described in **Error! Reference source not found.**. The Trigger frame serves as a reference DL frame for the STAs to do the aforementioned pre-corrections to the UL PPDUs. The accuracy requirements on these pre-corrections are specified in section x.x.x.

26.3.12.4.4 Power control in UL MU-MIMO

TBD

26.3.12.4.5 Maximum number of spatial streams in UL MU-MIMO PPDUs

An UL MU-MIMO capable STA shall support transmission of UL MU PPDUs with the number of space-time streams being less than or equal to its UL MU-MIMO STS Capability in HE Capabilities.

26.3.12.4.6 Requirements for STAs transmitting HE trigger-based PPDUs

A STA that transmits an HE trigger-based PPDU shall support per chain max(*P*-32, -10 dBm) as the minimum transmit power, with *P* the maximum power the STA can transmit at the antenna connector of that chain using MCS0 while meeting the TX EVM and spectral mask requirements. A STA transmitting at and above the minimum power shall support the EVM requirements for MCS7 (TBD whether support for higher MCS).

A STA that transmits an HE trigger-based PPDU shall support the absolute transmit power requirements and the RSSI measurement accuracy requirements defined in Table 26-35.

Table 26-35 - Transmit power and RSSI measurement accuracy

Parameter	Minimum Requirement		Comments
	Class A	Class B	
Absolute transmit power accuracy	±3 dB	±9 dB	Accuracy of achieving a specified transmit power
RSSI measurement accuracy	±2 dB	±5 dB	Difference between the actual RSSI and the measured RSSI Requirements are valid from minimum Rx to maximum Rx input power

A STA that transmits an HE trigger-based PPDU shall pre-compensate for carrier frequency offset (CFO) error and timing drift. After compensation, the absolute value of residual CFO error with respect to the PPDU carrying the associated Trigger frame shall not exceed 350 Hz for data subcarriers when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of -60 dBm in the primary 20MHz. The residual CFO error measurement shall be made on the HE trigger-based PPDU following the HE-SIG-A field.

A STA that transmits an HE trigger-based PPDU shall have timing accuracy of ±0.4 μs relative to the PPDU carrying the Trigger frame. This requirement does not include round trip delay.

26.3.13 Transmit specification

26.3.13.1 Transmit spectral mask

26.3.13.2 Spectral flatness

26.3.13.3 Transmit center frequency and symbol clock frequency tolerance

Transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator.

26.3.13.4 Modulation accuracy

26.3.13.4.1 Introduction to modulation accuracy tests

26.3.13.4.2 Transmit center frequency leakage

The TX LO leakage requirement for all transmission modes shall be the following. The power measured at the location of the RF LO using resolution BW 78.125 kHz shall not exceed the maximum of –32 dB relative to the total transmit power and −20 dBm, or equivalently max(P−32, −20), where P is the transmit power per antenna in dBm. The transmit center frequency leakage is specified per antenna.

26.3.13.4.3 Transmitter constellation error

26.3.14 HE transmit procedure

TBD

26.3.15 HE receive procedure

TBD

26.4 HE PLME

26.4.1 PLME_SAP sublayer management primitives

Table 25-1 (HE PHY MIB attributes (11ax)) lists the MIB attributes that may be accessed by the PHY entities and the intralayer of higher level LMEs. These attributes are accessed via the PLME-GET, PLME-SET, PLME-RESET, and PLME-CHARACTERISTICS primitives defined in 6.5 (PLME SAP interface).

26.4.2 PHY MIB

TBD

26.4.3 TXTIME and PSDU_LENGTH calculation

The value of the TXTIME parameter returned by the PLME-TXTIME.confirm primitive shall be calculated for a HE PPDU using Equation (26-115) for an HE SU PPDU and HE trigger-based PPDU, Equation (26-116) for an HE MU PPDU and Equation (26-117) for an HE extended range SU PPDU.

$$\text{TXTIME} = T_{LEG\_PREAMBLE} + T_{L-SIG} + T_{RL-SIG} + T_{HE-SIG-A} + T_{HE\_PREAMBLE} + N_{SYM}T_{SYM} + T_{PE} \quad \textbf{(26-115)}$$

$$\text{TXTIME} = T_{LEG\_PREAMBLE} + T_{L-SIG} + T_{RL-SIG} + T_{HE-SIG-A} + N_{HE-SIG-B}T_{HE-SIG-B} + T_{HE\_PREAMBLE} + N_{SYM}T_{SYM} + T_{PE} \quad \textbf{(26-116)}$$

$$\text{TXTIME} = T_{LEG\_PREAMBLE} + T_{L-SIG} + T_{RL-SIG} + T_{HE-SIG-A} + T_{HE-SIG-A-R} + T_{HE\_PREAMBLE} + N_{SYM}T_{SYM} + T_{PE} \quad \textbf{(26-117)}$$

where

$T_{\text{LEG\_PREAMBLE}} = T_{\text{L-STF}} + T_{\text{L-LTF}}$

$$T_{\text{HE\_PREAMBLE}} = \begin{cases} T_{\text{HE-STF}-T} + N_{HELTF} T_{\text{HE-LTF,SYM}}, & \text{for the HE\_TRIG} \\ T_{\text{HE-STF}-NT} + N_{HELTF} T_{\text{HE-LTF,SYM}}, & \text{Otherwise} \end{cases}$$

$T_{\text{L-STF}}$, $T_{\text{L-LTF}}$, $T_{\text{HE-STF}-T}$, $T_{\text{HE-STF}-NT}$, $T_{\text{HE-LTF,SYM}}$, $T_{\text{L-SIG}}$, $T_{\text{RL-SIG}}$, $T_{\text{HE-SIG-A}}$, $T_{\text{HE-SIG-A-R}}$, $T_{\text{HE-SIG-B}}$ and T_{SYM} are defined in Table 26-3 (Timing-related constants)

$N_{HE-SIG-B}$ and N_{HE-LTF} are defined in Table 26-6 (Frequently used parameters)

For an HE NDP PPDU, there is no Data field and $N_{SYM} = 0$.

For an HE SU PPDU and HE extended range SU PPDU using BCC encoding, the total number of OFDM symbols in the Data field is given by Equation (26-118).

$$N_{SYM} = m_{\text{STBC}} \times \left\lceil \frac{8 \cdot \text{APEP\_LENGTH} + N_{service} + N_{tail} \cdot N_{ES}}{m_{\text{STBC}} \cdot N_{DBPS}} \right\rceil \quad \textbf{(26-118)}$$

where

m_{STBC} is equal to 2 when STBC is used, and 1 otherwise.

For an HE SU PPDU and HE extended range SU PPDU using LDPC encoding, the total number of OFDM symbols in the Data field, N_{SYM}, is given in 26.3.10.3.2 (LDPC coding).

For an HE MU PPDU (including both MU-MIMO and OFDMA), the total number of OFDM symbols in the Data field, N_{SYM}, is given in 26.3.10.3.4 (Encoding process for an HE MU PPDU).

For an HE trigger-based PPDU, the total number of OFDM symbols in the Data field, N_{SYM}, is given in 26.3.10.3.5 (Encoding process for an HE trigger-based PPDU).

T_{PE} is given by Equation (26-112).

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an HE SU PPDU and HE extended range SU PPDU is calculated using Equation (26-119).

$$\text{PSDU\_LENGTH} = \begin{cases} \left\lfloor \frac{(N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.Last.init} - N_{service} - N_{tail} \cdot N_{ES}}{8} \right\rfloor & \text{for BCC encoding} \\ \left\lfloor \frac{(N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.Last.init} - N_{service}}{8} \right\rfloor & \text{for LDPC encoding} \end{cases} \quad \textbf{(26-119)}$$

where

$N_{SYM.init}$ is given by Equation (26-68) for BCC encoding and by Equation (26-73) for LDPC encoding;

m_{STBC} is 2 when STBC is used, and 1 otherwise;

N_{DBPS} is given in 26.5 (Parameters for HE-MCSs);

$N_{DBPS.Last.init}$ is given by Equation (26-64)

The value of the PSDU_LENGTH parameter for user *u* returned in the PLME-TXTIME.confirm primitive and in the RXVECTOR for a HE MU PPDU is calculated using Equation (26-120).

$$\text{PSDU\_LENGTH}_u = \begin{cases} \left\lfloor \frac{(N_{SYM.init} - m_{STBC}).N_{DBPS.u} + m_{STBC}.N_{DBPS.LAST.u} - N_{service} - N_{tail} \cdot N_{ES}}{8} \right\rfloor & \text{when BCC is used for user } u \\ \left\lfloor \frac{(N_{SYM.init} - m_{STBC}).N_{DBPS.u} + m_{STBC}.N_{DBPS.LAST.init.u} - N_{service}}{8} \right\rfloor & \text{when LDPC is used for user } u \end{cases} \quad \textbf{(26-120)}$$

where

$N_{SYM.init}$ is given by Equation (26-81)

$N_{DBPS.Last.init}$ is given by Equation (26-82)

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an HE NDP PPDU is 0.

26.4.4 HE PHY

The static HE PHY characteristics, provided through the PLME-CHARACTERISTICS service primitive, shall be as shown in Table 20-25 (HT PHY characteristics) unless otherwise listed in Table 26-36. The definitions for these characteristics are given in 6.5 (PLME SAP interface).

Table 26-36 - HE PHY characteristics

Characteristics	Value
aTxPHYDelay	Implementation dependent
aRxPHYDelay	Implementation dependent
aCCAMidTime	25 µs
aPPDUMaxTime	5.484 ms
aPSDUMaxLength	TBD

26.5 Parameters for HE-MCSs

The rate-dependent parameters for 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU and non-OFDMA 20 MHz, 484-tone RU and non-OFDMA 40 MHz, 996-tone RU and non-OFDMA 80 MHz, non-OFDMA 160 MHz and 80+80 MHz N_{SS} = 1, …, 8 are given in Table 26-85 through Table 26-92. Support for HE-MCS 8, 9, 10, and 11 (when valid) is optional in all cases. HE-MCS 10 and 11 (1024-QAM) are applicable only to RU sizes equal to or larger than 242 tones.

Dual sub-carrier modulation (DCM) is an optional modulation scheme for any OFDMA and non OFDMA transmissions. DCM is only applicable to MCS 0, 1, 3 and 4 with up to TBD number of streams and for TBD RU sizes. A HE STA shall support single spatial stream HE-MCSs within the range HE-MCS 0 to HE-MCS 7 for all channel widths for which it has indicated support regardless of the Tx or Rx Highest Supported Long GI Data Rate subfield values in the Supported HE-MCS and NSS Set field. When more than one spatial stream is supported, the Tx or Rx Highest Supported Long GI Data Rate subfield values in the Supported HE-MCS and NSS Set field may result in a reduced HE-MCS range (cut-off) for N_{SS} = 2, …, 8. Support for OFDMA 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU, and 996-tone RU with N_{SS} = 1 is TBD mandatory/optional. Support for non-OFDMA 20 MHz, 40 MHz, and 80 MHz with N_{SS} =1 is mandatory. Support for more than one spatial stream is optional in all cases. Support for OFDMA and non-OFDMA 160 MHz and 80+80 MHz with N_{SS} = 1, …, 8 is optional. N_{ES} values were chosen to yield an integer number of punctured blocks for each BCC encoder per OFDM symbol.

Table 26-37 to Table 26-92 define HE-MCSs not only for SU transmission but also for user u at r-th RU of an MU transmission. In the case of HE-MCSs for MU transmissions, the parameters, N_{SS}, R, N_{BPSCS}, N_{CBPS}, N_{DBPS}, and N_{ES} are replaced with $N_{SS,r,u}$, $R_{r,u}$, $N_{BPSCS,r,u}$, $N_{CBPS,r,u}$, $N_{DBPS,r,u}$, and $N_{ES,r,u}$, respectively.

In the tables below, the number of streams and RU sizes that DCM is applicable to are TBD.

Table 26-37 - HE-MCSs for TBD mandatory/optional 26-tone RU, NSS = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	24	6	1	0.4	0.4	0.4
0	0		1/2	1			24	12	1	0.9	0.8	0.8
1	1	QPSK	1/4	2			48	12	1	0.9	0.8	0.8
1	0		1/2	2			48	24	1	1.8	1.7	1.5
2	N/A		3/4	2			48	36	1	2.6	2.5	2.3
3	1	16-QAM	1/4	4			96	24	1	1.8	1.7	1.5
3	0		1/2	4			96	48	1	3.5	3.3	3.0
4	1		3/8	4			96	36	1	2.6	2.5	2.3
4	0		3/4	4			96	72	1	5.3	5.0	4.5
5	N/A	64-QAM	2/3	6			144	96	1	7.1	6.7	6.0
6			3/4	6			144	108	1	7.9	7.5	6.8
7			5/6	6			144	120	1	8.8	8.3	7.5
8		256-QAM	3/4	8			192	144	1	10.6	10.0	9.0
9			5/6	8			192	160	1	11.8	11.1	10.0

Table 26-38 HE-MCSs for TBD mandatory/optional 26-tone RU, NSS = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	48	12	1	0.9	0.8	0.8
0	0		1/2	1			48	24	1	1.8	1.7	1.5
1	1	QPSK	1/4	2			96	24	1	1.8	1.7	1.5
1	0		1/2	2			96	48	1	3.5	3.3	3.0
2	N/A		3/4	2			96	72	1	5.3	5.0	4.5
3	1	16-QAM	1/4	4			192	48	1	3.5	3.3	3.0
3	0		1/2	4			192	96	1	7.1	6.7	6.0
4	1		3/8	4			192	72	1	5.3	5.0	4.5
4	0		3/4	4			192	144	1	10.6	10.0	9.0
5	N/A	64-QAM	2/3	6			288	192	1	14.1	13.3	12.0
6			3/4	6			288	216	1	15.9	15.0	13.5
7			5/6	6			288	240	1	17.6	16.7	15.0
8		256-QAM	3/4	8			384	288	1	21.2	20.0	18.0
9			5/6	8			384	320	1	23.5	22.2	20.0

Table 26-39 HE-MCSs for TBD mandatory/optional 26-tone RU, Nss = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	72	18	1	1.3	1.3	1.1
0	0		1/2	1			72	36	1	2.6	2.5	2.3
1	1	QPSK	1/4	2			144	36	1	2.6	2.5	2.3
1	0		1/2	2			144	72	1	5.3	5.0	4.5
2	N/A		3/4	2			144	108	1	7.9	7.5	6.8
3	1	16-QAM	1/4	4			288	72	1	5.3	5.0	4.5
3	0		1/2	4			288	144	1	10.6	10.0	9.0
4	1		3/8	4			288	108	1	7.9	7.5	6.8
4	0		3/4	4			288	216	1	15.9	15.0	13.5
5	N/A	64-QAM	2/3	6			432	288	1	21.2	20.0	18.0
6			3/4	6			432	324	1	23.8	22.5	20.3
7			5/6	6			432	360	1	26.5	25.0	22.5
8		256-QAM	3/4	8			576	432	1	31.8	30.0	27.0
9			5/6	8			576	480	1	35.3	33.3	30.0

Table 26-40 HE-MCSs for TBD mandatory/optional 26-tone RU, Nss = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	96	24	1	1.8	1.7	1.5
0	0		1/2	1			96	48	1	3.5	3.3	3.0
1	1	QPSK	1/4	2			192	48	1	3.5	3.3	3.0
1	0		1/2	2			192	96	1	7.1	6.7	6.0
2	N/A		3/4	2			192	144	1	10.6	10.0	9.0
3	1	16-QAM	1/4	4			384	96	1	7.1	6.7	6.0
3	0		1/2	4			384	192	1	14.1	13.3	12.0
4	1		3/8	4			384	144	1	10.6	10.0	9.0
4	0		3/4	4			384	288	1	21.2	20.0	18.0
5	N/A	64-QAM	2/3	6			576	384	1	28.2	26.7	24.0
6			3/4	6			576	432	1	31.8	30.0	27.0
7			5/6	6			576	480	1	35.3	33.3	30.0
8		256-QAM	3/4	8			768	576	1	42.4	40.0	36.0
9			5/6	8			768	640	1	47.1	44.4	40.0

Table 26-41 HE-MCSs for TBD mandatory/optional 26-tone RU, Nss = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	120	30	1	2.2	2.1	1.9
0	0		1/2	1			120	60	1	4.4	4.2	3.8
1	1	QPSK	1/4	2			240	60	1	4.4	4.2	3.8
1	0		1/2	2			240	120	1	8.8	8.3	7.5
2	N/A		3/4	2			240	180	1	13.2	12.5	11.3
3	1	16-QAM	1/4	4			480	120	1	8.8	8.3	7.5
3	0		1/2	4			480	240	1	17.6	16.7	15.0
4	1		3/8	4			480	180	1	13.2	12.5	11.3
4	0		3/4	4			480	360	1	26.5	25.0	22.5
5	N/A	64-QAM	2/3	6			720	480	1	35.3	33.3	30.0
6			3/4	6			720	540	1	39.7	37.5	33.8
7			5/6	6			720	600	1	44.1	41.7	37.5
8		256-QAM	3/4	8			960	720	1	52.9	50.0	45.0
9			5/6	8			960	800	1	58.8	55.6	50.0

Table 26-42 HE-MCSs for TBD mandatory/optional 26-tone RU, Nss = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	144	36	1	2.6	2.5	2.3
0	0		1/2	1			144	72	1	5.3	5.0	4.5
1	1	QPSK	1/4	2			288	72	1	5.3	5.0	4.5
1	0		1/2	2			288	144	1	10.6	10.0	9.0
2	N/A		3/4	2			288	216	1	15.9	15.0	13.5
3	1	16-QAM	1/4	4			576	144	1	10.6	10.0	9.0
3	0		1/2	4			576	288	1	21.2	20.0	18.0
4	1		3/8	4			576	216	1	15.9	15.0	13.5
4	0		3/4	4			576	432	1	31.8	30.0	27.0
5	N/A	64-QAM	2/3	6			864	576	1	42.4	40.0	36.0
6			3/4	6			864	648	1	47.6	45.0	40.5
7			5/6	6			864	720	1	52.9	50.0	45.0
8		256-QAM	3/4	8			1152	864	1	63.5	60.0	54.0
9			5/6	8			1152	960	1	70.6	66.7	60.0

Table 26-43 HE-MCSs for TBD mandatory/optional 26-tone RU, Nss = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	168	42	1	3.1	2.9	2.6
0	0		1/2	1			168	84	1	6.2	5.8	5.3
1	1	QPSK	1/4	2			336	84	1	6.2	5.8	5.3
1	0		1/2	2			336	168	1	12.4	11.7	10.5
2	N/A		3/4	2			336	252	1	18.5	17.5	15.8
3	1	16-QAM	1/4	4			672	168	1	12.4	11.7	10.5
3	0		1/2	4			672	336	1	24.7	23.3	21.0
4	1		3/8	4			672	252	1	18.5	17.5	15.8
4	0		3/4	4			672	504	1	37.1	35.0	31.5
5	N/A	64-QAM	2/3	6			1008	672	1	49.4	46.7	42.0
6			3/4	6			1008	756	1	55.6	52.5	47.3
7			5/6	6			1008	840	1	61.8	58.3	52.5
8		256-QAM	3/4	8			1344	1008	1	74.1	70.0	63.0
9			5/6	8			1344	1120	1	82.4	77.8	70.0

Table 26-44 HE-MCSs for TBD mandatory/optional 26-tone RU, Nss = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	192	48	1	3.5	3.3	3.0
0	0		1/2	1			192	96	1	7.1	6.7	6.0
1	1	QPSK	1/4	2			384	96	1	7.1	6.7	6.0
1	0		1/2	2			384	192	1	14.1	13.3	12.0
2	N/A		3/4	2			384	288	1	21.2	20.0	18.0
3	1	16-QAM	1/4	4			768	192	1	14.1	13.3	12.0
3	0		1/2	4			768	384	1	28.2	26.7	24.0
4	1		3/8	4			768	288	1	21.2	20.0	18.0
4	0		3/4	4			768	576	1	42.4	40.0	36.0
5	N/A	64-QAM	2/3	6			1152	768	1	56.5	53.3	48.0
6			3/4	6			1152	864	1	63.5	60.0	54.0
7			5/6	6			1152	960	1	70.6	66.7	60.0
8		256-QAM	3/4	8			1536	1152	1	84.7	80.0	72.0
9			5/6	8			1536	1280	1	94.1	88.9	80.0

Table 26-45 HE-MCSs for TBD mandatory/optional 52-tone RU, Nss = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	48	12	1	0.9	0.8	0.8
0	0		1/2	1			48	24	1	1.8	1.7	1.5
1	1	QPSK	1/4	2			96	24	1	1.8	1.7	1.5
1	0		1/2	2			96	48	1	3.5	3.3	3.0
2	N/A		3/4	2			96	72	1	5.3	5.0	4.5
3	1	16-QAM	1/4	4			192	48	1	3.5	3.3	3.0
3	0		1/2	4			192	96	1	7.1	6.7	6.0
4	1		3/8	4			192	72	1	5.3	5.0	4.5
4	0		3/4	4			192	144	1	10.6	10.0	9.0
5	N/A	64-QAM	2/3	6			288	192	1	14.1	13.3	12.0
6			3/4	6			288	216	1	15.9	15.0	13.5
7			5/6	6			288	240	1	17.6	16.7	15.0
8		256-QAM	3/4	8			384	288	1	21.2	20.0	18.0
9			5/6	8			384	320	1	23.5	22.2	20.0

Table 26-46 HE-MCSs for TBD mandatory/optional 52-tone RU, Nss = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	96	24	1	1.8	1.7	1.5
0	0		1/2	1			96	48	1	3.5	3.3	3.0
1	1	QPSK	1/4	2			192	48	1	3.5	3.3	3.0
1	0		1/2	2			192	96	1	7.1	6.7	6.0
2	N/A		3/4	2			192	144	1	10.6	10.0	9.0
3	1	16-QAM	1/4	4			384	96	1	7.1	6.7	6.0
3	0		1/2	4			384	192	1	14.1	13.3	12.0
4	1		3/8	4			384	144	1	10.6	10.0	9.0
4	0		3/4	4			384	288	1	21.2	20.0	18.0
5	N/A	64-QAM	2/3	6			576	384	1	28.2	26.7	24.0
6			3/4	6			576	432	1	31.8	30.0	27.0
7			5/6	6			576	480	1	35.3	33.3	30.0
8		256-QAM	3/4	8			768	576	1	42.4	40.0	36.0
9			5/6	8			768	640	1	47.1	44.4	40.0

Table 26-47 HE-MCSs for TBD mandatory/optional 52-tone RU, Nss = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	144	36	1	2.6	2.5	2.3
0	0		1/2	1			144	72	1	5.3	5.0	4.5
1	1	QPSK	1/4	2			288	72	1	5.3	5.0	4.5
1	0		1/2	2			288	144	1	10.6	10.0	9.0
2	N/A		3/4	2			288	216	1	15.9	15.0	13.5
3	1	16-QAM	1/4	4			576	144	1	10.6	10.0	9.0
3	0		1/2	4			576	288	1	21.2	20.0	18.0
4	1		3/8	4			576	216	1	15.9	15.0	13.5
4	0		3/4	4			576	432	1	31.8	30.0	27.0
5	N/A	64-QAM	2/3	6			864	576	1	42.4	40.0	36.0
6			3/4	6			864	648	1	47.6	45.0	40.5
7			5/6	6			864	720	1	52.9	50.0	45.0
8		256-QAM	3/4	8			1152	864	1	63.5	60.0	54.0
9			5/6	8			1152	960	1	70.6	66.7	60.0

Table 26-48 HE-MCSs for TBD mandatory/optional 52-tone RU, Nss = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	192	48	1	3.5	3.3	3.0
0	0		1/2	1			192	96	1	7.1	6.7	6.0
1	1	QPSK	1/4	2			384	96	1	7.1	6.7	6.0
1	0		1/2	2			384	192	1	14.1	13.3	12.0
2	N/A		3/4	2			384	288	1	21.2	20.0	18.0
3	1	16-QAM	1/4	4			768	192	1	14.1	13.3	12.0
3	0		1/2	4			768	384	1	28.2	26.7	24.0
4	1		3/8	4			768	288	1	21.2	20.0	18.0
4	0		3/4	4			768	576	1	42.4	40.0	36.0
5	N/A	64-QAM	2/3	6			1152	768	1	56.5	53.3	48.0
6			3/4	6			1152	864	1	63.5	60.0	54.0
7			5/6	6			1152	960	1	70.6	66.7	60.0
8		256-QAM	3/4	8			1536	1152	1	84.7	80.0	72.0
9			5/6	8			1536	1280	1	94.1	88.9	80.0

Table 26-49 HE-MCSs for TBD mandatory/optional 52-tone RU, Nss = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	240	60	1	4.4	4.2	3.8
0	0		1/2	1			240	120	1	8.8	8.3	7.5
1	1	QPSK	1/4	2			480	120	1	8.8	8.3	7.5
1	0		1/2	2			480	240	1	17.6	16.7	15.0
2	N/A		3/4	2			480	360	1	26.5	25.0	22.5
3	1	16-QAM	1/4	4			960	240	1	17.6	16.7	15.0
3	0		1/2	4			960	480	1	35.3	33.3	30.0
4	1		3/8	4			960	360	1	26.5	25.0	22.5
4	0		3/4	4			960	720	1	52.9	50.0	45.0
5	N/A	64-QAM	2/3	6			1440	960	1	70.6	66.7	60.0
6			3/4	6			1440	1080	1	79.4	75.0	67.5
7			5/6	6			1440	1200	1	88.2	83.3	75.0
8		256-QAM	3/4	8			1920	1440	1	105.9	100.0	90.0
9			5/6	8			1920	1600	1	117.6	111.1	100.0

Table 26-50 HE-MCSs for TBD mandatory/optional 52-tone RU, Nss = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	288	72	1	5.3	5.0	4.5
0	0		1/2	1			288	144	1	10.6	10.0	9.0
1	1	QPSK	1/4	2			576	144	1	10.6	10.0	9.0
1	0		1/2	2			576	288	1	21.2	20.0	18.0
2	N/A		3/4	2			576	432	1	31.8	30.0	27.0
3	1	16-QAM	1/4	4			1152	288	1	21.2	20.0	18.0
3	0		1/2	4			1152	576	1	42.4	40.0	36.0
4	1		3/8	4			1152	432	1	31.8	30.0	27.0
4	0		3/4	4			1152	864	1	63.5	60.0	54.0
5	N/A	64-QAM	2/3	6			1728	1152	1	84.7	80.0	72.0
6			3/4	6			1728	1296	1	95.3	90.0	81.0
7			5/6	6			1728	1440	1	105.9	100.0	90.0
8		256-QAM	3/4	8			2304	1728	1	127.1	120.0	108.0
9			5/6	8			2304	1920	1	141.2	133.3	120.0

Table 26-51 HE-MCSs for TBD mandatory/optional 52-tone RU, Nss = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	336	84	1	6.2	5.8	5.3
0	0		1/2	1			336	168	1	12.4	11.7	10.5
1	1	QPSK	1/4	2			672	168	1	12.4	11.7	10.5
1	0		1/2	2			672	336	1	24.7	23.3	21.0
2	N/A		3/4	2			672	504	1	37.1	35.0	31.5
3	1	16-QAM	1/4	4			1344	336	1	24.7	23.3	21.0
3	0		1/2	4			1344	672	1	49.4	46.7	42.0
4	1		3/8	4			1344	504	1	37.1	35.0	31.5
4	0		3/4	4			1344	1008	1	74.1	70.0	63.0
5	N/A	64-QAM	2/3	6			2016	1344	1	98.8	93.3	84.0
6			3/4	6			2016	1512	1	111.2	105.0	94.5
7			5/6	6			2016	1680	1	123.5	116.7	105.0
8		256-QAM	3/4	8			2688	2016	1	148.2	140.0	126.0
9			5/6	8			2688	2240	1	164.7	155.6	140.0

Table 26-52 HE-MCSs for TBD mandatory/optional 52-tone RU, Nss = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	384	96	1	7.1	6.7	6.0
0	0		1/2	1			384	192	1	14.1	13.3	12.0
1	1	QPSK	1/4	2			768	192	1	14.1	13.3	12.0
1	0		1/2	2			768	384	1	28.2	26.7	24.0
2	N/A		3/4	2			768	576	1	42.4	40.0	36.0
3	1	16-QAM	1/4	4			1536	384	1	28.2	26.7	24.0
3	0		1/2	4			1536	768	1	56.5	53.3	48.0
4	1		3/8	4			1536	576	1	42.4	40.0	36.0
4	0		3/4	4			1536	1152	1	84.7	80.0	72.0
5	N/A	64-QAM	2/3	6			2304	1536	1	112.9	106.7	96.0
6			3/4	6			2304	1728	1	127.1	120.0	108.0
7			5/6	6			2304	1920	1	141.2	133.3	120.0
8		256-QAM	3/4	8			3072	2304	1	169.4	160.0	144.0
9			5/6	8			3072	2560	1	188.2	177.8	160.0

Table 26-53 HE-MCSs for TBD mandatory/optional 106-tone RU, Nss = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	102	25	1	1.8	1.7	1.6
0	0		1/2	1			102	51	1	3.8	3.5	3.2
1	1	QPSK	1/4	2			204	51	1	3.8	3.5	3.2
1	0		1/2	2			204	102	1	7.5	7.1	6.4
2	N/A		3/4	2			204	153	1	11.3	10.6	9.6
3	1	16-QAM	1/4	4			408	102	1	7.5	7.1	6.4
3	0		1/2	4			408	204	1	15.0	14.2	12.8
4	1		3/8	4			408	153	1	11.3	10.6	9.6
4	0		3/4	4			408	306	1	22.5	21.3	19.1
5	N/A	64-QAM	2/3	6			612	408	1	30.0	28.3	25.5
6			3/4	6			612	459	1	33.8	31.9	28.7
7			5/6	6			612	510	1	37.5	35.4	31.9
8		256-QAM	3/4	8			816	612	1	45.0	42.5	38.3
9			5/6	8			816	680	1	50.0	47.2	42.5

Table 26-54 HE-MCSs for TBD mandatory/optional 106-tone RU, Nss = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	204	51	1	3.8	3.5	3.2
0	0		1/2	1			204	102	1	7.5	7.1	6.4
1	1	QPSK	1/4	2			408	102	1	7.5	7.1	6.4
1	0		1/2	2			408	204	1	15.0	14.2	12.8
2	N/A		3/4	2			408	306	1	22.5	21.3	19.1
3	1	16-QAM	1/4	4			816	204	1	15.0	14.2	12.8
3	0		1/2	4			816	408	1	30.0	28.3	25.5
4	1		3/8	4			816	306	1	22.5	21.3	19.1
4	0		3/4	4			816	612	1	45.0	42.5	38.3
5	N/A	64-QAM	2/3	6			1224	816	1	60.0	56.7	51.0
6			3/4	6			1224	918	1	67.5	63.8	57.4
7			5/6	6			1224	1,020	1	75.0	70.8	63.8
8		256-QAM	3/4	8			1632	1,224	1	90.0	85.0	76.5
9			5/6	8			1632	1,360	1	100.0	94.4	85.0

Table 26-55 HE-MCSs for TBD mandatory/optional 106-tone RU, Nss = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	306	76	1	5.6	5.3	4.8
0	0		1/2	1			306	153	1	11.3	10.6	9.6
1	1	QPSK	1/4	2			612	153	1	11.3	10.6	9.6
1	0		1/2	2			612	306	1	22.5	21.3	19.1
2	N/A		3/4	2			612	459	1	33.8	31.9	28.7
3	1	16-QAM	1/4	4			1224	306	1	22.5	21.3	19.1
3	0		1/2	4			1224	612	1	45.0	42.5	38.3
4	1		3/8	4			1224	459	1	33.8	31.9	28.7
4	0		3/4	4			1224	918	1	67.5	63.8	57.4
5	N/A	64-QAM	2/3	6			1836	1,224	1	90.0	85.0	76.5
6			3/4	6			1836	1,377	1	101.3	95.6	86.1
7			5/6	6			1836	1,530	1	112.5	106.3	95.6
8		256-QAM	3/4	8			2448	1,836	1	135.0	127.5	114.8
9			5/6	8			2448	2,040	1	150.0	141.7	127.5

Table 26-56 HE-MCSs for TBD mandatory/optional 106-tone RU, Nss = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	408	102	1	7.5	7.1	6.4
0	0		1/2	1			408	204	1	15.0	14.2	12.8
1	1	QPSK	1/4	2			816	204	1	15.0	14.2	12.8
1	0		1/2	2			816	408	1	30.0	28.3	25.5
2	N/A		3/4	2			816	612	1	45.0	42.5	38.3
3	1	16-QAM	1/4	4			1632	408	1	30.0	28.3	25.5
3	0		1/2	4			1632	816	1	60.0	56.7	51.0
4	1		3/8	4			1632	612	1	45.0	42.5	38.3
4	0		3/4	4			1632	1,224	1	90.0	85.0	76.5
5	N/A	64-QAM	2/3	6			2448	1,632	1	120.0	113.3	102.0
6			3/4	6			2448	1,836	1	135.0	127.5	114.8
7			5/6	6			2448	2,040	1	150.0	141.7	127.5
8		256-QAM	3/4	8			3264	2,448	1	180.0	170.0	153.0
9			5/6	8			3264	2,720	1	200.0	188.9	170.0

Table 26-57 HE-MCSs for TBD mandatory/optional 106-tone RU, Nss = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	510	127	1	9.3	8.8	7.9
0	0		1/2	1			510	255	1	18.8	17.7	15.9
1	1	QPSK	1/4	2			1020	255	1	18.8	17.7	15.9
1	0		1/2	2			1020	510	1	37.5	35.4	31.9
2	N/A		3/4	2			1020	765	1	56.3	53.1	47.8
3	1	16-QAM	1/4	4			2040	510	1	37.5	35.4	31.9
3	0		1/2	4			2040	1,020	1	75.0	70.8	63.8
4	1		3/8	4			2040	765	1	56.3	53.1	47.8
4	0		3/4	4			2040	1,530	1	112.5	106.3	95.6
5	N/A	64-QAM	2/3	6			3060	2,040	1	150.0	141.7	127.5
6			3/4	6			3060	2,295	1	168.8	159.4	143.4
7			5/6	6			3060	2,550	1	187.5	177.1	159.4
8		256-QAM	3/4	8			4080	3,060	1	225.0	212.5	191.3
9			5/6	8			4080	3,400	1	250.0	236.1	212.5

Table 26-58 HE-MCSs for TBD mandatory/optional 106-tone RU, Nss = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	612	153	1	11.3	10.6	9.6
0	0		1/2	1			612	306	1	22.5	21.3	19.1
1	1	QPSK	1/4	2			1224	306	1	22.5	21.3	19.1
1	0		1/2	2			1224	612	1	45.0	42.5	38.3
2	N/A		3/4	2			1224	918	1	67.5	63.8	57.4
3	1	16-QAM	1/4	4			2448	612	1	45.0	42.5	38.3
3	0		1/2	4			2448	1,224	1	90.0	85.0	76.5
4	1		3/8	4			2448	918	1	67.5	63.8	57.4
4	0		3/4	4			2448	1,836	1	135.0	127.5	114.8
5	N/A	64-QAM	2/3	6			3672	2,448	1	180.0	170.0	153.0
6			3/4	6			3672	2,754	1	202.5	191.3	172.1
7			5/6	6			3672	3,060	1	225.0	212.5	191.3
8		256-QAM	3/4	8			4896	3,672	1	270.0	255.0	229.5
9			5/6	8			4896	4,080	1	300.0	283.3	255.0

Table 26-59 HE-MCSs for TBD mandatory/optional 106-tone RU, Nss = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	714	178	1	13.1	12.4	11.1
0	0		1/2	1			714	357	1	26.3	24.8	22.3
1	1	QPSK	1/4	2			1428	357	1	26.3	24.8	22.3
1	0		1/2	2			1428	714	1	52.5	49.6	44.6
2	N/A		3/4	2			1428	1,071	1	78.8	74.4	66.9
3	1	16-QAM	1/4	4			2856	714	1	52.5	49.6	44.6
3	0		1/2	4			2856	1,428	1	105.0	99.2	89.3
4	1		3/8	4			2856	1,071	1	78.8	74.4	66.9
4	0		3/4	4			2856	2,142	1	157.5	148.8	133.9
5	N/A	64-QAM	2/3	6			4284	2,856	1	210.0	198.3	178.5
6			3/4	6			4284	3,213	1	236.3	223.1	200.8
7			5/6	6			4284	3,570	1	262.5	247.9	223.1
8		256-QAM	3/4	8			5712	4,284	1	315.0	297.5	267.8
9			5/6	8			5712	4,760	1	350.0	330.6	297.5

Table 26-60 HE-MCSs for TBD mandatory/optional 106-tone RU, Nss = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	816	204	1	15.0	14.2	12.8
0	0		1/2	1			816	408	1	30.0	28.3	25.5
1	1	QPSK	1/4	2			1632	408	1	30.0	28.3	25.5
1	0		1/2	2			1632	816	1	60.0	56.7	51.0
2	N/A		3/4	2			1632	1,224	1	90.0	85.0	76.5
3	1	16-QAM	1/4	4			3264	816	1	60.0	56.7	51.0
3	0		1/2	4			3264	1,632	1	120.0	113.3	102.0
4	1		3/8	4			3264	1,224	1	90.0	85.0	76.5
4	0		3/4	4			3264	2,448	1	180.0	170.0	153.0
5	N/A	64-QAM	2/3	6			4896	3,264	1	240.0	226.7	204.0
6			3/4	6			4896	3,672	1	270.0	255.0	229.5
7			5/6	6			4896	4,080	1	300.0	283.3	255.0
8		256-QAM	3/4	8			6528	4,896	1	360.0	340.0	306.0
9			5/6	8			6528	5,440	1	400.0	377.8	340.0

Table 26-61 HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20MHz, Nss = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	234	58	1	4.3	4.0	3.6
0	0		1/2	1			234	117	1	8.6	8.1	7.3
1	1	QPSK	1/4	2			468	117	1	8.6	8.1	7.3
1	0		1/2	2			468	234	1	17.2	16.3	14.6
2	N/A		3/4	2			468	351	1	25.8	24.4	21.9
3	1	16-QAM	1/4	4			936	234	1	17.2	16.3	14.6
3	0		1/2	4			936	468	1	34.4	32.5	29.3
4	1		3/8	4			936	351	1	25.8	24.4	21.9
4	0		3/4	4			936	702	1	51.6	48.8	43.9
5	N/A	64-QAM	2/3	6			1404	936	1	68.8	65.0	58.5
6			3/4	6			1404	1,053	1	77.4	73.1	65.8
7			5/6	6			1404	1,170	1	86.0	81.3	73.1
8		256-QAM	3/4	8			1872	1,404	1	103.2	97.5	87.8
9			5/6	8			1872	1,560	1	114.7	108.3	97.5
10		1024-QAM	3/4	10			2340	1,755	1	129.0	121.9	109.7
11			5/6	10			2340	1,950	1	143.4	135.4	121.9

Table 26-62 HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20MHz, Nss = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	468	117	1	8.6	8.1	7.3
0	0		1/2	1			468	234	1	17.2	16.3	14.6
1	1	QPSK	1/4	2			936	234	1	17.2	16.3	14.6
1	0		1/2	2			936	468	1	34.4	32.5	29.3
2	N/A		3/4	2			936	702	1	51.6	48.8	43.9
3	1	16-QAM	1/4	4			1872	468	1	34.4	32.5	29.3
3	0		1/2	4			1872	936	1	68.8	65.0	58.5
4	1		3/8	4			1872	702	1	51.6	48.8	43.9
4	0		3/4	4			1872	1,404	1	103.2	97.5	87.8
5	N/A	64-QAM	2/3	6			2808	1,872	1	137.6	130.0	117.0
6			3/4	6			2808	2,106	1	154.9	146.3	131.6
7			5/6	6			2808	2,340	1	172.1	162.5	146.3
8		256-QAM	3/4	8			3744	2,808	1	206.5	195.0	175.5
9			5/6	8			3744	3,120	1	229.4	216.7	195.0
10		1024-QAM	3/4	10			4680	3,510	1	258.1	243.8	219.4
11			5/6	10			4680	3,900	1	286.8	270.8	243.8

Table 26-63 HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20MHz, Nss = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	702	175	1	12.9	12.2	10.9
0	0		1/2	1			702	351	1	25.8	24.4	21.9
1	1	QPSK	1/4	2			1404	351	1	25.8	24.4	21.9
1	0		1/2	2			1404	702	1	51.6	48.8	43.9
2	N/A		3/4	2			1404	1,053	1	77.4	73.1	65.8
3	1	16-QAM	1/4	4			2808	702	1	51.6	48.8	43.9
3	0		1/2	4			2808	1,404	1	103.2	97.5	87.8
4	1		3/8	4			2808	1,053	1	77.4	73.1	65.8
4	0		3/4	4			2808	2,106	1	154.9	146.3	131.6
5	N/A	64-QAM	2/3	6			4212	2,808	1	206.5	195.0	175.5
6			3/4	6			4212	3,159	1	232.3	219.4	197.4
7			5/6	6			4212	3,510	1	258.1	243.8	219.4
8		256-QAM	3/4	8			5616	4,212	1	309.7	292.5	263.3
9			5/6	8			5616	4,680	1	344.1	325.0	292.5
10		1024-QAM	3/4	10			7020	5,265	1	387.1	365.6	329.1
11			5/6	10			7020	5,850	1	430.1	406.3	365.6

Table 26-64 HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20MHz, Nss = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	936	234	1	17.2	16.3	14.6
0	0		1/2	1			936	468	1	34.4	32.5	29.3
1	1	QPSK	1/4	2			1872	468	1	34.4	32.5	29.3
1	0		1/2	2			1872	936	1	68.8	65.0	58.5
2	N/A		3/4	2			1872	1,404	1	103.2	97.5	87.8
3	1	16-QAM	1/4	4			3744	936	1	68.8	65.0	58.5
3	0		1/2	4			3744	1,872	1	137.6	130.0	117.0
4	1		3/8	4			3744	1,404	1	103.2	97.5	87.8
4	0		3/4	4			3744	2,808	1	206.5	195.0	175.5
5	N/A	64-QAM	2/3	6			5616	3,744	1	275.3	260.0	234.0
6			3/4	6			5616	4,212	1	309.7	292.5	263.3
7			5/6	6			5616	4,680	1	344.1	325.0	292.5
8		256-QAM	3/4	8			7488	5,616	1	412.9	390.0	351.0
9			5/6	8			7488	6,240	1	458.8	433.3	390.0
10		1024-QAM	3/4	10			9360	7,020	1	516.2	487.5	438.8
11			5/6	10			9360	7,800	1	573.5	541.7	487.5

Table 26-65 HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20MHz, Nss = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1170	292	1	21.5	20.3	18.3
0	0		1/2	1			1170	585	1	43.0	40.6	36.6
1	1	QPSK	1/4	2			2340	585	1	43.0	40.6	36.6
1	0		1/2	2			2340	1,170	1	86.0	81.3	73.1
2	N/A		3/4	2			2340	1,755	1	129.0	121.9	109.7
3	1	16-QAM	1/4	4			4680	1,170	1	86.0	81.3	73.1
3	0		1/2	4			4680	2,340	1	172.1	162.5	146.3
4	1		3/8	4			4680	1,755	1	129.0	121.9	109.7
4	0		3/4	4			4680	3,510	1	258.1	243.8	219.4
5	N/A	64-QAM	2/3	6			7020	4,680	1	344.1	325.0	292.5
6			3/4	6			7020	5,265	1	387.1	365.6	329.1
7			5/6	6			7020	5,850	1	430.1	406.3	365.6
8		256-QAM	3/4	8			9360	7,020	1	516.2	487.5	438.8
9			5/6	8			9360	7,800	1	573.5	541.7	487.5
10		1024-QAM	3/4	10			11700	8,775	1	645.2	609.4	548.4
11			5/6	10			11700	9,750	1	716.9	677.1	609.4

Table 26-66 HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20MHz, Nss = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1404	351	1	25.8	24.4	21.9
0	0		1/2	1			1404	702	1	51.6	48.8	43.9
1	1	QPSK	1/4	2			2808	702	1	51.6	48.8	43.9
1	0		1/2	2			2808	1,404	1	103.2	97.5	87.8
2	N/A		3/4	2			2808	2,106	1	154.9	146.3	131.6
3	1	16-QAM	1/4	4			5616	1,404	1	103.2	97.5	87.8
3	0		1/2	4			5616	2,808	1	206.5	195.0	175.5
4	1		3/8	4			5616	2,106	1	154.9	146.3	131.6
4	0		3/4	4			5616	4,212	1	309.7	292.5	263.3
5	N/A	64-QAM	2/3	6			8424	5,616	1	412.9	390.0	351.0
6			3/4	6			8424	6,318	1	464.6	438.8	394.9
7			5/6	6			8424	7,020	1	516.2	487.5	438.8
8		256-QAM	3/4	8			11232	8,424	1	619.4	585.0	526.5
9			5/6	8			11232	9,360	1	688.2	650.0	585.0
10		1024-QAM	3/4	10			14040	10,530	1	774.3	731.3	658.1
11			5/6	10			14040	11,700	1	860.3	812.5	731.3

Table 26-67 HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20MHz, Nss = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1638	409	1	30.1	28.4	25.6
0	0		1/2	1			1638	819	1	60.2	56.9	51.2
1	1	QPSK	1/4	2			3276	819	1	60.2	56.9	51.2
1	0		1/2	2			3276	1,638	1	120.4	113.8	102.4
2	N/A		3/4	2			3276	2,457	1	180.7	170.6	153.6
3	1	16-QAM	1/4	4			6552	1,638	1	120.4	113.8	102.4
3	0		1/2	4			6552	3,276	1	240.9	227.5	204.8
4	1		3/8	4			6552	2,457	1	180.7	170.6	153.6
4	0		3/4	4			6552	4,914	1	361.3	341.3	307.1
5	N/A	64-QAM	2/3	6			9828	6,552	1	481.8	455.0	409.5
6			3/4	6			9828	7,371	1	542.0	511.9	460.7
7			5/6	6			9828	8,190	1	602.2	568.8	511.9
8		256-QAM	3/4	8			13104	9,828	1	722.6	682.5	614.3
9			5/6	8			13104	10,920	1	802.9	758.3	682.5
10		1024-QAM	3/4	10			16380	12,285	1	903.3	853.1	767.8
11			5/6	10			16380	13,650	1	1,003.7	947.9	853.1

Table 26-68 HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20MHz, Nss = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1872	468	1	34.4	32.5	29.3
0	0		1/2	1			1872	936	1	68.8	65.0	58.5
1	1	QPSK	1/4	2			3744	936	1	68.8	65.0	58.5
1	0		1/2	2			3744	1,872	1	137.6	130.0	117.0
2	N/A		3/4	2			3744	2,808	1	206.5	195.0	175.5
3	1	16-QAM	1/4	4			7488	1,872	1	137.6	130.0	117.0
3	0		1/2	4			7488	3,744	1	275.3	260.0	234.0
4	1		3/8	4			7488	2,808	1	206.5	195.0	175.5
4	0		3/4	4			7488	5,616	1	412.9	390.0	351.0
5	N/A	64-QAM	2/3	6			11232	7,488	1	550.6	520.0	468.0
6			3/4	6			11232	8,424	1	619.4	585.0	526.5
7			5/6	6			11232	9,360	1	688.2	650.0	585.0
8		256-QAM	3/4	8			14976	11,232	1	825.9	780.0	702.0
9			5/6	8			14976	12,480	1	917.6	866.7	780.0
10		1024-QAM	3/4	10			18720	14,040	1	1,032.4	975.0	877.5
11			5/6	10			18720	15,600	1	1,147.1	1,083.3	975.0

Table 26-69 HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40MHz, Nss = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	468	117	1	8.6	8.1	7.3
0	0		1/2	1			468	234	1	17.2	16.3	14.6
1	1	QPSK	1/4	2			936	234	1	17.2	16.3	14.6
1	0		1/2	2			936	468	1	34.4	32.5	29.3
2	N/A		3/4	2			936	702	1	51.6	48.8	43.9
3	1	16-QAM	1/4	4			1872	468	1	34.4	32.5	29.3
3	0		1/2	4			1872	936	1	68.8	65.0	58.5
4	1		3/8	4			1872	702	1	51.6	48.8	43.9
4	0		3/4	4			1872	1,404	1	103.2	97.5	87.8
5	N/A	64-QAM	2/3	6			2808	1,872	1	137.6	130.0	117.0
6			3/4	6			2808	2,106	1	154.9	146.3	131.6
7			5/6	6			2808	2,340	1	172.1	162.5	146.3
8		256-QAM	3/4	8			3744	2,808	1	206.5	195.0	175.5
9			5/6	8			3744	3,120	1	229.4	216.7	195.0
10		1024-QAM	3/4	10			4680	3,510	1	258.1	243.8	219.4
11			5/6	10			4680	3,900	1	286.8	270.8	243.8

Table 26-70 HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40MHz, Nss = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	936	234	1	17.2	16.3	14.6
0	0		1/2	1			936	468	1	34.4	32.5	29.3
1	1	QPSK	1/4	2			1872	468	1	34.4	32.5	29.3
1	0		1/2	2			1872	936	1	68.8	65.0	58.5
2	N/A		3/4	2			1872	1,404	1	103.2	97.5	87.8
3	1	16-QAM	1/4	4			3744	936	1	68.8	65.0	58.5
3	0		1/2	4			3744	1,872	1	137.6	130.0	117.0
4	1		3/8	4			3744	1,404	1	103.2	97.5	87.8
4	0		3/4	4			3744	2,808	1	206.5	195.0	175.5
5	N/A	64-QAM	2/3	6			5616	3,744	1	275.3	260.0	234.0
6			3/4	6			5616	4,212	1	309.7	292.5	263.3
7			5/6	6			5616	4,680	1	344.1	325.0	292.5
8		256-QAM	3/4	8			7488	5,616	1	412.9	390.0	351.0
9			5/6	8			7488	6,240	1	458.8	433.3	390.0
10		1024-QAM	3/4	10			9360	7,020	1	516.2	487.5	438.8
11			5/6	10			9360	7,800	1	573.5	541.7	487.5

Table 26-71 HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40MHz, Nss = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	1404	351	1	25.8	24.4	21.9
0	0		1/2	1			1404	702	1	51.6	48.8	43.9
1	1	QPSK	1/4	2			2808	702	1	51.6	48.8	43.9
1	0		1/2	2			2808	1,404	1	103.2	97.5	87.8
2	N/A		3/4	2			2808	2,106	1	154.9	146.3	131.6
3	1	16-QAM	1/4	4			5616	1,404	1	103.2	97.5	87.8
3	0		1/2	4			5616	2,808	1	206.5	195.0	175.5
4	1		3/8	4			5616	2,106	1	154.9	146.3	131.6
4	0		3/4	4			5616	4,212	1	309.7	292.5	263.3
5	N/A	64-QAM	2/3	6			8424	5,616	1	412.9	390.0	351.0
6			3/4	6			8424	6,318	1	464.6	438.8	394.9
7			5/6	6			8424	7,020	1	516.2	487.5	438.8
8		256-QAM	3/4	8			11232	8,424	1	619.4	585.0	526.5
9			5/6	8			11232	9,360	1	688.2	650.0	585.0
10		1024-QAM	3/4	10			14040	10,530	1	774.3	731.3	658.1
11			5/6	10			14040	11,700	1	860.3	812.5	731.3

Table 26-72 HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40MHz, Nss = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	1872	468	1	34.4	32.5	29.3
0	0		1/2	1			1872	936	1	68.8	65.0	58.5
1	1	QPSK	1/4	2			3744	936	1	68.8	65.0	58.5
1	0		1/2	2			3744	1,872	1	137.6	130.0	117.0
2	N/A		3/4	2			3744	2,808	1	206.5	195.0	175.5
3	1	16-QAM	1/4	4			7488	1,872	1	137.6	130.0	117.0
3	0		1/2	4			7488	3,744	1	275.3	260.0	234.0
4	1		3/8	4			7488	2,808	1	206.5	195.0	175.5
4	0		3/4	4			7488	5,616	1	412.9	390.0	351.0
5	N/A	64-QAM	2/3	6			11232	7,488	1	550.6	520.0	468.0
6			3/4	6			11232	8,424	1	619.4	585.0	526.5
7			5/6	6			11232	9,360	1	688.2	650.0	585.0
8		256-QAM	3/4	8			14976	11,232	1	825.9	780.0	702.0
9			5/6	8			14976	12,480	1	917.6	866.7	780.0
10		1024-QAM	3/4	10			18720	14,040	1	1,032.4	975.0	877.5
11			5/6	10			18720	15,600	1	1,147.1	1,083.3	975.0

Table 26-73 HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40MHz, Nss = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	2340	585	1	43.0	40.6	36.6
0	0		1/2	1			2340	1,170	1	86.0	81.3	73.1
1	1	QPSK	1/4	2			4680	1,170	1	86.0	81.3	73.1
1	0		1/2	2			4680	2,340	1	172.1	162.5	146.3
2	N/A		3/4	2			4680	3,510	1	258.1	243.8	219.4
3	1	16-QAM	1/4	4			9360	2,340	1	172.1	162.5	146.3
3	0		1/2	4			9360	4,680	1	344.1	325.0	292.5
4	1		3/8	4			9360	3,510	1	258.1	243.8	219.4
4	0		3/4	4			9360	7,020	1	516.2	487.5	438.8
5	N/A	64-QAM	2/3	6			14040	9,360	1	688.2	650.0	585.0
6			3/4	6			14040	10,530	1	774.3	731.3	658.1
7			5/6	6			14040	11,700	1	860.3	812.5	731.3
8		256-QAM	3/4	8			18720	14,040	1	1,032.4	975.0	877.5
9			5/6	8			18720	15,600	1	1,147.1	1,083.3	975.0
10		1024-QAM	3/4	10			23400	17,550	1	1,290.4	1,218.8	1,096.9
11			5/6	10			23400	19,500	1	1,433.8	1,354.2	1,218.8

Table 26-74 HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40MHz, Nss = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	2808	702	1	51.6	48.8	43.9
0	0		1/2	1			2808	1,404	1	103.2	97.5	87.8
1	1	QPSK	1/4	2			5616	1,404	1	103.2	97.5	87.8
1	0		1/2	2			5616	2,808	1	206.5	195.0	175.5
2	N/A		3/4	2			5616	4,212	1	309.7	292.5	263.3
3	1	16-QAM	1/4	4			11232	2,808	1	206.5	195.0	175.5
3	0		1/2	4			11232	5,616	1	412.9	390.0	351.0
4	1		3/8	4			11232	4,212	1	309.7	292.5	263.3
4	0		3/4	4			11232	8,424	1	619.4	585.0	526.5
5	N/A	64-QAM	2/3	6			16848	11,232	1	825.9	780.0	702.0
6			3/4	6			16848	12,636	1	929.1	877.5	789.8
7			5/6	6			16848	14,040	1	1,032.4	975.0	877.5
8		256-QAM	3/4	8			22464	16,848	1	1,238.8	1,170.0	1,053.0
9			5/6	8			22464	18,720	1	1,376.5	1,300.0	1,170.0
10		1024-QAM	3/4	10			28080	21,060	1	1,548.5	1,462.5	1,316.3
11			5/6	10			28080	23,400	1	1,720.6	1,625.0	1,462.5

Table 26-75 HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40MHz, Nss = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	3276	819	1	60.2	56.9	51.2
0	0		1/2	1			3276	1,638	1	120.4	113.8	102.4
1	1	QPSK	1/4	2			6552	1,638	1	120.4	113.8	102.4
1	0		1/2	2			6552	3,276	1	240.9	227.5	204.8
2	N/A		3/4	2			6552	4,914	1	361.3	341.3	307.1
3	1	16-QAM	1/4	4			13104	3,276	1	240.9	227.5	204.8
3	0		1/2	4			13104	6,552	1	481.8	455.0	409.5
4	1		3/8	4			13104	4,914	1	361.3	341.3	307.1
4	0		3/4	4			13104	9,828	1	722.6	682.5	614.3
5	N/A	64-QAM	2/3	6			19656	13,104	1	963.5	910.0	819.0
6			3/4	6			19656	14,742	1	1,084.0	1,023.8	921.4
7			5/6	6			19656	16,380	1	1,204.4	1,137.5	1,023.8
8		256-QAM	3/4	8			26208	19,656	1	1,445.3	1,365.0	1,228.5
9			5/6	8			26208	21,840	1	1,605.9	1,516.7	1,365.0
10		1024-QAM	3/4	10			32760	24,570	1	1,806.6	1,706.3	1,535.6
11			5/6	10			32760	27,300	1	2,007.4	1,895.8	1,706.3

Table 26-76 HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40MHz, Nss = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	3744	936	1	68.8	65.0	58.5
0	0		1/2	1			3744	1,872	1	137.6	130.0	117.0
1	1	QPSK	1/4	2			7488	1,872	1	137.6	130.0	117.0
1	0		1/2	2			7488	3,744	1	275.3	260.0	234.0
2	N/A		3/4	2			7488	5,616	1	412.9	390.0	351.0
3	1	16-QAM	1/4	4			14976	3,744	1	275.3	260.0	234.0
3	0		1/2	4			14976	7,488	1	550.6	520.0	468.0
4	1		3/8	4			14976	5,616	1	412.9	390.0	351.0
4	0		3/4	4			14976	11,232	1	825.9	780.0	702.0
5	N/A	64-QAM	2/3	6			22464	14,976	1	1,101.2	1,040.0	936.0
6			3/4	6			22464	16,848	1	1,238.8	1,170.0	1,053.0
7			5/6	6			22464	18,720	1	1,376.5	1,300.0	1,170.0
8		256-QAM	3/4	8			29952	22,464	1	1,651.8	1,560.0	1,404.0
9			5/6	8			29952	24,960	1	1,835.3	1,733.3	1,560.0
10		1024-QAM	3/4	10			37440	28,080	1	2,064.7	1,950.0	1,755.0
11			5/6	10			37440	31,200	1	2,294.1	2,166.7	1,950.0

Table 26-77 HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80MHz, Nss = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	980	245	1	18.0	17.0	15.3
0	0		1/2	1			980	490	1	36.0	34.0	30.6
1	1	QPSK	1/4	2			1960	490	1	36.0	34.0	30.6
1	0		1/2	2			1960	980	1	72.1	68.1	61.3
2	N/A		3/4	2			1960	1,470	1	108.1	102.1	91.9
3	1	16-QAM	1/4	4			3920	980	1	72.1	68.1	61.3
3	0		1/2	4			3920	1,960	1	144.1	136.1	122.5
4	1		3/8	4			3920	1,470	1	108.1	102.1	91.9
4	0		3/4	4			3920	2,940	1	216.2	204.2	183.8
5	N/A	64-QAM	2/3	6			5880	3,920	1	288.2	272.2	245.0
6			3/4	6			5880	4,410	1	324.3	306.3	275.6
7			5/6	6			5880	4,900	1	360.3	340.3	306.3
8		256-QAM	3/4	8			7840	5,880	1	432.4	408.3	367.5
9			5/6	8			7840	6,533	1	480.4	453.7	408.3
10		1024-QAM	3/4	10			9800	7,350	1	540.4	510.4	459.4
11			5/6	10			9800	8,166	1	600.4	567.1	510.4

Table 26-78 HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80MHz, Nss = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	1960	490	1	36.0	34.0	30.6
0	0		1/2	1			1960	980	1	72.1	68.1	61.3
1	1	QPSK	1/4	2			3920	980	1	72.1	68.1	61.3
1	0		1/2	2			3920	1,960	1	144.1	136.1	122.5
2	N/A		3/4	2			3920	2,940	1	216.2	204.2	183.8
3	1	16-QAM	1/4	4			7840	1,960	1	144.1	136.1	122.5
3	0		1/2	4			7840	3,920	1	288.2	272.2	245.0
4	1		3/8	4			7840	2,940	1	216.2	204.2	183.8
4	0		3/4	4			7840	5,880	1	432.4	408.3	367.5
5	N/A	64-QAM	2/3	6			11760	7,840	1	576.5	544.4	490.0
6			3/4	6			11760	8,820	1	648.5	612.5	551.3
7			5/6	6			11760	9,800	1	720.6	680.6	612.5
8		256-QAM	3/4	8			15680	11,760	1	864.7	816.7	735.0
9			5/6	8			15680	13,066	1	960.7	907.4	816.6
10		1024-QAM	3/4	10			19600	14,700	1	1,080.9	1,020.8	918.8
11			5/6	10			19600	16,333	1	1,201.0	1,134.2	1,020.8

Table 26-79 HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80MHz, Nss = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	2940	735	1	54.0	51.0	45.9
0	0		1/2	1			2940	1,470	1	108.1	102.1	91.9
1	1	QPSK	1/4	2			5880	1,470	1	108.1	102.1	91.9
1	0		1/2	2			5880	2,940	1	216.2	204.2	183.8
2	N/A		3/4	2			5880	4,410	1	324.3	306.3	275.6
3	1	16-QAM	1/4	4			11760	2,940	1	216.2	204.2	183.8
3	0		1/2	4			11760	5,880	1	432.4	408.3	367.5
4	1		3/8	4			11760	4,410	1	324.3	306.3	275.6
4	0		3/4	4			11760	8,820	1	648.5	612.5	551.3
5	N/A	64-QAM	2/3	6			17640	11,760	1	864.7	816.7	735.0
6			3/4	6			17640	13,230	1	972.8	918.8	826.9
7			5/6	6			17640	14,700	1	1,080.9	1,020.8	918.8
8		256-QAM	3/4	8			23520	17,640	1	1,297.1	1,225.0	1,102.5
9			5/6	8			23520	19,600	1	1,441.2	1,361.1	1,225.0
10		1024-QAM	3/4	10			29400	22,050	1	1,621.3	1,531.3	1,378.1
11			5/6	10			29400	24,500	1	1,801.5	1,701.4	1,531.3

Table 26-80 HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80MHz, Nss = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	3920	980	1	72.1	68.1	61.3
0	0		1/2	1			3920	1,960	1	144.1	136.1	122.5
1	1	QPSK	1/4	2			7840	1,960	1	144.1	136.1	122.5
1	0		1/2	2			7840	3,920	1	288.2	272.2	245.0
2	N/A		3/4	2			7840	5,880	1	432.4	408.3	367.5
3	1	16-QAM	1/4	4			15680	3,920	1	288.2	272.2	245.0
3	0		1/2	4			15680	7,840	1	576.5	544.4	490.0
4	1		3/8	4			15680	5,880	1	432.4	408.3	367.5
4	0		3/4	4			15680	11,760	1	864.7	816.7	735.0
5	N/A	64-QAM	2/3	6			23520	15,680	1	1,152.9	1,088.9	980.0
6			3/4	6			23520	17,640	1	1,297.1	1,225.0	1,102.5
7			5/6	6			23520	19,600	1	1,441.2	1,361.1	1,225.0
8		256-QAM	3/4	8			31360	23,520	1	1,729.4	1,633.3	1,470.0
9			5/6	8			31360	26,133	1	1,921.5	1,814.8	1,633.3
10		1024-QAM	3/4	10			39200	29,400	1	2,161.8	2,041.7	1,837.5
11			5/6	10			39200	32,666	1	2,401.9	2,268.5	2,041.6

Table 26-81 HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80MHz, Nss = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	4900	1,225	1	90.1	85.1	76.6
0	0		1/2	1			4900	2,450	1	180.1	170.1	153.1
1	1	QPSK	1/4	2			9800	2,450	1	180.1	170.1	153.1
1	0		1/2	2			9800	4,900	1	360.3	340.3	306.3
2	N/A		3/4	2			9800	7,350	1	540.4	510.4	459.4
3	1	16-QAM	1/4	4			19600	4,900	1	360.3	340.3	306.3
3	0		1/2	4			19600	9,800	1	720.6	680.6	612.5
4	1		3/8	4			19600	7,350	1	540.4	510.4	459.4
4	0		3/4	4			19600	14,700	1	1,080.9	1,020.8	918.8
5	N/A	64-QAM	2/3	6			29400	19,600	1	1,441.2	1,361.1	1,225.0
6			3/4	6			29400	22,050	1	1,621.3	1,531.3	1,378.1
7			5/6	6			29400	24,500	1	1,801.5	1,701.4	1,531.3
8		256-QAM	3/4	8			39200	29,400	1	2,161.8	2,041.7	1,837.5
9			5/6	8			39200	32,666	1	2,401.9	2,268.5	2,041.6
10		1024-QAM	3/4	10			49000	36,750	1	2,702.2	2,552.1	2,296.9
11			5/6	10			49000	40,833	1	3,002.4	2,835.6	2,552.1

Table 26-82 HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80MHz, Nss = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	5880	1,470	1	108.1	102.1	91.9
0	0		1/2	1			5880	2,940	1	216.2	204.2	183.8
1	1	QPSK	1/4	2			11760	2,940	1	216.2	204.2	183.8
1	0		1/2	2			11760	5,880	1	432.4	408.3	367.5
2	N/A		3/4	2			11760	8,820	1	648.5	612.5	551.3
3	1	16-QAM	1/4	4			23520	5,880	1	432.4	408.3	367.5
3	0		1/2	4			23520	11,760	1	864.7	816.7	735.0
4	1		3/8	4			23520	8,820	1	648.5	612.5	551.3
4	0		3/4	4			23520	17,640	1	1,297.1	1,225.0	1,102.5
5	N/A	64-QAM	2/3	6			35280	23,520	1	1,729.4	1,633.3	1,470.0
6			3/4	6			35280	26,460	1	1,945.6	1,837.5	1,653.8
7			5/6	6			35280	29,400	1	2,161.8	2,041.7	1,837.5
8		256-QAM	3/4	8			47040	35,280	1	2,594.1	2,450.0	2,205.0
9			5/6	8			47040	39,200	1	2,882.4	2,722.2	2,450.0
10		1024-QAM	3/4	10			58800	44,100	1	3,242.6	3,062.5	2,756.3
11			5/6	10			58800	49,000	1	3,602.9	3,402.8	3,062.5

Table 26-83 HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80MHz, Nss = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	6860	1,715	1	126.1	119.1	107.2
0	0		1/2	1			6860	3,430	1	252.2	238.2	214.4
1	1	QPSK	1/4	2			13720	3,430	1	252.2	238.2	214.4
1	0		1/2	2			13720	6,860	1	504.4	476.4	428.8
2	N/A		3/4	2			13720	10,290	1	756.6	714.6	643.1
3	1	16-QAM	1/4	4			27440	6,860	1	504.4	476.4	428.8
3	0		1/2	4			27440	13,720	1	1,008.8	952.8	857.5
4	1		3/8	4			27440	10,290	1	756.6	714.6	643.1
4	0		3/4	4			27440	20,580	1	1,513.2	1,429.2	1,286.3
5	N/A	64-QAM	2/3	6			41160	27,440	1	2,017.6	1,905.6	1,715.0
6			3/4	6			41160	30,870	1	2,269.9	2,143.8	1,929.4
7			5/6	6			41160	34,300	1	2,522.1	2,381.9	2,143.8
8		256-QAM	3/4	8			54880	41,160	1	3,026.5	2,858.3	2,572.5
9			5/6	8			54880	45,733	1	3,362.7	3,175.9	2,858.3
10		1024-QAM	3/4	10			68600	51,450	1	3,783.1	3,572.9	3,215.6
11			5/6	10			68600	57,166	1	4,203.4	3,969.9	3,572.9

Table 26-84 HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80MHz, Nss = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	7840	1,960	1	144.1	136.1	122.5
0	0		1/2	1			7840	3,920	1	288.2	272.2	245.0
1	1	QPSK	1/4	2			15680	3,920	1	288.2	272.2	245.0
1	0		1/2	2			15680	7,840	1	576.5	544.4	490.0
2	N/A		3/4	2			15680	11,760	1	864.7	816.7	735.0
3	1	16-QAM	1/4	4			31360	7,840	1	576.5	544.4	490.0
3	0		1/2	4			31360	15,680	1	1,152.9	1,088.9	980.0
4	1		3/8	4			31360	11,760	1	864.7	816.7	735.0
4	0		3/4	4			31360	23,520	1	1,729.4	1,633.3	1,470.0
5	N/A	64-QAM	2/3	6			47040	31,360	1	2,305.9	2,177.8	1,960.0
6			3/4	6			47040	35,280	1	2,594.1	2,450.0	2,205.0
7			5/6	6			47040	39,200	1	2,882.4	2,722.2	2,450.0
8		256-QAM	3/4	8			62720	47,040	1	3,458.8	3,266.7	2,940.0
9			5/6	8			62720	52,266	1	3,843.1	3,629.6	3,266.6
10		1024-QAM	3/4	10			78400	58,800	1	4,323.5	4,083.3	3,675.0
11			5/6	10			78400	65,333	1	4,803.9	4,537.0	4,083.3

Table 26-85 HE-MCSs for optional non-OFDMA 160/80+80MHz, Nss = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	1960	490	1	36.0	34.0	30.6
0	0		1/2	1			1960	980	1	72.1	68.1	61.3
1	1	QPSK	1/4	2			3920	980	1	72.1	68.1	61.3
1	0		1/2	2			3920	1,960	1	144.1	136.1	122.5
2	N/A		3/4	2			3920	2,940	1	216.2	204.2	183.8
3	1	16-QAM	1/4	4			7840	1,960	1	144.1	136.1	122.5
3	0		1/2	4			7840	3,920	1	288.2	272.2	245.0
4	1		3/8	4			7840	2,940	1	216.2	204.2	183.8
4	0		3/4	4			7840	5,880	1	432.4	408.3	367.5
5	N/A	64-QAM	2/3	6			11760	7,840	1	576.5	544.4	490.0
6			3/4	6			11760	8,820	1	648.5	612.5	551.3
7			5/6	6			11760	9,800	1	720.6	680.6	612.5
8		256-QAM	3/4	8			15680	11,760	1	864.7	816.7	735.0
9			5/6	8			15680	13,066	1	960.7	907.4	816.6
10		1024-QAM	3/4	10			19600	14,700	1	1,080.9	1,020.8	918.8
11			5/6	10			19600	16,333	1	1,201.0	1,134.2	1,020.8

Table 26-86 HE-MCSs for optional non-OFDMA 160/80+80MHz, Nss = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	3920	980	1	72.1	68.1	61.3
0	0		1/2	1			3920	1,960	1	144.1	136.1	122.5
1	1	QPSK	1/4	2			7840	1,960	1	144.1	136.1	122.5
1	0		1/2	2			7840	3,920	1	288.2	272.2	245.0
2	N/A		3/4	2			7840	5,880	1	432.4	408.3	367.5
3	1	16-QAM	1/4	4			15680	3,920	1	288.2	272.2	245.0
3	0		1/2	4			15680	7,840	1	576.5	544.4	490.0
4	1		3/8	4			15680	5,880	1	432.4	408.3	367.5
4	0		3/4	4			15680	11,760	1	864.7	816.7	735.0
5	N/A	64-QAM	2/3	6			23520	15,680	1	1,152.9	1,088.9	980.0
6			3/4	6			23520	17,640	1	1,297.1	1,225.0	1,102.5
7			5/6	6			23520	19,600	1	1,441.2	1,361.1	1,225.0
8		256-QAM	3/4	8			31360	23,520	1	1,729.4	1,633.3	1,470.0
9			5/6	8			31360	26,133	1	1,921.5	1,814.8	1,633.3
10		1024-QAM	3/4	10			39200	29,400	1	2,161.8	2,041.7	1,837.5
11			5/6	10			39200	32,666	1	2,401.9	2,268.5	2,041.6

Table 26-87 HE-MCSs for optional non-OFDMA 160/80+80MHz, Nss = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	5880	1,470	1	108.1	102.1	91.9
0	0		1/2	1			5880	2,940	1	216.2	204.2	183.8
1	1	QPSK	1/4	2			11760	2,940	1	216.2	204.2	183.8
1	0		1/2	2			11760	5,880	1	432.4	408.3	367.5
2	N/A		3/4	2			11760	8,820	1	648.5	612.5	551.3
3	1	16-QAM	1/4	4			23520	5,880	1	432.4	408.3	367.5
3	0		1/2	4			23520	11,760	1	864.7	816.7	735.0
4	1		3/8	4			23520	8,820	1	648.5	612.5	551.3
4	0		3/4	4			23520	17,640	1	1,297.1	1,225.0	1,102.5
5	N/A	64-QAM	2/3	6			35280	23,520	1	1,729.4	1,633.3	1,470.0
6			3/4	6			35280	26,460	1	1,945.6	1,837.5	1,653.8
7			5/6	6			35280	29,400	1	2,161.8	2,041.7	1,837.5
8		256-QAM	3/4	8			47040	35,280	1	2,594.1	2,450.0	2,205.0
9			5/6	8			47040	39,200	1	2,882.4	2,722.2	2,450.0
10		1024-QAM	3/4	10			58800	44,100	1	3,242.6	3,062.5	2,756.3
11			5/6	10			58800	49,000	1	3,602.9	3,402.8	3,062.5

Table 26-88 HE-MCSs for optional non-OFDMA 160/80+80MHz, Nss = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	7840	1,960	1	144.1	136.1	122.5
0	0		1/2	1			7840	3,920	1	288.2	272.2	245.0
1	1	QPSK	1/4	2			15680	3,920	1	288.2	272.2	245.0
1	0		1/2	2			15680	7,840	1	576.5	544.4	490.0
2	N/A		3/4	2			15680	11,760	1	864.7	816.7	735.0
3	1	16-QAM	1/4	4			31360	7,840	1	576.5	544.4	490.0
3	0		1/2	4			31360	15,680	1	1,152.9	1,088.9	980.0
4	1		3/8	4			31360	11,760	1	864.7	816.7	735.0
4	0		3/4	4			31360	23,520	1	1,729.4	1,633.3	1,470.0
5	N/A	64-QAM	2/3	6			47040	31,360	1	2,305.9	2,177.8	1,960.0
6			3/4	6			47040	35,280	1	2,594.1	2,450.0	2,205.0
7			5/6	6			47040	39,200	1	2,882.4	2,722.2	2,450.0
8		256-QAM	3/4	8			62720	47,040	1	3,458.8	3,266.7	2,940.0
9			5/6	8			62720	52,266	1	3,843.1	3,629.6	3,266.6
10		1024-QAM	3/4	10			78400	58,800	1	4,323.5	4,083.3	3,675.0
11			5/6	10			78400	65,333	1	4,803.9	4,537.0	4,083.3

Table 26-89 HE-MCSs for optional non-OFDMA 160/80+80MHz, Nss = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	9800	2,450	1	180.1	170.1	153.1
0	0		1/2	1			9800	4,900	1	360.3	340.3	306.3
1	1	QPSK	1/4	2			19600	4,900	1	360.3	340.3	306.3
1	0		1/2	2			19600	9,800	1	720.6	680.6	612.5
2	N/A		3/4	2			19600	14,700	1	1,080.9	1,020.8	918.8
3	1	16-QAM	1/4	4			39200	9,800	1	720.6	680.6	612.5
3	0		1/2	4			39200	19,600	1	1,441.2	1,361.1	1,225.0
4	1		3/8	4			39200	14,700	1	1,080.9	1,020.8	918.8
4	0		3/4	4			39200	29,400	1	2,161.8	2,041.7	1,837.5
5	N/A	64-QAM	2/3	6			58800	39,200	1	2,882.4	2,722.2	2,450.0
6			3/4	6			58800	44,100	1	3,242.6	3,062.5	2,756.3
7			5/6	6			58800	49,000	1	3,602.9	3,402.8	3,062.5
8		256-QAM	3/4	8			78400	58,800	1	4,323.5	4,083.3	3,675.0
9			5/6	8			78400	65,333	1	4,803.9	4,537.0	4,083.3
10		1024-QAM	3/4	10			98000	73,500	1	5,404.4	5,104.2	4,593.8
11			5/6	10			98000	81,666	1	6,004.9	5,671.3	5,104.1

Table 26-90 HE-MCSs for optional non-OFDMA 160/80+80MHz, Nss = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	11760	2,940	1	216.2	204.2	183.8
0	0		1/2	1			11760	5,880	1	432.4	408.3	367.5
1	1	QPSK	1/4	2			23520	5,880	1	432.4	408.3	367.5
1	0		1/2	2			23520	11,760	1	864.7	816.7	735.0
2	N/A		3/4	2			23520	17,640	1	1,297.1	1,225.0	1,102.5
3	1	16-QAM	1/4	4			47040	11,760	1	864.7	816.7	735.0
3	0		1/2	4			47040	23,520	1	1,729.4	1,633.3	1,470.0
4	1		3/8	4			47040	17,640	1	1,297.1	1,225.0	1,102.5
4	0		3/4	4			47040	35,280	1	2,594.1	2,450.0	2,205.0
5	N/A	64-QAM	2/3	6			70560	47,040	1	3,458.8	3,266.7	2,940.0
6			3/4	6			70560	52,920	1	3,891.2	3,675.0	3,307.5
7			5/6	6			70560	58,800	1	4,323.5	4,083.3	3,675.0
8		256-QAM	3/4	8			94080	70,560	1	5,188.2	4,900.0	4,410.0
9			5/6	8			94080	78,400	1	5,764.7	5,444.4	4,900.0
10		1024-QAM	3/4	10			117600	88,200	1	6,485.3	6,125.0	5,512.5
11			5/6	10			117600	98,000	1	7,205.9	6,805.6	6,125.0

Table 26-91 HE-MCSs for optional non-OFDMA 160/80+80MHz, Nss = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	13720	3,430	1	252.2	238.2	214.4
0	0		1/2	1			13720	6,860	1	504.4	476.4	428.8
1	1	QPSK	1/4	2			27440	6,860	1	504.4	476.4	428.8
1	0		1/2	2			27440	13,720	1	1,008.8	952.8	857.5
2	N/A		3/4	2			27440	20,580	1	1,513.2	1,429.2	1,286.3
3	1	16-QAM	1/4	4			54880	13,720	1	1,008.8	952.8	857.5
3	0		1/2	4			54880	27,440	1	2,017.6	1,905.6	1,715.0
4	1		3/8	4			54880	20,580	1	1,513.2	1,429.2	1,286.3
4	0		3/4	4			54880	41,160	1	3,026.5	2,858.3	2,572.5
5	N/A	64-QAM	2/3	6			82320	54,880	1	4,035.3	3,811.1	3,430.0
6			3/4	6			82320	61,740	1	4,539.7	4,287.5	3,858.8
7			5/6	6			82320	68,600	1	5,044.1	4,763.9	4,287.5
8		256-QAM	3/4	8			109760	82,320	1	6,052.9	5,716.7	5,145.0
9			5/6	8			109760	91,466	1	6,725.4	6,351.8	5,716.6
10		1024-QAM	3/4	10			137200	102,900	1	7,566.2	7,145.8	6,431.3
11			5/6	10			137200	114,333	1	8,406.8	7,939.8	7,145.8

Table 26-92 HE-MCSs for optional non-OFDMA 160/80+80MHz, Nss = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	15680	3,920	1	288.2	272.2	245.0
0	0		1/2	1			15680	7,840	1	576.5	544.4	490.0
1	1	QPSK	1/4	2			31360	7,840	1	576.5	544.4	490.0
1	0		1/2	2			31360	15,680	1	1,152.9	1,088.9	980.0
2	N/A		3/4	2			31360	23,520	1	1,729.4	1,633.3	1,470.0
3	1	16-QAM	1/4	4			62720	15,680	1	1,152.9	1,088.9	980.0
3	0		1/2	4			62720	31,360	1	2,305.9	2,177.8	1,960.0
4	1		3/8	4			62720	23,520	1	1,729.4	1,633.3	1,470.0
4	0		3/4	4			62720	47,040	1	3,458.8	3,266.7	2,940.0
5	N/A	64-QAM	2/3	6			94080	62,720	1	4,611.8	4,355.6	3,920.0
6			3/4	6			94080	70,560	1	5,188.2	4,900.0	4,410.0
7			5/6	6			94080	78,400	1	5,764.7	5,444.4	4,900.0
8		256-QAM	3/4	8			125440	94,080	1	6,917.6	6,533.3	5,880.0
9			5/6	8			125440	104,533	1	7,686.3	7,259.2	6,533.3
10		1024-QAM	3/4	10			156800	117,600	1	8,647.1	8,166.7	7,350.0
11			5/6	10			156800	130,666	1	9,607.8	9,074.0	8,166.6

Annex C

26.6 C.3 MIB Detail

Insert the following (after getting some sucker to validate MIB compilation, etc.):

```
dot11PPEThresholdsRequired OBJECT-TYPE
     SYNTAX TruthValue
     MAX-ACCESS read-only
     STATUS current
     DESCRIPTION
          "This is a capability variable.
          Its value is determined by device capabilities.
          This attribute, when true, indicates that Post-FEC
          Padding and Packet Extension Thresholds exist and are
          provided in the dot11PPEThresholdsTable MIB."
     DEFVAL { false }
     ::= { dot11StationConfigEntry <ANA> }

--------------------------------------------------------------------
------
--
--------------------------------------------------------------------
------
-- * dot11PPEThresholdsMappings TABLE
--
--------------------------------------------------------------------
------
dot11PPEThresholdsMappingsTable OBJECT-TYPE
     SYNTAX SEQUENCE OF Dot11PPEThresholdsMappingsEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          "Conceptual table for PPE Thresholds Mappings. The MIB
          supports the ability to share separate PPE Thresholds
          for each NSS/RU pair. The Thresholds Mappings Table
          contains one entry for each NSS/RU pair and contains
          two fields for each entry: PPET8 and PPET16. The PPE
          Thresholds mappings are logically WRITE-ONLY. Attempts
          to read the entries in this table return unsuccessful
          status and values of null or 0. The default value for
          all PPET8 fields is NONE."
     REFERENCE "IEEE Std 802.11-<year>, 9.47 (HE Post-FEC
Padding and Packet Extension)"
     ::= { dot11smt 4 }

dot11PPEThresholdsMappingsEntry OBJECT-TYPE
     SYNTAX Dot11PPEThresholdsMappingsEntry
```

```
      MAX-ACCESS not-accessible
      STATUS current
      DESCRIPTION
           "An Entry (conceptual row) in the PPE Thresholds
           Mappings Table. ifIndex - Each IEEE Std 802.11
           interface is represented by an ifEntry. Interface
           tables in this MIB module are indexed by ifIndex."
      INDEX { ifIndex, dot11PPEThresholdsMappingIndex }
      ::= { dot11PPEThresholdsMappingsTable 1 }

Dot11PPEThresholdsMappingsEntry ::=
      SEQUENCE {
           dot11PPEThresholdsMappingIndex           Unsigned32,
           dot11PPEThresholdsMappingNSS                Integer,
           dot11PPEThresholdsMappingRUIndex            Integer,
           dot11PPEThresholdsMappingPPET8              Integer,
           dot11PPEThresholdsMappingPPET16             Integer,
           dot11PPEThresholdsMappingStatus          RowStatus }

dot11PPEThresholdsMappingIndex OBJECT-TYPE
      SYNTAX Unsigned32
      MAX-ACCESS not-accessible
      STATUS current
      DESCRIPTION
                "The auxiliary variable used to identify
                instances of the columnar objects in the PPE
                Thresholds Mappings Table."
           ::= { dot11PPEThresholdsMappingsEntry 1 }

dot11PPEThresholdsMappingNSS OBJECT-TYPE
      SYNTAX Integer
      MAX-ACCESS read-create
      STATUS current
      DESCRIPTION
           "The NSS value portion of the NSS/RU pair for which
           the values from this Thresholds mapping entry are to
           be used."
      ::= { dot11PPEThresholdsMappingsEntry 2 }

dot11PPEThresholdsMappingRUIndex OBJECT-TYPE
      SYNTAX Integer
      MAX-ACCESS read-create
      STATUS current
      DESCRIPTION
           "The index of the RU value portion of the NSS/RU pair
           for which the values from this Thresholds mapping
           entry are to be used. The index values map to an RU as
           follows: RU Index of 0 is 996 tones, 1 is 448 tones, 2
           is TBD tones, 3 is reserved."
      ::= { dot11PPEThresholdsMappingsEntry 3 }
```

```
dot11PPEThresholdsMappingPPET8 OBJECT-TYPE
     SYNTAX TruthValue
     MAX-ACCESS read-create
     STATUS current
     DESCRIPTION
          "An index that determines a constellation value at or
          above which a Post FEC Padding and Packet Extension
          value of at least 8 us is required for the given
          NSS/RU pair corresponding to the row of the entry. The
          index values are mapped as follows: 0 is BPSK, 1 is
          QPSK, 2 is 16QAM, 3 is 64QAM, 4 is 256QAM, 5 is
          1024QAM, 6 is reserved, 7 is the special value of
          NONE."
     ::= { dot11PPEThresholdsMappingsEntry 4 }


dot11PPEThresholdsMappingPPET16 OBJECT-TYPE
     SYNTAX TruthValue
     MAX-ACCESS read-create
     STATUS current
     DESCRIPTION
          "An index that determines a constellation value at or
          above which a Post FEC Padding and Packet Extension
          value of 16 us is required for the given NSS/RU pair
          corresponding to the row of the entry. The index
          values are mapped as follows: 0 is BPSK, 1 is QPSK, 2
          is 16QAM, 3 is 64QAM, 4 is 256QAM, 5 is 1024QAM, 6 is
          reserved, 7 is the special value of NONE."
     ::= { dot11PPEThresholdsMappingsEntry 5 }

dot11PPEThresholdsMappingStatus OBJECT-TYPE
     SYNTAX RowStatus
     MAX-ACCESS read-create
     STATUS current
     DESCRIPTION
          "The status column used for creating, modifying, and
          deleting instances of the columnar objects in the PPE
          Thresholds mapping Table."
DEFVAL { active }
     ::= { dot11PPEThresholdsMappingsEntry 6 }

--********************************************************************
******
-- * End of dot11PPEThresholdsMappings TABLE
--
--********************************************************************
******
```

APPENDIX AF

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax, MAC Ad hoc

September 2016 Warsaw TGax MAC Ad hoc Meeting Minutes

Date: 2016-09-13

Author(s):

Name	Affiliation	Address	Phone	email
Reza Hedayat	Newracom			reza.hedayat at newracom.com

Abstract

TGax, MAC Ad Hoc meeting minutes from the IEEE 802.11 Warsaw session, September 12th – 16th, 2016.

IEEE 802.11 Task Group ax, MAC Ad hoc
September 2016 Warsaw Meeting
Grand Hyatt Manchester
September 12th – 16th, 2016

Monday, September 12th, 2016, PM2 TGax Session (16:00-18:30PM)

1. **The meeting called to order at 16:00pm by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 47 people are in the room.

2. **Announcement**
   2.1. Agenda Doc.11-16/1247 on the server. Rev. 0 is the working document.
   2.2. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform. [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents
         [Asked. ~~Did not ask~~]
      3.4.2. Potentially essential patents
         [None reported~~. Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings.

4. **The Chair called for presentations**
   4.1. No additional contributions were requested to be added to the list of contributions.

5. **The Chair asked for approval of the agenda**
   5.1. No objection raised

6. **Presentation of contributions**
   6.1. 11-16/864r4, "d0.1 comment resolution on clause 6"
      6.1.1. Presented by Yasuhiko Inoue (NTT)
      6.1.2. Strawpoll 1:
         6.1.2.1. "Do you agree to add to the 11ax specification D0.4 the comment resolutions in document 16/864r5 for CIDs: 83, 1227, 1228, 1229, 1238, 1239, 1240, 2292, 2293, 2294, 2304, 2305, 2306, 1125, 1230, 1241, 1596,1869, 2420, 1123"
         6.1.2.2. Results: Strawpoll passed with no objection
         6.1.2.3. Note: In Page 16 there is a more recent strawpoll related to the same CIDs but based on document 16/864r6. A TG motion should be based on the more recent strawpoll.

6.2. 11-16/869r1, "Comment resolution section 9.3 TWT"

6.2.1. Presented by Zhou Lan (Broadcom)

6.2.2. Strawpoll 1:

6.2.2.1. "Do you agree to add to the 11ax specification D0.4 the comment resolutions in document 16/869r2 for CIDs: 1315, 2424, 2589, 2590, 2591"

6.2.2.2. Results: Strawpoll passed with no objection

6.3. 11-16/881r0, "Comment resolution on ROMI"

6.3.1. Presented by Jayh Park (LGE)

6.3.2. Strawpoll 1:

6.3.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/881r1 for CIDs: 2, 60, 61, 184, 185, 207, 445, 446, 655, 685, 775, 856, 1223, 1224, 1562, 1565, 1568, 1569, 1572, 1573, 1574, 2200, 2236, 2238, 2239, 2328, 2330, 2657"

6.3.2.2. Results: Strawpoll passed with no objection

6.3.2.3. Note: In Page 6 there is a more recent strawpoll related to the same CIDs but based on document 16/881r2. A TG motion should be based on the more recent strawpoll.

6.4. 11-16/882r0, "Comment resolution on TOMI"

6.4.1. Presented by Alfred Asterjadhi (Qualcomm)

6.4.2. Strawpoll deferred to make additional changes

6.5. 11-16/883r1, "Comment resolution for CID152"

6.5.1. Presented by Jayh Park (LGE)

6.5.2. Strawpoll 1:

6.5.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/883r1 for CIDs: 152"

6.5.2.2. Results: Strawpoll passed with no objection

Tuesday, September 13th, 2016, AM2 TGax Session (10:30-12:30PM)

1. **The meeting called to order at 10:30am by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 37 people are in the room.

2. **Announcement**
   2.1. Agenda Doc.11-16/1247 on the server. Rev. 0 is the working document.
   2.2. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform. [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents
         [Asked. ~~Did not ask~~]
      3.4.2. Potentially essential patents
         [None reported~~. Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings.

4. **The Chair called for presentations**
   4.1. No additional contributions were requested to be added to the list of contributions.

5. **The Chair asked for approval of the agenda**
   5.1. No objection raised

6. **Presentation of contributions**

   6.1. 11-16/884r3, "Spec. Text for HE Operation element and AID Assign Rule"
      6.1.1.
      6.1.2. Presented by Tianyu Wu (MediaTek)
      6.1.3. Strawpoll 1:
         6.1.3.1. "Do you agree to add to the 11ax specification D0.4 the proposed text in document 16/884r3."
         6.1.3.2. Results: Strawpoll passed with no objection
         6.1.3.3. Note: In Page 12 there is a more recent strawpoll related to the same CIDs but based on document 16/884r4. A TG motion should be based on the more recent strawpoll.

   6.2. 11-16/961r2, "Consideration on Multi-STA BlockAck Optimization"
      6.2.1. Presented by Hanseul Hong (Yunsei Univ.)
      6.2.2. Strawpoll 1:
         6.2.2.1. "**Do you agree to add to the spec draft?**

9.3.1.9.7 Multi-STA BlockAck variant
If the Ack Type subfield is 1, the AID value of the Per AID TID Info field is set to 1ess than 2047, and the TID subfield of the Per AID TID Info field is 14, then the Block Ack Starting Sequence Control and Block Ack Bitmap are not present and the Per STA Info field acknowledges successful reception of all the MPDUs carried in the eliciting A-MPDU. The Ack Type field is not set to 1 when responding to a BlockAckReq frame or an MU-BAR frame. If the ACK Type field is 1, the AID value of the Per AID TID Info subfield is set to 2047 and the TID value of the Per AID TID Info subfield is set to 14, then the Block Ack Starting Sequence Control and Block Ack Bitmap are not present and the single Per STA Info field indicates the acknowledgement of successful reception of all the A-MPDUs of all the STAs elicited by the trigger frame."

6.2.2.2. Results: Y/N/A: 4/7/15. Strawpoll failed.

6.3. 11-16/924r0, "NAV resetting with RTS/MU-RTS" and 11-16/925r0, "Spec text on NAV resetting with RTS/MU-RTS"

6.3.1. Presented by Weimin Xing (ZTE)

6.3.2. Strawpoll 1:

6.3.2.1. "Do you agree to add to the 11ax specification D0.4 the proposed text in document 16/925r1."

6.3.2.2. Results: Strawpoll passed with no objection

6.4. 11-16/941r0, "CR HE Fragmentation - part 2"

6.4.1. Presented by Ming Gan (Huawei)

6.4.2. Strawpoll 1:

6.4.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/941r0 for CIDs: 1477, 675, 423, 166, 1823, 2270, 2268, 2254, 2198, 1824, 1818, 1800, 1796, 1663, 1491, 1489, 1488, 2630"

6.4.2.2. Results: Strawpoll passed with no objection

6.5. 11-16/942r1, "CR Service Field"

6.5.1. Presented by Ming Gan (Huawei)

6.5.2. Since the CIDs belong to the PHY ad hoc, the presenter was asked to re-present the CR contribution in PHY ad hoc.

6.6. 11-16/962r5, "EDCA rules-follow up 1"

6.6.1. Presented by Jing Ma (NICT)

6.6.2. Strawpoll 1:

6.6.2.1. **"**Do you agree to add the following sentence to the section 25.5.2.2.3 AP access procedures for UL MU operation on page 92 line 31:

- An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2 (HCF contention based channel access (EDCA)) for obtaining and sharing the TXOP."

6.6.2.2. Results: Y/N/A: 6/1/13

6.7. 11-16/998r0, "Rules for 2 EDCA parameters",
11-16/1180r0, "Proposed text changes for MU EDCA parameters"

6.7.1. Presented by laurent cariou (Intel)

6.7.2. Strawpoll 1:

6.7.2.1. "Do you agree to accept the spec changes proposed in document 16/1180r1"

6.7.2.2. Results: Strawpoll passed with no objection

6.6. 11-16/881r2, "Comment resolution on ROMI"

6.6.1. Presented by Jayh Park (LGE)

6.6.2. Strawpoll 1:

6.6.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/881r2 for CIDs: 2, 60, 61, 184, 185, 207, 445, 446, 655, 685, 775, 856, 1223, 1224, 1562, 1565, 1568, 1569, 1572, 1573, 1574, 2200, 2236, 2238, 2239, 2328, 2330, 2657"

6.6.2.2. Results: Strawpoll passed with no objection

Tuesday, September 13th, 2016, PM2 TGax Session (16:00-18:30PM)

1. **The meeting called to order at 16:00pm by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 48 people are in the room.

2. **Announcement**
   2.1. Agenda Doc.11-16/1247 on the server. Rev. 0 is the working document.
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   3.3. Patent Related Links. [reviewed~~, did not review~~]
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      3.4.1. Chair asked if anyone is aware of potentially essential patents
         [Asked. ~~Did not ask~~]
      3.4.2. Potentially essential patents
         [None reported~~. Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings.

4. **The Chair called for presentations**
   4.1. No additional contributions were requested to be added to the list of contributions.

5. **The Chair asked for approval of the agenda**
   5.1. No objection raised

6. **Presentation of contributions**

   6.1. 11-16/1110r0, "comment resolution on subclause 10.22.2 and 10.22.4"
      6.1.1. Presented by Yongho Srok (Newracom)
      6.1.2. Strawpoll 1:
         6.1.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1110r0 for CIDs: 2468, 2470, 2448, 2450, 2451, 809"
         6.1.2.2. Results: Strawpoll passed with no objection

   6.2. 11-16/1131r2, "comment resolution on mu ack policy"
      6.2.1. Presented by Yongho Srok (Newracom)
      6.2.2. Strawpoll 1:
         6.2.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1131r2 for CIDs:"
         6.2.2.2. Results: Strawpoll passed with no objection

   6.3. 11-16/1157r0, "Comment resolution on SU_MU ACK procedures"

6.3.1. Presented by Jeongki Kim (LGE)
6.3.2. Strawpoll 1:
6.3.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1157r0 for CIDs: 129, 130, 131, 132, 405, 406, 407, 408, 672"
6.6.2.3. Results: Strawpoll passed with no objection

6.4. 11-16/1181r1, "CW value after UL MU procedure"
6.4.1. Presented by Woojin Ahn (Willus)
6.4.2. Strawpoll 2:
6.4.2.1. "Do you agree to the spec test changes as below:

10.22.2.2 EDCA backoff procedure

When an HE STA successfully receives the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff timer countdown. If the remaining backoff timer reaches zero and no data exists for that AC, the CW[AC] value shall be set to CW_{min}[AC] "
6.4.2.2. Results: Y/N/A: 6/19/7. Strawpoll failed.

6.5. 11-16/1184r0, "A-MPDU 25.10 25.10.2 comment resolution"
6.5.1. Presented by Liwen Chu (Marvell)
6.5.2. Strawpoll 1:
- "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1184r1 for CIDs: 2258, 2446, 1588, 1645"

6.6.2.4. Results: Strawpoll passed with no objection

6.6. 11-16/1188r0, "MAC Capabilities in HE Capabilities IE"
6.6.1. Presented by Alfred Asterjadhi (Qualcomm)
6.6.2. Strawpoll 1:
6.6.2.1. "Do you agree to add the subfields below to the HE Capabilities IE?"

	+HTC-HE Support	HE Link Adaptation	All Ack Support	32 bit BA Bitmap Support	MU Cascading Supported	Broadcast TWT Supported	Ack-enabled Multi-TID Aggregation Support	Group Addressed Multi-STA BlockAck In DL MU Support	OMI A-Control Support	OFDMA RA Support
Bits:	1	2	1	1	1	1	1	1	1	1

6.6.2.2. Results: Strawpoll passed with no objection

6.6.3. Strawpoll 2:
6.6.3.1. "Do you support that:
- The reception of Action (ACK) frame aggregated with Data is optional.
- The reception of acknowledgement frames (ACK, BA, M-BA) aggregated with Data is optional (indicated via MU Cascading Supported bit).

- The reception of Basic variant Trigger frame aggregated with Data is mandatory."

Results: Strawpoll passed with no objection

Wednesday, September 14th, 2016, PM1 TGax Session (13:30-16:00PM)

1. **The meeting called to order at 13:30pm by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 50 people are in the room.

2. **Announcement**
   2.1. Agenda Doc.11-16/1247 on the server. Rev. 1 is the working document.
   2.2. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform. [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents
         [Asked. ~~Did not ask~~]
      3.4.2. Potentially essential patents
         [None reported~~. Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings.

4. **The Chair called for presentations**
   4.1. No additional contributions were requested to be added to the list of contributions.

5. **The Chair asked for approval of the agenda**
   5.1. No objection raised

6. **Presentation of contributions**

   6.1. 11-16/1185r1, "25.10.3 A-MPDU comment resolution**"**
      6.1.1. Presented by Liwen Chu(Marvell)
      6.1.2. Strawpoll 1:
         6.1.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1185r2 for CIDs: 984, 70, 229, 191, 2670, 1379, 1380"
         6.1.2.2. Results: Strawpoll passed with no objection

   6.7. 11-16/882r1, "Comment resolution on TOMI"
      6.7.1. Presented by Alfred Asterjadhi (Qualcomm)
      6.7.2. Strawpoll 1
         6.7.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/882r1 for CIDs: 95, 365, 656, 794, 1134, 1135, 1260, 2298, 2407, 2463, 2469, 2658, 2659"
         6.7.2.2. Results: 11/6/22. Strawpoll failed

6.7.3. Strawpoll 2

6.7.3.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/882r2 for CIDs: 95, 365, 656, 794, 1134, 1135, 1260, 2298, 2407, 2463, 2469, 2658, 2659"

6.7.3.2. Results: Strawpoll passed with no objection

6.7.3.3. Note: In Page 16 there is a more recent strawpoll related to the same CIDs but based on document 16/882r3. A TG motion should be based on the more recent strawpoll.

6.8. 11-16/1189r1, "CC0-TWT operation"

6.8.1. Presented by Alfred Asterjadhi (Qualcomm)

6.8.2. Strawpoll deferred to the next session.

Wednesday, September 14th, 2016, PM2 TGax Session (16:00-18:00PM)

1. **The meeting called to order at 16:00pm by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 50 people are in the room.

2. **Announcement**
   2.1. Agenda Doc.11-16/1247 on the server. Rev. 1 is the working document.
   2.2. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform. [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents
         [Asked. ~~Did not ask~~]
      3.4.2. Potentially essential patents
         [None reported~~. Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings.

4. **The Chair called for presentations**
   4.1. No additional contributions were requested to be added to the list of contributions.
   4.2. During the session it was requested to add document 16/1241 to the contribution list.

5. **The Chair asked for approval of the agenda**
   5.1. No objection raised

6. **Presentation of contributions**

1.1. 11-16/884r4, "Spec. Text for HE Operation element and AID Assign Rule"
   1.1.1. Presented by Tianyu Wu (MediaTek)
   1.1.2. Strawpoll 1:
      1.1.2.1. "Do you agree to add to the 11ax specification D0.4 the proposed text in document 16/884r5."
      1.1.2.2. Results: Strawpoll passed with no objection

6.9. 11-16/1189r2, "CC0-TWT operation"
   6.9.1. Presented by Alfred Asterjadhi (Qualcomm)
   6.9.2. Strawpoll 1
      6.9.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1189r2 for CIDs: 1214, 1779, 1658, 2899, 959, 416, 1735, 740, 1445, 1639, 137, 139, 2398, 2399, 1640, 1738, 2616, 1651, 1652, 1736, 1737, 742, 25, 138, 2617, 1653, 744, 957, 26, 141, 420, 142, 2618,

1741, 1874, 2400, 2845, 1649, 1650, 1740, 1739, 695, 1641, 976, 144, 1077, 145, 146, 452, 1642, 2619, 2621, 1643, 1647, 958, 745, 586, 143, 2622, 2820, 1656, 1654, 1657, 1646, 1318, 544, 155, 153, 151"

6.9.2.2. Results: Strawpoll passed with no objection

6.10. 11-16/1195r1, "MAC Clarifications"

6.10.1. Presented by Alfred Asterjadhi (Qualcomm)

6.10.2. Strawpoll 1

6.10.2.1. "Do you support to instruct the TGax Editor to make the following changes:

TGax Editor: Change the paragraph below of 9.3.1.23.1 of D0.4 as follows:

The TID Aggregation Limit subfield indicates the maximum number of TIDs ~~minus 1~~ that can be aggregated by a STA in a multi-TID A-MPDU carried in the responding HE trigger-based PPDU.

NOTE– A value of 7 in the TID Aggregation Limit subfield indicates to the STA that it can aggregate QoS Data frames from any number of different TID values in the multi-TID A-MPDU.

TGax Editor: Change the paragraph below of 25.5.2.2.2 of D0.4 as follows:

The AP shall set the value in the TID Aggregation Limit subfield in the Type dependent Per User Information field to 0 or 1 for an HE STA with STA that has indicated a zero value in the Multi-TID Aggregation Support field of the HE Capabilities element it transmits and is identified by the AID12 subfield of the User Info field of a Basic Trigger variant Trigger frame (see 9.3.1.23 (Trigger frame format)).(#2669) A value of zero indicates to the STA that it shall not solicit any immediate response for the MPDUs that the STA aggregates in the Trigger-based PPDU.

6.10.2.2. Results: Strawpoll passed with no objection

6.10.3. Strawpoll 2

6.10.3.1. "Do you support the following NAV update rule: A STA shall update its NAV, irrespectively of whether it is the intended receiver of an MPDU contained in the received PPDU, except that it shall ignore the NAV if the PPDU solicits an immediate response from the STA."

6.10.3.2. Results: Strawpoll passed with no objection

6.10.3.3. Note: the spec text changes related to this strawpoll would be in a separate contribution that will be presented in MU ad hoc.

6.1. 11-16/1204r0, "Intra-PPDU Power Save for a Multiple BSSID Set Case", 11-16/1205r0, "Text for Intra-PPDU Power Save for a Multiple BSSID Set Case",

6.1.1. Presented by Geonjung Ko (Willus)

6.1.2. Strawpoll 1:

6.1.2.1. "Do you agree to add to the 11ax specification D0.1 the proposed spec text change in document 16/1205r0"

6.1.2.2. Results: Strawpoll passed with no objection

6.2. 11-16/1210r0, "Comment Resolution on MU acknowledgement procedure"

6.2.1. Presented by Juninchi Iwatani (NTT)

6.2.2. Strawpoll 1:

6.2.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1210r1 for CIDs: 2313, 1410, 1454, 1728, 1897, 1411, 1729, 1898, 1899, 1730, 1731, 1403, 1427, 1409, 20, 1732, 1733, 17, 133"

6.2.2.2. Results: Strawpoll passed with no objection

6.3. 11-16/1211r1, "CR_CID_122_576_972_2598"

6.3.1. Presented by Huizhao Wang (Quantenna)

6.3.2. Strawpoll 1:

6.3.2.1. "**Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1211r2 for CIDs:122, 576, 972, 2598**"

6.3.2.2. Results: Strawpoll passed with no objection

6.4. 11-16/1266r2, "CC23 Proposed Resolutions for Elements"

6.4.1. Presented by Matthew Fischer (Broadcom)

6.4.2. Strawpoll deferred to the next session.

Thursday, September 15th, 2016, AM1 TGax Session (08:00-10:30AM)

1. **The meeting called to order at 8:00am by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 40 people are in the room.

2. **Announcement**
   2.1. Agenda Doc.11-16/1247 on the server. Rev. 1 is the working document.
   2.2. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform. [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents
         [Asked. ~~Did not ask~~]
      3.4.2. Potentially essential patents
         [None reported~~. Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings.
4. **The Chair called for presentations**
   4.1. No additional contributions were requested to be added to the list of contributions.
5. **The Chair asked for approval of the agenda**
   5.1. No objection raised
6. **Presentation of contributions**

   6.1. **11-16/1186r0, "**A-MPDU Content Comment Resolution**"**
      6.1.1. Presented by Liwen Chu (Marvell)
      6.1.2. Strawpoll 1:
         6.1.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1186r1 for CIDs: 805, 1354, 1356, 1357, 1358, 1360, 1359, 668, 1792, 2475, 2477, 2478, 2479, 2480, 1527, 2263, 120, 1366, 10, 1368, 1369, 1371, 1372, 1374, 1375, 394, 11,12, 669, 1378, 1376, 2455, 2592, 1381, 1384, 2456, 1377, 1635, 1804, 2309, 1367, 670, 2593, 2594, 2595, 1386"
         6.1.2.2. Results: Strawpoll passed with no objection

   6.11. 11-16/864r6, "d0.1 comment resolution on clause 6"
      6.11.1. Presented by Yasuhiko Inoue (NTT)
      6.11.2. Strawpoll 1:
         6.11.2.1. "Do you agree to add to the 11ax specification D0.4 the comment resolutions in document 16/864r6 for CIDs: 83, 1227, 1228, 1229, 1238, 1239, 1240, 2292, 2293, 2294, 2304, 2305, 2306, 1125, 1230, 1241, 1596,1869, 2420, 1123"
         6.11.2.2. Results: Strawpoll passed with no objection

6.12. 11-16/882r3, "Comment resolution on TOMI"

6.12.1. Presented by Alfred Asterjadhi (Qualcomm)

6.12.2. Strawpoll 2

6.12.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/882r3 for CIDs: 95, 365, 656, 794, 1134, 1135, 1260, 2298, 2407, 2463, 2469, 2658, 2659"

6.12.2.2. Results: Strawpoll passed with no objection

6.2. 11-16/1220r1, "MU mode EDCA control"

6.2.1. Presented by Jinsoo Ahn (Yunsei Univ.)

6.2.2. Strawpoll 1:

6.2.2.1. "**Do you agree to add the following text to Spec Draft?**

25.2.2 Obtaining an EDCA TxOP for UL MU capable STAs

- When the HEMUEDCATimer of an HE non-AP STA reaches 0, the backoff for the associated EDCAF resumes the backoff counter countdown and legacy EDCA parameters shall not be applied until the EDCAF initialization
  - Never changes existing back-off value
  - Gets a retransmission back-off counter from doubled CW value originated from MU_CW_min after the timer expire"

6.2.2.2. Results: Y/N/A: 5/14/many

6.3. 11-16/1237r0, "setting-quiet-time-period"

6.3.1. Presented by Chao-Chun Wang (MediaTek)

6.3.2. Strawpoll 1:

6.3.2.1. "Do you agree to include a mechanism based on the quiet time period element presented in this submission (16/1237r0) to 11ax specification

- The supportive amendment text will be provided at a later time"

6.3.2.2. Results: Y/N/A: 17/4/12

6.4. 11-16/1266r3, "CC23 Proposed Resolutions for Elements"

6.4.1. Presented by Matthew Fischer (Broadcom)

6.4.2. Strawpoll 1:

6.4.2.1. "Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1266r3 for CIDs: 113 114 115 116 117 156 196 197 198 199 200 201 202 213 263 264 267 387 388 389 390 391 392 393 457 571 572 573 620 621 666 667 682 723 724 971 1027 1152 1156 1157 1158 1159 1160 1161 1162 1163 1164 1183 1205 1206 1207 1314 1319 1320 1321 1322 1323 1324 1325 1327 1332 1333 1335 1343 1344 1346 1347 1348 1352 1415 1452 1453 1655 1679 1680 1721 1723 1724 1725 1764 1797 1798 1799 1803 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1896 2253 2276 2277 2278 2307 2308 2377 2390 2391 2392 2393 2394 2425 2426 2427 2466 2830 2831 2832 2836 2837 2838 2839"

6.12.2.3. Results: Strawpoll passed with no objection.

APPENDIX AG

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax, MAC Ad hoc **Jan 2016 Atlanta TGax MAC Ad hoc Meeting Minutes**				
Date: 2016-01-18				
Author(s):				
Name	**Affiliation**	**Address**	**Phone**	**Email**
Brian Hart	Cisco Systems			brianh@cisco.com

Abstract

TGax, MAC Ad Hoc meeting minutes from the IEEE 802.11 Atlanta session, Jan 18th – 21th, 2016.

Monday, Jan 18h, 2016, PM2 TGax MAC Ad hoc Session (4:00-6:00pm)

1. **The meeting called to order at 4:02pm by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 46 people are in the room at this time.

2. **Announcement**
   2.1. Agenda doc is 11-16/0109r0 is on the server.
   2.2. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents
         [Asked. ~~Did not ask~~]
      3.4.2. Potentially essential patents
         [None reported. ~~Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings. [reviewed~~, did not review~~]

4. The Chair called for presentations

4.1. No requests for additional presentations were made. Reordering of presentations was requested and accepted

5. The Chair asked for approval of the agenda

5.1. No objection raised

6. Presentation of contributions

Yongho Seok (Newracom) presented 11-16/0015r0 "Explicit Block Ack Request in DL MU PPDU"

SPs deferred to permit presentation of 11-16/0051.

Jian Yu (Huawei) presented 11-0016/51r0, "Response Give Trigger Type"

11-16/0051r0-SP1: Do you agree to add the TGax SFD:
6.2.1 Trigger frame
A recipient of a MU-BAR frame can transmit other data or management frame in addition to BA/ACK frame if it does not exceed the indicated UL MU duration.

Y30 N0 A26 – strawpoll [pre-motion] passes

11-16/0015r0-SP2: Do you agree to add the TGax SFD:
4.2 DL MU operation
Except for an implicit Block Ack request, the Block Ack Request frame and the MU-BAR frame are used for soliciting an immediate response carried in SU and MU PPDU, respectively.

Y4 N7 A41 – strawpoll fails

11-16/0015r0-SP3: Do you agree to add the TGax SFD:
4.2 DL MU operation
PPDU Type (SU or MU) of an immediate response is indicated in the Block Ack Request frame

Y6 N10 A=many – strawpoll fails

11-16/0015r0-SP1: Do you support to add the following to the SFD:
If the trigger frame requests a specific frame type as response, the response to this trigger frame shall contain at least the frame with the required type if the required type is

available at the STA side; if the STA has no frame with the required type, the STA should transmit QoS Null frame to AP.

Y38 N0 A19 - strawpoll [pre-motion] passes

Mid session attendee count: **about 76 people in the room.**

Evgeny Khorov (IITP) presented 11-16/0017r0 "Beacon Collision Avoidance"

11-16/0017r0-SP1: We need a mechanism that allows an HE AP to obtain the beacon timing information of the APs in its two-hop neighborhood. This information can be used for TBTT selection and TBTT adjustment in order to prevent beacon collisions caused by hidden APs in dense deployment scenarios.

Y2
N1
Need more information – many

Xiaofei Wang (Interdigital) presented 11-16/0029r0 "TXOP Truncation Enhancement"

11-16/0029r0-SP0: Do you agree to add the following to the SFD:
6.1 The spec should consider to use Duration settings in CF-End frames to facilitate resetting of NAVs

Y2 N21 A-uncounted

7. The Chair [recessed~~, did not recess~~] the MAC ad hoc session at 6:04 pm.
// recess = short break, adjournment = long break

Tuesday, Jan 19th, 2016, AM2 TGax MAC Ad hoc Session (10:30am-12:30pm)

1. **The meeting was called to order at 10:32pm by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 75 people are in the room at this time.

2. **Announcement**

2.1. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
2.2. Attendance reminder.
2.2.1. The attendance server: https://imat.ieee.org/

3. The chair reviewed the mandatory 5 slides of P&P.
3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
3.2. Participants, Patents, and Duty to Inform. [reviewed~~, did not review~~]
3.3. Patent Related Links. [reviewed~~, did not review~~]
3.4. Call for potentially essential patents.
3.4.1. Chair asked if anyone is aware of potentially essential patents [Asked.~~ Did not ask~~]
3.4.2. Potentially essential patents [None reported.~~ Reported as follows~~]
3.5. Other Guidelines for IEEE WG Meetings [reviewed~~, did not review~~]

4. The Chair reviewed the presentation order
4.1. Reordering of presentations was requested and accepted

5. The Chair asked for approval of the agenda
5.1. No objection raised

6. Presentation of contributions

Initial attendee count: **about 75 people in the room.**

Evgeny Khorov (IITP) presented 11-16/0018r2, "TDMA for Eliminating Hidden Station Effect in Dense Networks"

11-16/0018r2-SP1: Do you agree to add the following text in SFD:
x.y.z The spec shall include a mechanism that allows an HE AP to negotiate periodic time intervals for its BSS in advance. During these time intervals, an OBSS or a subset of STAs in the OBSS should not start their transmissions

Y7 N16 A-uncounted. Strawpoll fails

Xiaofei Wang (Interdigital), 11-0016/28r0 presented "Follow Up for Multi-STA BA for SU Transmissions"

11-0016/28r0-SP2: Do you agree that:
x.y.z The spec should allow the use of Multi-STA BA frame to acknowledge UL SU transmissions

Y11 N5 A41. Strawpoll fails

11-0016/28r0-SP1: Do you agree that: 11ax should allow the use of Multi-STA BA frame to acknowledge UL SU transmissions in PSMP sequences

Y10 N12 A-uncounted Strawpoll fails.

Sean Coffey (Realtek) presented 11-0016/0102r0, "High Efficiency Medium Access via Rosters"

No strawpolls

Mid session attendee count: **about 82 people in the room.**

Geonjung Ko (WILUS) presented 11-16/0042r1, "BSS Color Settings for a Multiple BSSID Set"

Strawpolls deferred

7. The Chair [recessed~~, did not recess~~] the MAC ad hoc session at 12:31 pm.

Tuesday, Jan 19th, 2016, PM1 TGax MAC Ad hoc Session (1:30pm-3:30pm)

1. **The meeting was called to order at 10:32pm by Reza Hedayat (Newracom), the co-chair of the TGax MAC Ad hoc**
   1.1. About 75 people are in the room at this time.

2. **Announcement**
   2.1. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
   2.2. Attendance reminder.
      2.2.1. The attendance server: https://imat.ieee.org/

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform. [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents [Asked.~~ Did not ask~~]
      3.4.2. Potentially essential patents [None reported.~~ Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings [reviewed~~, did not review~~]

4. **The Chair reviewed the presentation order**
   4.1. Reordering of presentations was requested and accepted

5. The Chair asked for approval of the agenda
5.1. No objection raised

6. Presentation of contributions

Initial attendee count: **about 69 people in the room.**

Liwen Chu (Marvell) presented 11-16/0068r0 "BSS Color and Multiple BSSID"

11-16/0042r1-SP2[modified]: Do you agree to add the following text into 11ax SFD?
5.y.z AP and STA in one BSS of a Multiple BSSID set shall consider a frame from another BSS of the same Multiple BSSID set as an intra-BSS frame (signaling for a Multiple BSSID set is TBD).
Y31 N0 A19 Strawpoll [Pre-motion] passes

11-16/0068r0-SP[modified]: Do you agree to add the following text into the SFD:
A same BSS Color shall be used for the virtual APs which are defined by TBD Multiple BSSID signaling

Y51 N0 A3 Strawpoll [Pre-motion] passes

Alfred Asterjadhi (Qualcomm) presented 11-16/0050r0 "Fragmentation for MU frames-Follow up on acks"

11-16/0050r0SP1: So you support to add to the SFD:
- 11ax STAs shall use the baseline (de-)fragmentation for signaling 11ax fragmentation within an A-MPDU
  - The SN identifies the MSDU/MMPDU, and the FN identifies the fragment of an MSDU/MMPDU

Y45 N1 A5 Strawpoll [Pre-motion] passes

11-16/0050r0SP2:
- **Do you support to add to the SFD:**
  - Under 11ax fragmentation, the following acknowledgement rules apply:
    - Fragmentation – Level I
      - Recipient shall respond with an Ack to a fragment carried in a "VHT" single MPDU soliciting immediate response
    - Fragmentation – Level II
      - Recipient shall respond with:
        - Ack frame to a fragment carried in a "VHT" single MPDU soliciting immediate response
        - C-BA frame to an A-MPDU soliciting immediate response

- Each bit in BlockAck Bitmap indicates successful reception of the carried fragment or of the full MSDU

Y45 N1 A8 Strawpoll [Pre-motion] passes

11-16/0050r0SP3:

- **Do you support to add to the SFD:**
  - Under 11ax fragmentation, the following acknowledgement rules apply:
    - Fragmentation – Level III
      - Recipient shall respond with:
        - Ack frame to a fragment carried in a "VHT" single MPDU soliciting immediate response
        - C-BA frame to an A-MPDU that does not carry fragments and soliciting immediate response
        - "Dedicated" C-BA frame to an A-MPDU carrying fragments and soliciting immediate response
          - Each bit in BlockAck Bitmap indicates successful reception of each of the carried fragments
          - The max number of fragments for which the BA frame signals the receive status is contained in a nonzero value of the FN subfield of the BA frame
      - Maximum number of fragments per MSDU in the eliciting A-MPDU transmitted by the originator shall be 4

Y42 N1 A9 Strawpoll [Pre-motion] passes

Liwen Chu (Marvell) presented 11-16/0069r0 "Multi-TID A-MPDU in MU Transmission"

11-16/0069r0-SP1: Do you agree to add the following text to the SFD 4.1 General?
MPDUs from multiple TIDs that ask for Ack and/or BA acknowledgement and management frame that asks for Ack acknowledgement may be aggregated in one A-MPDU of MU transmission

Y38 N0 A5 Strawpoll [Pre-motion] passes

11-16/0069r0-SP2: Do you agree to add the following text to the SFD subclause 4.2 DL MU Operation:
The spec shall allow UL MU transmission of Multi-STA Block ACK frame in response to multi-TID A-MPDU of DL MU transmission. The value of the AID field in M-BA is TBD

Y45 N0 A7 [Pre-motion] passes

Initial attendee count: **about 87 people in the room.**

Jinsoo Ahn (Yonsei University) presented 11-16/0087r1, "NAV cancellation issues on MU protection"

11-16/0087r1-SP2: Do you agree to add to the TG Specification Frame work document?

- AP may transmit CF-END frame after Trigger timer (TBD) expires following MU RTS Frame if AP cannot detect the (Simultaneous) CTS frame(s).
- CF-END frame may be transmitted after Trigger timer (TBD) expires following Trigger frame if AP cannot detect the UL response(s).

Y5 N15 A-many. Strawpoll fails.

The MAC ad hoc included one presentation originally intended for the Spatial Reuse ad hoc.
The chair Reza Hedayat proposed to transfer the chair role to Brian Hart (Cisco Systems). No objection was received.

Reza Hedayat (Newracom) presented 11-16/0060r1, "Recipient-aware Spatial Reuse"

11-16/0060r1-SP:

- Do you agree that the following text in 11ax SFD to be modified?

5.1: Features for operation in dense environments
The specification to consider a procedure that may revise the NAV depending on TBD conditions at the recipient of the ongoing OBSS frame.

- A STA that receives an inter-BSS frame with RSSI more than OBSS PD threshold and receives the response frame less than a TBD threshold (e.g. OBSS PD) may set back the NAV to the value before receiving the inter-BSS frame. Above rule does not apply if the inter-BSS frame is a Trigger frame.

Y10 N8 A-uncounted – strawpoll fails

8. The Chair [adjourned~~, adjourned~~] the MAC ad hoc session at 3:34 pm.

APPENDIX BD

IEEE 802.11, The Working Group for Wireless LANs Standards

This page is maintained by Stephen McCann . Comments are welcome.

IEEE 802.11 WG LETTER BALLOTS

Note - percentage results are rounded to the nearest integer

Note - Links to documents in the voting members' private area (such as drafts) will stop functioning once the project is complete, e.g., whe its output document has been published by the IEEE-SA.

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
288	TGbi	Technical TGbi Draft 1.00	LB# 288	Draft	Draft P802.11bi_D1.0.pdf	2025-01-27	2025-02-27	31	Pool	640
									Approve	309
				Redlined Doc	N/A				Disapprove	38
				Resolution Doc	N/A				Abstain	63
									Return%	64
				Comment	Template				Approve%	89
				Pool	LB# 288 Voters					
287	TGbk	Recirculation TGbk Draft 3.00	LB# 287	Draft	Draft P802.11bk_D3.0.pdf	2024-08-01	2024-08-15	14	Pool	559
									Approve	342
				Redlined Doc	Draft P802.11bk_D3.0_redline_compared_to_D2.0.pdf				Disapprove	6
				Resolution Doc	11-24-1011-02-00bk-lb286-cid-resolution-status-for-d2-0.xlsx				Abstain	47
									Return%	71
				Comment	Template				Approve%	98
				Pool	LB# 287 Voters					
286	TGbk	Recirculation TGbk Draft 2.00	LB# 286	Draft	Draft P802.11bk_D2.0.pdf	2024-04-10	2024-04-26	16	Pool	559
									Approve	321
				Redlined Doc	Draft P802.11bk_D2.0_redline_compared_to_D1.0.pdf				Disapprove	10
				Resolution Doc	11-24-0013-08-00bk-lb279-comments-on-d1-0.xlsx				Abstain	53
									Return%	69
				Comment	Template				Approve%	97
				Pool	LB# 286 Voters					
285	TGbf	Recirculation TGbf Draft 4.00	LB# 285	Draft	Draft P802.11bf_D4.0.pdf	2024-04-10	2024-04-26	16	Pool	491
									Approve	354
				Redlined Doc	Draft P802.11bf_D4.0_redline_compared_to_D3.0.pdf				Disapprove	13
				Resolution Doc	11-24-0028-14-00bf-lb281-comments-and-approved-resolutions.xlsx				Abstain	38
									Return%	82
				Comment	Template				Approve%	96
				Pool	LB# 285 Voters					
284	TGbh	Recirculation TGbh Draft 4.00	LB# 284	Draft	Draft P802.11bh_D4.0.pdf	2024-03-21	2024-04-06	16	Pool	527
									Approve	356
				Redlined Doc	Draft P802.11bh_D4.0 Redline Compared to D3.0.pdf				Disapprove	2
				Resolution Doc	11-24-0380-02-00bh-ieee-802-11bh-lb283-comments.xlsx				Abstain	52
									Return%	78
				Comment	Template				Approve%	99
				Pool	LB# 284 Voters					
283	TGbh	Recirculation TGbh Draft 3.00	LB# 283	Draft	Draft P802.11bh_D3.0.pdf	2024-02-09	2024-02-24	15	Pool	527
									Approve	341
				Redlined Doc	Draft P802.11bh_D3.0 Redline Compared to D2.0.pdf				Disapprove	8
				Resolution Doc	11-24-0040-10-00bh-ieee-802-11bh-lb282-comments.xlsx				Abstain	55
									Return%	77
				Comment	Template				Approve%	98
				Pool	LB# 283 Voters					
282	TGbh	Recirculation TGbh Draft 2.00	LB# 282	Draft	Draft P802.11bh_D2.0.pdf	2023-12-11	2024-01-05	25	Pool	527
									Approve	322
				Redlined Doc	Draft P802.11bh_D2.0 Redline Compared to D1.0.pdf				Disapprove	19
				Resolution Doc	11-23-1152-32-00bh-ieee-802-11bh-lb274-comments.xlsx				Abstain	52
									Return%	75
				Comment	Template				Approve%	94
				Pool	LB# 282 Voters					
281	TGbf	Recirculation TGbf Draft 3.00	LB# 281	Draft	Draft P802.11bf_D3.0.pdf	2023-12-05	2024-01-04	30	Pool	491
									Approve	335
				Redlined Doc	Draft P802.11bf_D3.0_redline_compared_to_D2.0.pdf				Disapprove	27
				Resolution Doc	11-23-1394-12-00bf-lb276-comments-and-approved-resolutions.xlsx				Abstain	42
									Return%	82
				Comment	Template				Approve%	93
				Pool	LB# 281 Voters					
280	TGbe	Recirculation TGbe Draft 5.00	LB# 280	Draft	Draft P802.11be_D5.0.pdf	2023-12-01	2023-12-16	15	Pool	491
									Approve	397
				Redlined Doc	Draft P802.11be_D5.0_redline_D4.0.pdf				Disapprove	21
				Resolution Doc	11-23-1375-25-00be-ieee-802-11be-lb275-comments.xlsx				Abstain	5

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	86
				Comment	Template				Approve%	95
				Pool	LB# 280 Voters					
279	TGbk	Technical TGbk Draft 1.00	LB# 279	Draft	Draft P802.11bk_D1.0.pdf	2023-11-28	2023-12-28	30	Pool	559
									Approve	290
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	46
									Return%	63
				Comment	Template				Approve%	95
				Pool	LB# 279 Voters					
278	WG Tech Ed	Technical WG Tech Ed Draft 1.00	LB# 278	Draft	Draft P802.11-2020_Cor2_D1.0.pdf	2023-09-25	2023-10-25	30	Pool	535
									Approve	272
				Redlined Doc	N/A				Disapprove	1
				Resolution Doc	N/A				Abstain	25
									Return%	56
				Comment	Template				Approve%	100
				Pool	LB# 278 Voters					
277	TGme	Recirculation TGme Draft 4.00	LB# 277	Draft	Draft P802.11REVme_D4.0.pdf	2023-08-10	2023-08-30	20	Pool	485
									Approve	338
				Redlined Doc	Draft P802.11REVme_D4.0 Redline Compared to D3.0.pdf				Disapprove	13
				Resolution Doc	11-22-0065-23-000m-revme-wg-ballot-comments.xls				Abstain	21
									Return%	77
				Comment	Template				Approve%	96
				Pool	LB# 277 Voters					
276	TGbf	Recirculation TGbf Draft 2.00	LB# 276	Draft	Draft P802.11bf_D2.0.pdf	2023-07-26	2023-08-20	25	Pool	491
									Approve	291
				Redlined Doc	Draft P802.11bf_D2.0_redline_compared_to_D1.0.pdf				Disapprove	48
				Resolution Doc	11-23-0314-21-00bf-lb272-comments-and-approved-resolutions.xlsx				Abstain	49
									Return%	79
				Comment	Template				Approve%	86
				Pool	LB# 276 Voters					
275	TGbe	Recirculation TGbe Draft 4.00	LB# 275	Draft	Draft P802.11be_D4.0.pdf	2023-07-24	2023-08-13	20	Pool	491
									Approve	364
				Redlined Doc	Draft P802.11be_D4.0_redline_D3.0.pdf				Disapprove	40
				Resolution Doc	11-23-0272-36-00be-ieee-802-11be-lb271-comments.xlsx				Abstain	4
									Return%	83
				Comment	Template				Approve%	90
				Pool	LB# 275 Voters					
274	TGbh	Technical TGbh Draft 1.00	LB# 274	Draft	Draft P802.11bh_D1.0.pdf	2023-06-01	2023-07-01	30	Pool	527
									Approve	247
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	N/A				Abstain	52
									Return%	61
				Comment	Template				Approve%	92
				Pool	LB# 274 Voters					
273	TGme	Recirculation TGme Draft 3.00	LB# 273	Draft	Draft P802.11REVme_D3.0.pdf	2023-04-12	2023-05-07	25	Pool	485
									Approve	321
				Redlined Doc	Draft P802.11REVme_D3.0 Redline Compared to D2.0.pdf				Disapprove	25
				Resolution Doc	11-22-0065-17-000m-revme-wg-ballot-comments.xls				Abstain	18
									Return%	75
				Comment	Template				Approve%	93
				Pool	LB# 273 Voters					
272	TGbf	Technical TGbf Draft 1.00	LB# 272	Draft	Draft P802.11bf_D1.0.pdf	2023-01-30	2023-03-02	31	Pool	491
									Approve	244
				Redlined Doc	N/A				Disapprove	70
				Resolution Doc	N/A				Abstain	46
									Return%	73
				Comment	Template				Approve%	78
				Pool	LB# 272 Voters					
271	TGbe	Technical TGbe Draft 3.00	LB# 271	Draft	Draft P802.11be_D3.0.pdf	2023-01-30	2023-03-02	31	Pool	491
									Approve	302
				Redlined Doc	N/A				Disapprove	76
				Resolution Doc	N/A				Abstain	6
									Return%	78
				Comment	Template				Approve%	80
				Pool	LB# 271 Voters					
270	TGme	Recirculation TGme Draft 2.00	LB# 270	Draft	Draft P802.11REVme_D2.0.pdf	2022-10-17	2022-11-11	25	Pool	485
									Approve	282
				Redlined Doc	Draft P802.11REVme_D2.0 Redline Compared to D1.0.pdf				Disapprove	44
				Resolution Doc	11-22-0065-12-000m-revme-wg-ballot-comments.xls				Abstain	25
									Return%	72
				Comment	Template				Approve%	87
				Pool	LB# 270 Voters					
269	TGbb	Recirculation TGbb Draft 4.00	LB# 269	Draft	Draft P802.11bb_D4.0.pdf	2022-09-16	2022-10-01	15	Pool	485
									Approve	301
				Redlined Doc	Draft P802.11bb_D4.0_redline compared to D3.0.pdf				Disapprove	2
				Resolution Doc	11-22-1498-06-00bb-lb267-poll-comments.xlsx				Abstain	71

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	77
				Comment	Template				Approve%	99
				Pool	LB# 269 Voters					
268	TGbc	Recirculation TGbc Draft 4.00	LB# 268	Draft	Draft P802.11bc_D4.0.pdf	2022-08-10	2022-08-25	15	Pool	369
									Approve	236
				Redlined Doc	Draft P802.11bc Redline D4.0 to D3.0.pdf				Disapprove	12
				Resolution Doc	11-22-0686-16-00bc-lb264-comments-on-p802-11bc-d3-0.xlsx				Abstain	35
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 268 Voters					
267	TGbb	Recirculation TGbb Draft 3.00	LB# 267	Draft	Draft P802.11bb_D3.0.pdf	2022-08-01	2022-08-31	30	Pool	485
									Approve	281
				Redlined Doc	Draft P802.11bb_D3.0_redline compared to D2.1.pdf				Disapprove	15
				Resolution Doc	11-22-0949-07-00bb-comments-from-cc-against-d2-1.xlsx				Abstain	75
									Return%	76
				Comment	Template				Approve%	95
				Pool	LB# 267 Voters					
266	TGbe	Technical TGbe Draft 2.00	LB# 266	Draft	Draft P802.11be_D2.0.pdf	2022-05-25	2022-07-04	40	Pool	512
									Approve	228
				Redlined Doc	N/A				Disapprove	127
				Resolution Doc	N/A				Abstain	11
									Return%	71
				Comment	Template				Approve%	64
				Pool	LB# 266 Voters					
265	WG Tech Ed	Recirculation WG Tech Ed Draft 2.10	LB# 265	Draft	Draft P802.11-2020_Cor1_D2.1.pdf	2022-05-17	2022-06-01	15	Pool	511
									Approve	290
				Redlined Doc	Draft P802.11-2020-Cor1_D2.1 Redline Compared to D1.0.pdf				Disapprove	1
				Resolution Doc	11-22-0648-04-0000-comments-on-p802-11-cor1-d1-0.xlsx				Abstain	36
									Return%	64
				Comment	Template				Approve%	100
				Pool	LB# 265 Voters					
264	TGbc	Recirculation TGbc Draft 3.00	LB# 264	Draft	Draft P802.11bc Redline D3.0 to D2.0.pdf	2022-04-08	2022-04-28	20	Pool	380
									Approve	228
				Redlined Doc	Draft P802.11bc Redline D3.0 to D2.0.pdf				Disapprove	19
				Resolution Doc	11-21-1758-29-00bc-lb257-comments-on-p802-11bc-d2-0.xlsx				Abstain	34
									Return%	74
				Comment	Template				Approve%	92
				Pool	LB# 264 Voters					
263	TGbb	Recirculation TGbb Draft 2.00	LB# 263	Draft	Draft P802.11bb_D2.0.pdf	2022-04-07	2022-04-22	15	Pool	485
									Approve	271
				Redlined Doc	Draft P802.11bb_D2.0 redline compared to D1.0.pdf				Disapprove	18
				Resolution Doc	11-22-0074-20-00bb-lb260-comments.xlsx				Abstain	68
									Return%	74
				Comment	Template				Approve%	94
				Pool	LB# 263 Voters					
262	WG Tech Ed	Technical WG Tech Ed Draft 1.00	LB# 262	Draft	Draft P802.11-2020_Cor1_D1.0.pdf	2022-03-15	2022-04-14	30	Pool	511
									Approve	260
				Redlined Doc	N/A				Disapprove	3
				Resolution Doc	N/A				Abstain	41
									Return%	59
				Comment	Template				Approve%	99
				Pool	LB# 262 Voters					
261	TGbd	Recirculation TGbd Draft 4.00	LB# 261	Draft	Draft P802.11bd_D4.0.pdf	2022-03-15	2022-03-30	15	Pool	340
									Approve	245
				Redlined Doc	Draft P802.11bd_D4.0 Redline Compared to D3.0.pdf				Disapprove	3
				Resolution Doc	11-21-2018-07-00bd-tgbd-lb259-comments.xlsx				Abstain	26
									Return%	81
				Comment	Template				Approve%	99
				Pool	LB# 261 Voters					
260	TGbb	Technical TGbb Draft 1.00	LB# 260	Draft	P802.11bb_D1.0.pdf	2021-12-03	2022-01-12	40	Pool	485
									Approve	221
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	59
									Return%	65
				Comment	Template				Approve%	87
				Pool	LB# 260 Voters					
259	TGbd	Recirculation TGbd Draft 3.00	LB# 259	Draft	Draft P802.11bd_D3.0.pdf	2021-12-01	2021-12-16	15	Pool	340
									Approve	223
				Redlined Doc	Draft P802.11bd_D3.0 Redline Compared to D2.0.pdf				Disapprove	15
				Resolution Doc	11-21-1296-07-00bd-tgbd-lb254-comments.xlsx				Abstain	29
									Return%	79
				Comment	Template				Approve%	94
				Pool	LB# 259 Voters					
258	TGme	Technical TGme Draft 1.00	LB# 258	Draft	Draft P802.11REVme_D1.0.pdf	2021-12-01	2022-01-10	40	Pool	485
									Approve	243
				Redlined Doc	Draft P802.11REVme_D1.0 Redline Compared to D0.0.pdf				Disapprove	45
				Resolution Doc	N/A				Abstain	25

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	65
				Comment	Template				Approve%	84
				Pool	LB# 258 Voters					
257	TGbc	Recirculation TGbc Draft 2.00	LB# 257	Draft	Draft P802.11bc_D2.0.pdf	2021-10-08	2021-10-28	20	Pool	369
									Approve	198
				Redlined Doc	Draft P802.11bc Redline D2.0 to D1.0.pdf				Disapprove	22
				Resolution Doc	11-20-1985-49-00bc-lb-252-comments-on-p802-11bc-draft-1-0.xlsx				Abstain	34
									Return%	69
				Comment	Template				Approve%	90
				Pool	LB# 257 Voters					
256	TGaz	Recirculation TGaz Draft 4.00	LB# 256	Draft	Draft P802.11az_D4.0.pdf	2021-09-21	2021-10-01	10	Pool	329
									Approve	262
				Redlined Doc	Draft P802.11az_D4.0_redline_compared_to_D3.0.pdf				Disapprove	5
				Resolution Doc	11-21-1471-02-00az-lb-255-comments.xlsx				Abstain	24
									Return%	88
				Comment	Template				Approve%	98
				Pool	LB# 256 Voters					
255	TGaz	Recirculation TGaz Draft 4.00	LB# 255	Draft	Draft P802.11az_D4.0.pdf	2021-08-23	2021-09-07	15	Pool	329
									Approve	253
				Redlined Doc	Draft P802.11az_D4.0_redline_compared_to_D3.0.pdf				Disapprove	14
				Resolution Doc	11-21-0258-08-00az-lb253-comments.xlsx				Abstain	24
									Return%	88
				Comment	Template				Approve%	95
				Pool	LB# 255 Voters					
254	TGbd	Recirculation TGbd Draft 2.00	LB# 254	Draft	Draft P802.11bd_D2.0.pdf	2021-07-12	2021-08-01	20	Pool	340
									Approve	200
				Redlined Doc	Draft P802.11bd_D2.0 Redline Compared to D1.0.pdf				Disapprove	26
				Resolution Doc	11-20-1887-11-00bd-tgbd-lb251-comments.xlsx				Abstain	28
									Return%	75
				Comment	Template				Approve%	88
				Pool	LB# 254 Voters					
253	TGaz	Recirculation TGaz Draft 3.00	LB# 253	Draft	Draft P802.11az_D3.0.pdf	2021-01-26	2021-02-10	15	Pool	329
									Approve	231
				Redlined Doc	Draft P802.11az_D3.0_redline_compared_to_D2.0.pdf				Disapprove	31
				Resolution Doc	11-20-0017-12-00az-lb249-comment.xlsx				Abstain	25
									Return%	87
				Comment	Template				Approve%	88
				Pool	LB# 253 Voters					
252	TGbc	Technical TGbc Draft 1.00	LB# 252	Draft	Draft P802.11bc_D1.0.pdf	2020-11-20	2020-12-20	30	Pool	369
									Approve	153
				Redlined Doc	N/A				Disapprove	32
				Resolution Doc	N/A				Abstain	32
									Return%	59
				Comment	Template				Approve%	83
				Pool	LB# 252 Voters					
251	TGbd	Technical TGbd Draft 1.00	LB# 251	Draft	Draft P802.11bd_D1.0.pdf	2020-10-19	2020-11-18	30	Pool	340
									Approve	174
				Redlined Doc	N/A				Disapprove	39
				Resolution Doc	N/A				Abstain	21
									Return%	69
				Comment	Template				Approve%	82
				Pool	LB# 251 Voters					
250	TGba	Recirculation TGba Draft 6.00	LB# 250	Draft	Draft P802.11ba D6.0.pdf	2020-01-17	2020-02-01	15	Pool	329
									Approve	266
				Redlined Doc	Draft P802.11ba_D6.0_Redline_Compared_to_D5.0.pdf				Disapprove	4
				Resolution Doc	11-19-2162-02-00ba-comments-on-tgba-d5-0.xlsx				Abstain	23
									Return%	89
				Comment	Template				Approve%	99
				Pool	LB# 250 Voters					
249	TGaz	Recirculation TGaz Draft 2.00	LB# 249	Draft	Draft P802.11az_D2.0.pdf	2019-12-09	2020-01-03	25	Pool	329
									Approve	219
				Redlined Doc	Draft P802.11az_D2.0 redline compared to D1.0.pdf				Disapprove	33
				Resolution Doc	11-20-1719-05-00az-tgaz-lb240-comment-resolution.docx				Abstain	28
									Return%	85
				Comment	Template				Approve%	87
				Pool	LB# 249 Voters					
248	TGba	Recirculation TGba Draft 5.00	LB# 248	Draft	Draft P802.11ba D5.0.pdf	2019-12-02	2019-12-17	15	Pool	329
									Approve	258
				Redlined Doc	Draft P802.11ba_D5.0_Redline_Compared_to_D4.0.pdf				Disapprove	12
				Resolution Doc	11-19-1770-08-00ba-comments-on-tgba-d4-0.xlsx				Abstain	22
									Return%	89
				Comment	Template				Approve%	96
				Pool	LB# 248 Voters					
247	TGax	Recirculation TGax Draft 6.00	LB# 247	Draft	Draft P802.11ax_D6.0.pdf	2019-11-26	2019-12-11	15	Pool	303
									Approve	271
				Redlined Doc	Draft P802.11ax_D6.0 Redline Compared to D5.0.pdf				Disapprove	7
				Resolution Doc	11-19-1782-10-00ax-comments-on-d5-0.xlsx				Abstain	3

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	93
				Comment	Template				Approve%	97
				Pool	LB# 247 Voters					
246	TGay	Recirculation TGay Draft 5.00	LB# 246	Draft	Draft P802.11ay_D5.0.pdf	2019-10-24	2019-11-08	15	Pool	322
									Approve	260
				Redlined Doc	Draft P802.11ay_D5.0 redline compared to D4.0.pdf				Disapprove	3
				Resolution Doc	11-19-1180-05-00ay-comments-on-tgay-d4-0.xlsx				Abstain	25
									Return%	89
				Comment	Template				Approve%	99
				Pool	LB# 246 Voters					
245	TGmd	Recirculation TGmd Draft 3.00	LB# 245	Draft	Draft P802.11REVmd_D3.0.pdf	2019-10-13	2019-10-30	17	Pool	254
									Approve	213
				Redlined Doc	Draft P802.11REVmd_D3.0 Redline Compared to D2.0.pdf				Disapprove	8
				Resolution Doc	11-19-1837-02-000m-revmd-wg-lb245-comment-resolutions.xls				Abstain	7
									Return%	90
				Comment	Template				Approve%	96
				Pool	LB# 245 Voters					
244	TGax	Recirculation TGax Draft 5.00	LB# 244	Draft	Draft P802.11ax_D5.0.pdf	2019-10-06	2019-10-24	18	Pool	303
									Approve	258
				Redlined Doc	Draft P802.11ax_D5.0 Redline Compared to D4.0.pdf				Disapprove	17
				Resolution Doc	11-19-0292-29-00ax-comments-on-tgax-d4-0.xlsx				Abstain	4
									Return%	92
				Comment	Template				Approve%	94
				Pool	LB# 244 Voters					
243	TGba	Recirculation TGba Draft 4.00	LB# 243	Draft	Draft P802.11ba D4.0.pdf	2019-09-27	2019-10-15	18	Pool	329
									Approve	238
				Redlined Doc	Draft P802.11ba_D4.0_Redline_Compared_to_D3.0.pdf				Disapprove	27
				Resolution Doc	11-19-1016-10-00ba-comments-on-tgba-d3-0.xlsx				Abstain	24
									Return%	88
				Comment	Template				Approve%	90
				Pool	LB# 243 Voters					
242	TGay	Recirculation TGay Draft 4.00	LB# 242	Draft	Draft P802.11ay_D4.0.pdf	2019-06-20	2019-07-08	18	Pool	322
									Approve	259
				Redlined Doc	Draft P802.11ay_D4.0 redline compared to D3.0.pdf				Disapprove	6
				Resolution Doc	11-19-0297-08-00ay-comments-on-11ay-d3-0.xlsx				Abstain	25
									Return%	90
				Comment	Template				Approve%	98
				Pool	LB# 242 Voters					
241	TGba	Recirculation TGba Draft 3.00	LB# 241	Draft	Draft P802.11ba D3.0.pdf	2019-06-03	2019-06-18	15	Pool	329
									Approve	214
				Redlined Doc	Draft P802.11ba_D3.0_Redline_Compared_to_D2.1.pdf				Disapprove	40
				Resolution Doc	11-19-0312-12-00ba-comments-on-tgba-d2-0.xlsx				Abstain	26
									Return%	85
				Comment	Template				Approve%	84
				Pool	LB# 241 Voters					
240	TGaz	Technical TGaz Draft 1.00	LB# 240	Draft	Draft P802.11az_D1.0.pdf	2019-02-05	2019-03-09	32	Pool	329
									Approve	186
				Redlined Doc	P802.11az_D1.0_Redline compared to D0.6.pdf				Disapprove	49
				Resolution Doc	N/A				Abstain	29
									Return%	80
				Comment	Template				Approve%	79
				Pool	LB# 240 Voters					
239	TGay	Recirculation TGay Draft 3.00	LB# 239	Draft	Draft P802.11ay_D3.0.pdf	2019-02-04	2019-02-28	24	Pool	322
									Approve	243
				Redlined Doc	Draft P802.11ay_D3.0 redline compared to D2.0.pdf				Disapprove	18
				Resolution Doc	11-18-1483-07-00ay-comment-database-on-d2-0.xlsx				Abstain	30
									Return%	90
				Comment	Template				Approve%	93
				Pool	LB# 239 Voters					
238	TGax	Recirculation TGax Draft 4.00	LB# 238	Draft	Draft P802.11ax_D4.0.pdf	2019-02-01	2019-02-25	24	Pool	303
									Approve	260
				Redlined Doc	Draft P802.11ax_D4.0 Redline Compared to D3.0.pdf				Disapprove	22
				Resolution Doc	11-18-1123-24-00ax-comments-on-tgax-d3-0.xlsx				Abstain	3
									Return%	94
				Comment	Template				Approve%	92
				Pool	LB# 238 Voters					
237	TGba	Technical TGba Draft 2.00	LB# 237	Draft	Draft P802.11ba D2.0.pdf	2019-01-30	2019-03-03	32	Pool	329
									Approve	202
				Redlined Doc	Draft P802.11ba_D2.0_Redline_Compared_to_D1.0.pdf				Disapprove	43
				Resolution Doc	11-18-1794-11-00ba-comments-on-tgba-d1-0.xlsx				Abstain	26
									Return%	82
				Comment	Template				Approve%	82
				Pool	LB# 237 Voters					
236	TGmd	Recirculation TGmd Draft 2.00	LB# 236	Draft	Draft P802.11REVmd_D2.0.pdf	2018-12-11	2019-01-10	30	Pool	254
									Approve	199
				Redlined Doc	Draft P802.11REVmd_D2.0 Redline Compared to D1.0.pdf				Disapprove	16
				Resolution Doc	11-18-0611-29-000m-revmd-wg-ballot-comments.xls				Abstain	7

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	87
				Comment	Template				Approve%	93
				Pool	LB# 236 Voters					
235	TGba	Technical TGba Draft 1.00	LB# 235	Draft	Draft P802.11ba D1.0.pdf	2018-09-24	2018-10-24	30	Pool	319
									Approve	159
				Redlined Doc	Draft P802.11ba_D1.0_Redline_Compared_to_D0.4.pdf				Disapprove	62
				Resolution Doc	N/A				Abstain	23
									Return%	76
				Comment	Template				Approve%	72
				Pool	LB# 235 Voters					
234	TGay	Technical TGay Draft 2.00	LB# 234	Draft	Draft P802.11ay_D2.0.pdf	2018-08-01	2018-08-31	30	Pool	322
									Approve	219
				Redlined Doc	Draft P802.11ay_D2.0 redline compared to D1.0.pdf				Disapprove	17
				Resolution Doc	11-18-0067-11-00ay-11ay-d1-0-comment-database.xlsx				Abstain	29
									Return%	82
				Comment	Template				Approve%	93
				Pool	LB# 234 Voters					
233	TGax	Technical TGax Draft 3.00	LB# 233	Draft	Draft P802.11ax_D3.0.pdf	2018-06-01	2018-07-01	30	Pool	303
									Approve	212
				Redlined Doc	Draft P802.11ax_D3.0 Redline Compared to D2.0.pdf				Disapprove	33
				Resolution Doc	11-17-1682-13-00ax-comments-on-tgax-d2-0.xlsx				Abstain	4
									Return%	82
				Comment	Template				Approve%	87
				Pool	LB# 233 Voters					
232	TGmd	Technical TGmd Draft 1.00	LB# 232	Draft	Draft P802.11REVmd_D1.0.pdf	2018-02-05	2018-03-17	40	Pool	254
									Approve	166
				Redlined Doc	Draft P802.11REVmd_D1.0 Redline Compared to D0.1.pdf				Disapprove	29
				Resolution Doc	11-17-0914-13-000m-revmd-wg-cc-comments.xls				Abstain	11
									Return%	81
				Comment	Template				Approve%	85
				Pool	LB# 232 Voters					
231	TGay	Technical TGay Draft 1.00	LB# 231	Draft	Draft P802.11ay_D1.0.pdf	2017-11-24	2018-01-07	44	Pool	288
									Approve	147
				Redlined Doc	Draft P802.11ay_D1.0 Redline Compared to D0.8.pdf				Disapprove	51
				Resolution Doc	N/A				Abstain	31
									Return%	80
				Comment	Template				Approve%	74
				Pool	LB# 231 Voters					
230	TGax	Technical TGax Draft 2.00	LB# 230	Draft	Draft P802.11ax_D2.0.pdf	2017-10-05	2017-11-04	30	Pool	329
									Approve	137
				Redlined Doc	Draft P802.11ax_D2.0 Redline Compared to D1.0.pdf				Disapprove	81
				Resolution Doc	11-17-0010-14-00ax-comments-on-tgax-d1-0.xlsx				Abstain	8
									Return%	69
				Comment	Template				Approve%	63
				Pool	LB# 230 Voters					
229	TGak	Recirculation TGak Draft 4.00	LB# 229	Draft	Draft P802.11ak_D4.0.pdf	2017-03-15	2017-03-30	15	Pool	359
									Approve	202
				Redlined Doc	Draft P802.11ak_D4.0 Redline.pdf				Disapprove	10
				Resolution Doc	11-17-0025-09-00ak-11ak-wg-lb-comments.xlsx				Abstain	41
									Return%	70
				Comment	Template				Approve%	95
				Pool	LB# 229 Voters					
228	TGaj	Recirculation TGaj Draft 5.00	LB# 228	Draft	Draft P802.11aj_D5.0.pdf	2017-02-17	2017-03-04	15	Pool	377
									Approve	247
				Redlined Doc	Draft P802.11aj_D5.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-16-1639-02-00aj-lb226-comments-database.xlsx				Abstain	51
									Return%	83
				Comment	Template				Approve%	95
				Pool	LB# 228 Voters					
227	TGak	Recirculation TGak Draft 3.00	LB# 227	Draft	Draft P802.11ak_D3.0.pdf	2016-12-21	2017-01-10	20	Pool	359
									Approve	198
				Redlined Doc	Draft P802.11ak_D3.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-15-0556-34-00ak-lb212-working-group-ballot-comments.xlsx				Abstain	43
									Return%	70
				Comment	Template				Approve%	94
				Pool	LB# 227 Voters					
226	TGaj	Recirculation TGaj Draft 4.00	LB# 226	Draft	Draft P802.11aj_D4.0.pdf	2016-12-06	2016-12-21	15	Pool	377
									Approve	234
				Redlined Doc	Draft P802.11aj_D4.0 Redline.pdf				Disapprove	21
				Resolution Doc	11-16-1129-02-00aj-lb223-comments-database.xlsx				Abstain	55
									Return%	82
				Comment	Template				Approve%	92
				Pool	LB# 226 Voters					
225	TGax	Technical TGax Draft 1.00	LB# 225	Draft	Draft P802.11ax_D1.0.pdf	2016-12-01	2017-01-08	38	Pool	371
									Approve	145
				Redlined Doc	Draft P80211ax_D1.0 Redline Compared to D0.5.pdf				Disapprove	106
				Resolution Doc	N/A				Abstain	25

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	74
				Comment	Template				Approve%	58
				Pool	LB# 225 Voters					
224	TGaq	Recirculation TGaq Draft 7.00	LB# 224	Draft	Draft P802.11aq_D7.0.pdf	2016-09-10	2016-09-25	15	Pool	357
									Approve	226
				Redlined Doc	Draft P802.11aq_D7.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-16-1108-03-00aq-lb222-wg-comments-for-11aq-draft-6-0.xlsx				Abstain	47
									Return%	78
				Comment	Template				Approve%	97
				Pool	LB# 224 Voters					
223	TGaj	Recirculation TGaj Draft 3.00	LB# 223	Draft	Draft P802.11aj_D3.0.pdf	2016-08-15	2016-08-30	15	Pool	377
									Approve	221
				Redlined Doc	Draft P802.11aj_D3.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-16-0811-02-00aj-lb220-comments-database.xlsx				Abstain	57
									Return%	81
				Comment	Template				Approve%	89
				Pool	LB# 223 Voters					
222	TGaq	Recirculation TGaq Draft 6.00	LB# 222	Draft	Draft P802.11aq_D6.0.pdf	2016-08-04	2016-08-19	15	Pool	357
									Approve	223
				Redlined Doc	Draft P802.11aq_D6.0 Redline.pdf				Disapprove	10
				Resolution Doc	11-16-0982-04-00aq-lb221-wg-comments-for-11aq-draft-5-0.xlsx				Abstain	47
									Return%	78
				Comment	Template				Approve%	96
				Pool	LB# 222 Voters					
221	TGaq	Recirculation TGaq Draft 5.00	LB# 221	Draft	Draft P802.11aq_D5.0.pdf	2016-07-04	2016-07-19	15	Pool	357
									Approve	218
				Redlined Doc	Draft P802.11aq_D5.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-16-0553-04-00aq-lb219-wg-comments-for-11aq-draft-4-0.xlsx				Abstain	46
									Return%	78
				Comment	Template				Approve%	93
				Pool	LB# 221 Voters					
220	TGaj	Recirculation TGaj Draft 2.00	LB# 220	Draft	Draft P802.11aj_D2.0.pdf	2016-06-15	2016-06-30	15	Pool	377
									Approve	218
				Redlined Doc	Draft P802.11aj_D2.0 Redline.pdf				Disapprove	28
				Resolution Doc	11-16-0193-04-00aj-lb217-comments-database.xlsx				Abstain	53
									Return%	79
				Comment	Template				Approve%	89
				Pool	LB# 220 Voters					
219	TGaq	Recirculation TGaq Draft 4.00	LB# 219	Draft	Draft P802.11aq_D4.0.pdf	2016-04-06	2016-04-21	15	Pool	357
									Approve	213
				Redlined Doc	Draft P802.11aq_D4.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-15-1377-17-00aq-lb216-wg-ballot-comments-for-11aq-draft-3-0.xlsx				Abstain	45
									Return%	77
				Comment	Template				Approve%	93
				Pool	LB# 219 Voters					
218	TGak	Recirculation TGak Draft 2.00	LB# 218	Draft	Draft P802.11ak_D2.0.pdf	2016-02-24	2016-03-10	15	Pool	361
									Approve	174
				Redlined Doc	Draft P802.11ak_D2.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-15-0556-19-00ak-lb212-working-group-ballot-comments.xlsx				Abstain	33
									Return%	62
				Comment	Template				Approve%	91
				Pool	LB# 218 Voters					
217	TGaj	Technical TGaj Draft 1.00	LB# 217	Draft	Draft P802.11aj_D1.0.pdf	2015-12-21	2016-01-20	30	Pool	368
									Approve	221
				Redlined Doc	N/A				Disapprove	30
				Resolution Doc	N/A				Abstain	31
									Return%	77
				Comment	Template				Approve%	88
				Pool	LB# 217 Voters					
216	TGaq	Technical TGaq Draft 3.00	LB# 216	Draft	Draft P802.11aq_D3.0.pdf	2015-10-08	2015-11-07	30	Pool	358
									Approve	202
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	39
									Return%	72
				Comment	Template				Approve%	93
				Pool	LB# 216 Voters					
215	TGah	Recirculation TGah Draft 5.00	LB# 215	Draft	Draft P802.11ah_D5.0.pdf	2015-09-18	2015-10-03	15	Pool	330
									Approve	262
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	11-15-0525-02-00ah-tgah-lb211-comments-on-d5-0.xlsx				Abstain	15
									Return%	86
				Comment	Template				Approve%	98
				Pool	LB# 215 Voters					
214	TGai	Recirculation TGai Draft 6.00	LB# 214	Draft	Draft P802.11ai_D6.0.pdf	2015-07-16	2015-07-31	15	Pool	336
									Approve	252
				Redlined Doc	Draft P802.11ai_D6.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-15-0772-08-00ai-lb213comments-for-draft-5-0.xlsx				Abstain	21

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	83
				Comment	Template				Approve%	97
				Pool	LB# 214 Voters					
213	TGai	Recirculation TGai Draft 5.00	LB# 213	Draft	Draft P802.11ai_D5.0.pdf	2015-06-11	2015-06-26	15	Pool	336
									Approve	238
				Redlined Doc	Draft P802.11ai_D5.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-15-0281-20-00ai-tbai-lb209-comments-on-draft-d4-0.xlsx				Abstain	21
									Return%	83
				Comment	Template				Approve%	92
				Pool	LB# 213 Voters					
212	TGak	Technical TGak Draft 1.00	LB# 212	Draft	Draft P802.11ak_D1.0.pdf	2015-04-06	2015-05-06	30	Pool	361
									Approve	134
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	27
									Return%	51
				Comment	Template				Approve%	85
				Pool	LB# 212 Voters					
211	TGah	Recirculation TGah Draft 5.00	LB# 211	Draft	Draft P802.11ah_D5.0.pdf	2015-04-01	2015-04-16	15	Pool	330
									Approve	248
				Redlined Doc	Draft P802.11ah_D5.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-15-0261-07-00ah-tgah-lb207-comments-on-d4-0.xlsx				Abstain	16
									Return%	86
				Comment	Template				Approve%	93
				Pool	LB# 211 Voters					
210	TGmc	Recirculation TGmc Draft 4.00	LB# 210	Draft	Draft P802.11REVmc_D4.0.pdf	2015-03-11	2015-03-26	15	Pool	325
									Approve	241
				Redlined Doc	N/A				Disapprove	10
				Resolution Doc	11-13-0233-56-0000-revmc-wg-ballot-comments.xls				Abstain	18
									Return%	83
				Comment	Template				Approve%	96
				Pool	LB# 210 Voters					
209	TGai	Recirculation TGai Draft 4.00	LB# 209	Draft	Draft P802.11ai_D4.0.pdf	2015-02-09	2015-02-24	15	Pool	336
									Approve	230
				Redlined Doc	Draft P802.11ai_D4.0 Redline.pdf				Disapprove	25
				Resolution Doc	11-14-1351-30-00ai-tgai-lb204-comments-for-draft-3-0.xlsx				Abstain	22
									Return%	82
				Comment	Template				Approve%	90
				Pool	LB# 209 Voters					
208	TGaq	Technical TGaq Draft 1.00	LB# 208	Draft	Draft P802.11aq_D1.0.pdf	2015-02-02	2015-03-04	30	Pool	363
									Approve	139
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	42
									Return%	64
				Comment	Template				Approve%	73
				Pool	LB# 208 Voters					
207	TGah	Recirculation TGah Draft 4.00	LB# 207	Draft	Draft P802.11ah_D4.0.pdf	2015-01-30	2015-02-14	15	Pool	330
									Approve	245
				Redlined Doc	Draft P802.11ah_D4.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-14-1372-09-00ah-tgah-lb205-comments-on-d3-0.xlsx				Abstain	18
									Return%	85
				Comment	Template				Approve%	93
				Pool	LB# 207 Voters					
206	TGmc	Recirculation TGmc Draft 4.00	LB# 206	Draft	Draft P802.11REVmc_D4.0.pdf	2015-01-28	2015-02-17	20	Pool	325
									Approve	237
				Redlined Doc	Draft P802.11REVmc_D4.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-13-0233-51-0000-revmc-wg-ballot-comments.xls				Abstain	18
									Return%	83
				Comment	Template				Approve%	94
				Pool	LB# 206 Voters					
205	TGah	Recirculation TGah Draft 3.00	LB# 205	Draft	Draft P802.11ah_D3.0.pdf	2014-10-10	2014-10-25	15	Pool	330
									Approve	234
				Redlined Doc	Draft P802.11ah_D3.0_Redline.pdf				Disapprove	27
				Resolution Doc	11-14-0796-11-00ah-tgah-lb203-comments-on-d2-0.xlsx				Abstain	17
									Return%	84
				Comment	Template				Approve%	90
				Pool	LB# 205 Voters					
204	TGai	Recirculation TGai Draft 3.00	LB# 204	Draft	Draft P802.11ai_D3.0.pdf	2014-09-29	2014-10-14	15	Pool	336
									Approve	214
				Redlined Doc	Draft P802.11ai_D3.0 Redline.pdf				Disapprove	28
				Resolution Doc	11-14-0565-24-00ai-tgai-lb201-comments-for-draft-2-0.xlsx				Abstain	28
									Return%	80
				Comment	Template				Approve%	88
				Pool	LB# 204 Voters					
203	TGah	Technical TGah Draft 2.00	LB# 203	Draft	Draft P802.11ah_D2.0.pdf	2014-06-05	2014-07-05	30	Pool	330
									Approve	204
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	11-13-1336-16-00ah-tgah-lb200-comments-on-d1-0.xlsx				Abstain	24

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	82
				Comment	Template				Approve%	83
				Pool	LB# 203 Voters					
202	TGmc	Recirculation TGmc Draft 3.00	LB# 202	Draft	Draft P802.11REVmc_D3.0.pdf	2014-06-03	2014-06-23	20	Pool	325
									Approve	219
				Redlined Doc	Draft P802.11REVmc_D3.0 Redline.pdf				Disapprove	24
				Resolution Doc	11-13-0233-32-0000-revmc-wg-ballot-comments.xls				Abstain	19
									Return%	81
				Comment	Template				Approve%	90
				Pool	LB# 202 Voters					
201	TGai	Technical TGai Draft 2.00	LB# 201	Draft	Draft P802.11ai_D2.0.pdf	2014-04-07	2014-05-07	30	Pool	336
									Approve	195
				Redlined Doc	Draft P802.11ai_D2.0 Redline.pdf				Disapprove	34
				Resolution Doc	11-13-1076-34-00ai-tgai-lb-198-comments-for-d1-0.xlsx				Abstain	28
									Return%	76
				Comment	Template				Approve%	85
				Pool	LB# 201 Voters					
200	TGah	Technical TGah Draft 1.00	LB# 200	Draft	Draft P802.11ah_D1.0.pdf	2013-10-05	2013-11-04	30	Pool	323
									Approve	144
				Redlined Doc	N/A				Disapprove	54
				Resolution Doc	N/A				Abstain	18
									Return%	67
				Comment	Template				Approve%	73
				Pool	LB# 200 Voters					
199	TGmc	Recirculation TGmc Draft 2.00	LB# 199	Draft	Draft P802.11REVmc_D2.0.pdf	2013-10-03	2013-10-23	20	Pool	325
									Approve	207
				Redlined Doc	Draft P802.11REVmc_D2.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-13-0233-18-0000-revmc-wg-ballot-comments.xls				Abstain	22
									Return%	78
				Comment	Template				Approve%	90
				Pool	LB# 199 Voters					
198	TGai	Technical TGai Draft 1.00	LB# 198	Draft	Draft P802.11ai_D1.0.pdf	2013-08-13	2013-09-12	30	Pool	334
									Approve	147
				Redlined Doc	N/A				Disapprove	51
				Resolution Doc	N/A				Abstain	22
									Return%	66
				Comment	Template				Approve%	74
				Pool	LB# 198 Voters					
197	TGaf	Recirculation TGaf Draft 5.00	LB# 197	Draft	Draft P802.11af_D5.0.pdf	2013-07-17	2013-08-01	15	Pool	300
									Approve	228
				Redlined Doc	N/A				Disapprove	3
				Resolution Doc	11-12-1017-50-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	7
									Return%	79
				Comment	Template				Approve%	99
				Pool	LB# 197 Voters					
196	TGaf	Recirculation TGaf Draft 5.00	LB# 196	Draft	Draft P802.11af_D5.0.pdf	2013-05-30	2013-06-14	15	Pool	300
									Approve	215
				Redlined Doc	Draft P802.11af_D5.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-12-1017-46-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	8
									Return%	79
				Comment	Template				Approve%	94
				Pool	LB# 196 Voters					
195	TGaf	Recirculation TGaf Draft 4.00	LB# 195	Draft	Draft P802.11af_D4.0.pdf	2013-04-02	2013-04-17	15	Pool	300
									Approve	211
				Redlined Doc	Draft P802.11af_D4.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-12-1017-38-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	7
									Return%	79
				Comment	Template				Approve%	92
				Pool	LB# 195 Voters					
194	TGac	Recirculation TGac Draft 5.00	LB# 194	Draft	Draft P802.11ac_D5.0.pdf	2013-03-20	2013-04-04	15	Pool	300
									Approve	252
				Redlined Doc	N/A				Disapprove	10
				Resolution Doc	11-13-0199-03-00ac-lb191-comments-tgac-d5-0.xls				Abstain	10
									Return%	91
				Comment	Template				Approve%	96
				Pool	LB# 194 Voters					
193	TGmc	Technical TGmc Draft 1.00	LB# 193	Draft	Draft P802.11REVmc_D1.0.pdf	2013-01-31	2013-03-02	30	Pool	325
									Approve	197
				Redlined Doc	N/A				Disapprove	26
				Resolution Doc	N/A				Abstain	22
									Return%	75
				Comment	Template				Approve%	88
				Pool	LB# 193 Voters					
192	TGaf	Recirculation TGaf Draft 3.00	LB# 192	Draft	Draft P802.11af_D3.0.pdf	2013-01-24	2013-02-08	15	Pool	300
									Approve	194
				Redlined Doc	Draft P802.11af_D3.0 Redline.pdf				Disapprove	30
				Resolution Doc	11-12-1017-30-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	8

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	77
				Comment	Template				Approve%	87
				Pool	LB# 192 Voters					
191	TGac	Recirculation TGac Draft 5.00	LB# 191	Draft	Draft P802.11ac_D5.0.pdf	2013-01-17	2013-02-01	15	Pool	300
									Approve	249
				Redlined Doc	Draft P802.11ac_D5.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-12-1277-10-00ac-lb190-comments-tgac-d4-0.xls				Abstain	10
									Return%	90
				Comment	Template				Approve%	95
				Pool	LB# 191 Voters					
190	TGac	Recirculation TGac Draft 4.00	LB# 190	Draft	Draft P802.11ac_D4.0.pdf	2012-10-17	2012-11-01	15	Pool	300
									Approve	242
				Redlined Doc	Draft P802.11ac_D4.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-12-0752-17-00ac-lb188-comments-tgac-d3-0.xls				Abstain	14
									Return%	90
				Comment	Template				Approve%	94
				Pool	LB# 190 Voters					
189	TGaf	Technical TGaf Draft 2.00	LB# 189	Draft	Draft P802.11af_D2.0.pdf	2012-07-20	2012-08-19	30	Pool	300
									Approve	163
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	N/A				Abstain	14
									Return%	73
				Comment	Template				Approve%	79
				Pool	LB# 189 Voters					
188	TGac	Recirculation TGac Draft 3.00	LB# 188	Draft	Draft P802.11ac_D3.0.pdf	2012-06-05	2012-06-25	20	Pool	300
									Approve	233
				Redlined Doc	Draft P802.11ac_D3.0 Redline.pdf				Disapprove	24
				Resolution Doc	11-12-0223-24-00ac-lb187-comment-tgac-d2-0.xls				Abstain	14
									Return%	90
				Comment	Template				Approve%	91
				Pool	LB# 188 Voters					
187	TGac	Technical TGac Draft 2.00	LB# 187	Draft	Draft P802.11ac_D2.0.pdf	2012-01-19	2012-02-18	30	Pool	300
									Approve	223
				Redlined Doc	N/A				Disapprove	28
				Resolution Doc	N/A				Abstain	19
									Return%	90
				Comment	Template				Approve%	89
				Pool	LB# 187 Voters					
186	TGad	Recirculation TGad Draft 5.00	LB# 186	Draft	Draft P802.11ad_D5.0.pdf	2011-11-09	2011-11-24	15	Pool	278
									Approve	197
				Redlined Doc	N/A				Disapprove	11
				Resolution Doc	11-11-1374-02-00ad-lb185-comment-database.xlsx				Abstain	21
									Return%	82
				Comment	Template				Approve%	95
				Pool	LB# 186 Voters					
185	TGad	Recirculation TGad Draft 5.00	LB# 185	Draft	Draft P802.11ad_D5.0.pdf	2011-09-21	2011-10-06	15	Pool	278
									Approve	196
				Redlined Doc	Draft P802.11ad_D5.0 Redline.pdf				Disapprove	13
				Resolution Doc	11-11-1113-05-00ad-lb183-comment-database.xlsx				Abstain	19
									Return%	82
				Comment	Template				Approve%	94
				Pool	LB# 185 Voters					
184	TGaa	Recirculation TGaa Draft 6.00	LB# 184	Draft	Draft P802.11aa_D6.0.pdf	2011-08-16	2011-08-31	15	Pool	257
									Approve	151
				Redlined Doc	N/A				Disapprove	8
				Resolution Doc	11-11-1118-01-00aa-proposed-resolutions-to-lb182-comments.xls				Abstain	38
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 184 Voters					
183	TGad	Recirculation TGad Draft 4.00	LB# 183	Draft	Draft P802.11ad_D4.0.pdf	2011-07-25	2011-08-09	15	Pool	278
									Approve	195
				Redlined Doc	Draft P802.11ad_D4.0 Redline.pdf				Disapprove	11
				Resolution Doc	11-11-0850-06-00ad-lb177-comment-database.xlsx				Abstain	22
									Return%	82
				Comment	Template				Approve%	95
				Pool	LB# 183 Voters					
182	TGaa	Recirculation TGaa Draft 6.00	LB# 182	Draft	Draft P802.11aa_D6.0.pdf	2011-07-25	2011-08-09	15	Pool	257
									Approve	149
				Redlined Doc	Draft P802.11aa_D6.0 Redline.pdf				Disapprove	9
				Resolution Doc	11-11-0876-07-00aa-lb179-comments.xlsx				Abstain	38
									Return%	76
				Comment	Template				Approve%	94
				Pool	LB# 182 Voters					
181	TGae	Recirculation TGae Draft 5.00	LB# 181	Draft	Draft P802.11ae_D5.0.pdf	2011-07-20	2011-08-04	15	Pool	278
									Approve	182
				Redlined Doc	Draft P802.11ae_D5.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-11-0888-08-00ae-lb-180-comment-resolutions.xls				Abstain	35

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	81
				Comment	Template				Approve%	96
				Pool	LB# 181 Voters					
180	TGae	Recirculation TGae Draft 4.00	LB# 180	Draft	Draft P802.11ae_D4.0.pdf	2011-06-03	2011-06-18	15	Pool	278
									Approve	180
				Redlined Doc	Draft P802.11ae_D4.0 Redline.pdf				Disapprove	8
				Resolution Doc	11-11-0598-07-00ae-tgae-lb-176-comment-resolutions.xls				Abstain	35
									Return%	80
				Comment	Template				Approve%	96
				Pool	LB# 180 Voters					
179	TGaa	Recirculation TGaa Draft 5.00	LB# 179	Draft	Draft P802.11aa_D5.0.pdf	2011-06-02	2011-06-17	15	Pool	257
									Approve	142
				Redlined Doc	Draft P802.11aa_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-11-0523-08-00aa-lb175-comments.xls				Abstain	39
									Return%	76
				Comment	Template				Approve%	90
				Pool	LB# 179 Voters					
178	TGac	Technical TGac Draft 1.00	LB# 178	Draft	Draft P802.11ac_D1.0.pdf	2011-05-26	2011-06-25	30	Pool	315
									Approve	148
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	16
									Return%	69
				Comment	Template				Approve%	74
				Pool	LB# 178 Voters					
177	TGad	Recirculation TGad Draft 3.00	LB# 177	Draft	Draft P802.11ad_D3.0.pdf	2011-05-17	2011-06-01	15	Pool	278
									Approve	188
				Redlined Doc	Draft P802.11ad_D3.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-11-0508-07-00ad-lb174-comment-database.xlsx				Abstain	24
									Return%	82
				Comment	Template				Approve%	92
				Pool	LB# 177 Voters					
176	TGae	Recirculation TGae Draft 3.00	LB# 176	Draft	Draft P802.11ae_D3.0.pdf	2011-04-11	2011-04-26	15	Pool	278
									Approve	163
				Redlined Doc	Draft P802.11ae_D3.0 Redline.pdf				Disapprove	21
				Resolution Doc	11-11-0255-03-00ae-tgae-lb-172-comment-resolutions.xls				Abstain	37
									Return%	79
				Comment	Template				Approve%	89
				Pool	LB# 176 Voters					
175	TGaa	Recirculation TGaa Draft 4.00	LB# 175	Draft	Draft P802.11aa_D4.0.pdf	2011-03-25	2011-04-09	15	Pool	257
									Approve	135
				Redlined Doc	Draft P802.11aa_D4.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-11-0267-03-00aa-lb173-comments.xls				Abstain	37
									Return%	76
				Comment	Template				Approve%	85
				Pool	LB# 175 Voters					
174	TGad	Recirculation TGad Draft 2.00	LB# 174	Draft	Draft P802.11ad_D2.0.pdf	2011-03-21	2011-04-05	15	Pool	278
									Approve	175
				Redlined Doc	Draft P802.11ad_D2.0 Redline.pdf				Disapprove	25
				Resolution Doc	11-10-1220-21-00ad-lb168-comment-database.xlsx				Abstain	25
									Return%	81
				Comment	Template				Approve%	88
				Pool	LB# 174 Voters					
173	TGaa	Recirculation TGaa Draft 3.00	LB# 173	Draft	Draft P802.11aa_D3.0.pdf	2011-02-09	2011-02-24	15	Pool	257
									Approve	127
				Redlined Doc	Draft P802.11aa_D3.0 Redline.pdf				Disapprove	30
				Resolution Doc	11-10-1441-10-00aa-lb170-comments.xls				Abstain	37
									Return%	75
				Comment	Template				Approve%	81
				Pool	LB# 173 Voters					
172	TGae	Recirculation TGae Draft 2.00	LB# 172	Draft	Draft P802.11ae_D2.0.pdf	2011-02-03	2011-02-18	15	Pool	278
									Approve	155
				Redlined Doc	Draft P802.11ae_D2.0 Redline.pdf				Disapprove	26
				Resolution Doc	11-10-1221-24-00ae-tgae-lb169-comment-resolutions.xls				Abstain	38
									Return%	79
				Comment	Template				Approve%	86
				Pool	LB# 172 Voters					
171	TGaf	Technical TGaf Draft 1.00	LB# 171	Draft	Draft P802.11af_D1.0.pdf	2011-01-25	2011-02-24	30	Pool	300
									Approve	125
				Redlined Doc	N/A				Disapprove	76
				Resolution Doc	N/A				Abstain	35
									Return%	79
				Comment	Template				Approve%	62
				Pool	LB# 171 Voters					
170	TGaa	Recirculation TGaa Draft 2.00	LB# 170	Draft	Draft P802.11aa_D2.0.pdf	2010-11-23	2010-12-08	15	Pool	257
									Approve	117
				Redlined Doc	Draft P802.11aa_D2.0 Redline.pdf				Disapprove	32
				Resolution Doc	11-10-1395-02-00aa-lb164-consolidated-comments-editorial-notes.xls				Abstain	36

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	72
				Comment	Template				Approve%	79
				Pool	LB# 170 Voters					
169	TGae	Technical TGae Draft 1.00	LB# 169	Draft	Draft P802.11ae_D1.0.pdf	2010-09-27	2010-10-27	30	Pool	278
									Approve	134
				Redlined Doc	N/A				Disapprove	32
				Resolution Doc	N/A				Abstain	40
									Return%	74
				Comment	Template				Approve%	81
				Pool	LB# 169 Voters					
168	TGad	Technical TGad Draft 1.00	LB# 168	Draft	Draft P802.11ad_D1.0.pdf	2010-09-24	2010-10-24	30	Pool	278
									Approve	163
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	26
									Return%	77
				Comment	Template				Approve%	87
				Pool	LB# 168 Voters					
167	TGmb	Recirculation TGmb Draft 5.00	LB# 167	Draft	Draft P802.11REVmb_D5.0.pdf	2010-08-04	2010-08-19	15	Pool	246
									Approve	172
				Redlined Doc	Draft P802.11REVmb_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0706-15-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	92
				Pool	LB# 167 Voters					
166	TGs	Recirculation TGs Draft 7.00	LB# 166	Draft	Draft P802.11s_D7.0.pdf	2010-07-29	2010-08-13	15	Pool	248
									Approve	167
				Redlined Doc	Draft P802.11s_D7.0 Redline.pdf				Disapprove	9
				Resolution Doc	11-10-0725-09-000s-lb-165-comment-resolutions.xls				Abstain	34
									Return%	85
				Comment	Template				Approve%	95
				Pool	LB# 166 Voters					
165	TGs	Recirculation TGs Draft 6.00	LB# 165	Draft	Draft P802.11s_D6.0.pdf	2010-06-13	2010-06-28	15	Pool	248
									Approve	157
				Redlined Doc	Draft P802.11s_D6.0 Redline Compared to P802.11s_D5.0.pdf				Disapprove	20
				Resolution Doc	11-10-0478-09-000s-lb-161-comment-resolutions.xls				Abstain	33
									Return%	85
				Comment	Template				Approve%	89
				Pool	LB# 165 Voters					
164	TGaa	Technical TGaa Draft 1.00	LB# 164	Draft	Draft P802.11aa_D1.0.pdf	2010-06-10	2010-07-10	30	Pool	257
									Approve	112
				Redlined Doc	N/A				Disapprove	31
				Resolution Doc	N/A				Abstain	37
									Return%	70
				Comment	Template				Approve%	78
				Pool	LB# 164 Voters					
163	TGmb	Recirculation TGmb Draft 4.00	LB# 163	Draft	Draft P802.11REVmb_D4.0.pdf	2010-06-10	2010-06-25	15	Pool	246
									Approve	164
				Redlined Doc	Draft P802.11REVmb_D4.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-12-000m-revmb-wg-ballot-comments.xls				Abstain	28
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 163 Voters					
162	TGmb	Recirculation TGmb Draft 3.00	LB# 162	Draft	Draft P802.11REVmb_D3.0.pdf	2010-03-31	2010-04-25	25	Pool	246
									Approve	167
				Redlined Doc	Draft P802.11REVmb_D3.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-10-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 162 Voters					
161	TGs	Recirculation TGs Draft 5.00	LB# 161	Draft	Draft P802.11s_D5.0.pdf	2010-03-31	2010-04-15	15	Pool	248
									Approve	159
				Redlined Doc	Draft P802.11s_D5.0 Redline Compared to P802.11s_D4.0.pdf				Disapprove	19
				Resolution Doc	11-10-0032-13-000s-lb-159-comment-resolutions.xls				Abstain	32
									Return%	85
				Comment	Template				Approve%	89
				Pool	LB# 161 Voters					
160	TGmb	Recirculation TGmb Draft 2.00	LB# 160	Draft	Draft P802.11REVmb_D2.0.pdf	2009-12-11	2010-01-08	28	Pool	246
									Approve	166
				Redlined Doc	Draft P802.11REVmb_D2.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-06-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 160 Voters					
159	TGs	Recirculation TGs Draft 4.00	LB# 159	Draft	Draft P802.11s_D4.0.pdf	2009-12-09	2010-01-08	30	Pool	248
									Approve	150
				Redlined Doc	Draft P802.11s_D4.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-09-0471-24-000s-lb-147-comment-resolutions.xls				Abstain	33

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	85
				Comment	Template				Approve%	85
				Pool	LB# 159 Voters					
158	TGp	Recirculation TGp Draft 9.00	LB# 158	Draft	Draft P802.11p_D9.0.pdf	2009-09-25	2009-10-10	15	Pool	232
									Approve	171
				Redlined Doc	Draft P802.11p_D9.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-09-0927-03-000p-lb154-tgp-comment-resolution-master.xls				Abstain	29
									Return%	91
				Comment	Template				Approve%	93
				Pool	LB# 158 Voters					
157	TGz	Recirculation TGz Draft 6.00	LB# 157	Draft	Draft P802.11z_D6.0.pdf	2009-08-11	2009-08-26	15	Pool	254
									Approve	187
				Redlined Doc	Draft P802.11z_D6.0 Redline.pdf				Disapprove	8
				Resolution Doc	11-09-0739-04-000z-tgz-lb153-comment-spreadsheet.xls				Abstain	38
									Return%	92
				Comment	Template				Approve%	96
				Pool	LB# 157 Voters					
156	TGu	Recirculation TGu Draft 8.00	LB# 156	Draft	Draft P802.11u_D8.0.pdf	2009-08-03	2009-08-18	15	Pool	213
									Approve	148
				Redlined Doc	Draft P802.11u_D8.0 Redline.pdf				Disapprove	11
				Resolution Doc	11-09-0692-14-000u-lb152-comment-spreadsheet.xls				Abstain	35
									Return%	91
				Comment	Template				Approve%	93
				Pool	LB# 156 Voters					
155	TGv	Recirculation TGv Draft 7.00	LB# 155	Draft	Draft P802.11v_D7.0.pdf	2009-07-23	2009-08-07	15	Pool	254
									Approve	176
				Redlined Doc	Draft P802.11v_D7.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-09-0676-07-000v-lb-150-comments.xls				Abstain	38
									Return%	91
				Comment	Template				Approve%	92
				Pool	LB# 155 Voters					
154	TGp	Recirculation TGp Draft 8.00	LB# 154	Draft	Draft P802.11p_D8.0.pdf	2009-07-21	2009-08-05	15	Pool	232
									Approve	163
				Redlined Doc	Draft P802.11p_D8.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0688-03-000p-LB151-TGp Comment Resolution Master2.xls				Abstain	28
									Return%	91
				Comment	Template				Approve%	89
				Pool	LB# 154 Voters					
153	TGz	Recirculation TGz Draft 5.00	LB# 153	Draft	Draft P802.11z_D5.0.pdf	2009-06-08	2009-06-23	15	Pool	254
									Approve	183
				Redlined Doc	Draft P802.11z_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0313-03-000z-tgz-lb143-comment-spreadsheet.xls				Abstain	34
									Return%	91
				Comment	Template				Approve%	92
				Pool	LB# 153 Voters					
152	TGu	Recirculation TGu Draft 7.00	LB# 152	Draft	Draft P802.11u_D7.0.pdf	2009-06-04	2009-06-19	15	Pool	213
									Approve	142
				Redlined Doc	Draft P802.11u_D7.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-09-0489-13-000u-lb148-comment-spreadsheet.xls				Abstain	33
									Return%	91
				Comment	Template				Approve%	88
				Pool	LB# 152 Voters					
151	TGp	Recirculation TGp Draft 7.00	LB# 151	Draft	Draft P802.11p_D7.0.pdf	2009-05-29	2009-06-13	15	Pool	232
									Approve	158
				Redlined Doc	Draft P802.11p_D7.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-09-0432-05-000p-lb144-tgp-comment-resolution-master.xls				Abstain	26
									Return%	91
				Comment	Template				Approve%	85
				Pool	LB# 151 Voters					
150	TGv	Recirculation TGv Draft 6.00	LB# 150	Draft	Draft P802.11v_D6.0.pdf	2009-05-28	2009-06-12	15	Pool	254
									Approve	172
				Redlined Doc	Draft P802.11v_D6.0 Redline Compared to P802.11v_D5.0.pdf				Disapprove	20
				Resolution Doc	11-09-0434-04-000v-lb146.xls				Abstain	38
									Return%	91
				Comment	Template				Approve%	90
				Pool	LB# 150 Voters					
149	TGmb	Technical TGmb Draft 1.00	LB# 149	Draft	Draft P802.11REVmb_D1.0.pdf	2009-05-18	2009-06-27	40	Pool	246
									Approve	155
				Redlined Doc	N/A				Disapprove	23
				Resolution Doc	N/A				Abstain	29
									Return%	84
				Comment	Template				Approve%	87
				Pool	LB# 149 Voters					
148	TGu	Recirculation TGu Draft 6.00	LB# 148	Draft	Draft P802.11u_D6.0.pdf	2009-04-09	2009-04-24	15	Pool	213
									Approve	142
				Redlined Doc	Draft P802.11u_D6.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0245-10-000u-lb142-comment-spreadsheet.xls				Abstain	35

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	90
				Comment	Template				Approve%	90
				Pool	LB# 148 Voters					
147	TGs	Technical TGs Draft 3.00	LB# 147	Draft	Draft P802.11s_D3.0.pdf	2009-04-04	2009-05-04	30	Pool	248
									Approve	132
				Redlined Doc	N/A				Disapprove	35
				Resolution Doc	N/A				Abstain	34
									Return%	81
				Comment	Template				Approve%	79
				Pool	LB# 147 Voters					
146	TGv	Recirculation TGv Draft 5.00	LB# 146	Draft	Draft P802.11v_D5.0.pdf	2009-03-20	2009-04-04	15	Pool	254
									Approve	155
				Redlined Doc	Draft P802.11v_D5.0 Redline Compared to P802.11v_D4.0.pdf				Disapprove	32
				Resolution Doc	11-08-1467-04-000v-lb140-comments.xls				Abstain	41
									Return%	90
				Comment	Template				Approve%	83
				Pool	LB# 146 Voters					
145	TGs	Procedural TGs Draft 3.00	LB# 145	Draft	Draft P802.11s_D3.0.pdf	2009-03-19	2009-04-03	15	Pool	247
									Approve	166
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	N/A				Abstain	24
									Return%	79
				Comment	Template				Approve%	97
				Pool	LB# 145 Voters					
144	TGp	Recirculation TGp Draft 6.00	LB# 144	Draft	Draft P802.11p_D6.0.pdf	2009-03-16	2009-03-31	15	Pool	232
									Approve	161
				Redlined Doc	Draft P802.11p_6.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-08-1452-06-000p-lb141-tgp-comment-resolution-master.xls				Abstain	29
									Return%	91
				Comment	Template				Approve%	89
				Pool	LB# 144 Voters					
143	TGz	Recirculation TGz Draft 4.00	LB# 143	Draft	Draft P802.11z_D4.0.pdf	2009-02-18	2009-03-05	15	Pool	254
									Approve	170
				Redlined Doc	Draft P802.11z_D4.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-09-0097-02-000z-lb139-comment-resolution.xls				Abstain	37
									Return%	91
				Comment	Template				Approve%	88
				Pool	LB# 143 Voters					
142	TGu	Recirculation TGu Draft 5.00	LB# 142	Draft	Draft P802.11u_D5.0.pdf	2009-02-05	2009-02-20	15	Pool	213
									Approve	125
				Redlined Doc	Draft P802.11u_D5.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-08-1225-25-000u-lb137-comment-spreadsheet.xls				Abstain	39
									Return%	90
				Comment	Template				Approve%	82
				Pool	LB# 142 Voters					
141	TGp	Recirculation TGp Draft 5.00	LB# 141	Draft	Draft P802.11p_D5.0.pdf	2008-11-20	2008-12-05	15	Pool	232
									Approve	149
				Redlined Doc	Draft P802.11p_D5.0 Redline Compared to P802.11p_D4.0.pdf				Disapprove	26
				Resolution Doc	11-08-0514-06-000p-lb125-tgp-comment-resolution-master.xls				Abstain	35
									Return%	91
				Comment	Template				Approve%	85
				Pool	LB# 141 Voters					
140	TGv	Technical TGv Draft 4.00	LB# 140	Draft	Draft P802.11v_D4.0.pdf	2008-11-19	2008-12-19	30	Pool	254
									Approve	149
				Redlined Doc	Draft P802.11v_D4.0 Redline.pdf				Disapprove	36
				Resolution Doc	11-08-0801-05-000v-lb133-comments.xls				Abstain	40
									Return%	89
				Comment	Template				Approve%	81
				Pool	LB# 140 Voters					
139	TGz	Technical TGz Draft 3.00	LB# 139	Draft	Draft P802.11z_D3.0.pdf	2008-11-18	2008-12-18	30	Pool	254
									Approve	155
				Redlined Doc	N/A				Disapprove	29
				Resolution Doc	N/A				Abstain	41
									Return%	89
				Comment	Template				Approve%	84
				Pool	LB# 139 Voters					
138	TGn	Recirculation TGn Draft 7.00	LB# 138	Draft	Draft P802.11n_D7.0.pdf	2008-11-17	2008-12-02	15	Pool	325
									Approve	281
				Redlined Doc	N/A				Disapprove	14
				Resolution Doc	11-08-1417-00-000n-p802-11n-wg-ballot-unsatisfied-comments.xls				Abstain	20
									Return%	97
				Comment	Template				Approve%	95
				Pool	LB# 138 Voters					
137	TGu	Recirculation TGu Draft 4.00	LB# 137	Draft	Draft P802.11u_D4.0.pdf	2008-09-23	2008-10-08	15	Pool	213
									Approve	118
				Redlined Doc	Draft P802.11u_D4.0 Redline.pdf				Disapprove	34
				Resolution Doc	11-08-0722-27-000u-lb-132-comment-spreadsheet.xls				Abstain	37

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	89
				Comment	Template				Approve%	78
				Pool	LB# 137 Voters					
136	TGn	Recirculation TGn Draft 7.00	LB# 136	Draft	Draft P802.11n_D7.0.pdf	2008-09-15	2008-09-30	15	Pool	325
									Approve	276
				Redlined Doc	Draft P802.11n_D7.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-08-0958-02-000n-tgn-lb134-composite-comments.xls				Abstain	21
									Return%	97
				Comment	Template				Approve%	94
				Pool	LB# 136 Voters					
135	TGz	Technical TGz Draft 2.00	LB# 135	Draft	Draft P802.11z_D2.0.pdf	2008-07-21	2008-08-20	30	Pool	242
									Approve	99
				Redlined Doc	N/A				Disapprove	51
				Resolution Doc	N/A				Abstain	48
									Return%	82
				Comment	Template				Approve%	66
				Pool	LB# 135 Voters					
134	TGn	Recirculation TGn Draft 6.00	LB# 134	Draft	Draft P802.11n_D6.0.pdf	2008-07-21	2008-08-05	15	Pool	325
									Approve	266
				Redlined Doc	Draft P802.11n_D6.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-08-0713-02-000n-tgn-lb129-composite-comments.xls				Abstain	21
									Return%	97
				Comment	Template				Approve%	91
				Pool	LB# 134 Voters					
133	TGv	Technical TGv Draft 3.00	LB# 133	Draft	Draft P802.11v_D3.0.pdf	2008-06-13	2008-07-13	30	Pool	213
									Approve	106
				Redlined Doc	Draft P802.11v_D3.0 Redline.pdf				Disapprove	47
				Resolution Doc	11-08-0265-04-000v-lb123-comments.xls				Abstain	28
									Return%	85
				Comment	Template				Approve%	69
				Pool	LB# 133 Voters					
132	TGu	Technical TGu Draft 3.00	LB# 132	Draft	Draft P802.11u_D3.0.pdf	2008-06-12	2008-07-12	30	Pool	213
									Approve	113
				Redlined Doc	Draft P802.11u_D3.0 Redline.pdf				Disapprove	34
				Resolution Doc	N/A				Abstain	35
									Return%	85
				Comment	Template				Approve%	77
				Pool	LB# 132 Voters					
131	TGv	Procedural TGv Draft 2.02	LB# 131	Draft	Draft P802.11v_D2.02.pdf	2008-05-28	2008-06-12	15	Pool	213
									Approve	175
				Redlined Doc	Draft P802.11v_D2.02 Redline.pdf				Disapprove	14
				Resolution Doc	11-08-0265-04-000v-lb123-comments.xls				Abstain	18
									Return%	97
				Comment	Template				Approve%	93
				Pool	LB# 131 Voters					
130	TGu	Procedural TGu Draft 3.00	LB# 130	Draft	Draft P802.11u_D3.0.pdf	2008-05-27	2008-06-11	15	Pool	212
									Approve	159
				Redlined Doc	Draft P802.11u_D3.0 Redline.pdf				Disapprove	8
				Resolution Doc	N/A				Abstain	19
									Return%	88
				Comment	Template				Approve%	95
				Pool	LB# 130 Voters					
129	TGn	Recirculation TGn Draft 5.00	LB# 129	Draft	Draft P802.11n_D5.0.pdf	2008-05-23	2008-06-12	20	Pool	325
									Approve	261
				Redlined Doc	Draft P802.11n_D5.0 Redline.pdf				Disapprove	29
				Resolution Doc	11-08-0460-02-000n-tgn-lb124-composite-comments.xls				Abstain	23
									Return%	96
				Comment	Template				Approve%	90
				Pool	LB# 129 Voters					
128	TGw	Recirculation TGw Draft 6.00	LB# 128	Draft	Draft P802.11w_D6.0.pdf	2008-04-03	2008-04-18	15	Pool	427
									Approve	266
				Redlined Doc	11-08-0448-00-000w-Redlined Draft P802.11w_D6.0 Compared To Draft P802.11w_5.0.pdf				Disapprove	8
				Resolution Doc	11-08-0261-05-000w-lb121-comment-resolution.xls				Abstain	54
									Return%	77
				Comment	Template				Approve%	97
				Pool	LB# 128 Voters					
127	TGz	Technical TGz Draft 1.00	LB# 127	Draft	Draft P802.11z_D1.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	103
				Redlined Doc	N/A				Disapprove	59
				Resolution Doc	N/A				Abstain	47
									Return%	90
				Comment	Template				Approve%	64
				Pool	LB# 127 Voters					
126	TGs	Technical TGs Draft 2.00	LB# 126	Draft	Draft P802.11s_D2.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	103
				Redlined Doc	N/A				Disapprove	67
				Resolution	N/A				Abstain	36

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Doc					Return%	88
				Comment	Template				Approve%	61
				Pool	LB# 126 Voters					
125	TGp	Technical TGp Draft 4.00	LB# 125	Draft	Draft P802.11p D4.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	136
				Redlined Doc	index.html				Disapprove	37
				Resolution Doc	index.html				Abstain	32
									Return%	88
				Comment	Template				Approve%	79
				Pool	LB# 125 Voters					
124	TGn	Recirculation TGn Draft 4.00	LB# 124	Draft	index.html	2008-03-28	2008-04-12	15	Pool	325
									Approve	253
				Redlined Doc	index.html				Disapprove	34
				Resolution Doc	11-07-2783-08-000n-tgn-lb115-editor-comments.xls				Abstain	25
									Return%	96
				Comment	Template				Approve%	88
				Pool	LB# 124 Voters					
123	TGv	Technical TGv Draft 2.00	LB# 123	Draft	Draft P802.11v_D2.0.pdf	2008-02-14	2008-03-15	30	Pool	261
									Approve	126
				Redlined Doc	index.html				Disapprove	62
				Resolution Doc	index.html				Abstain	34
									Return%	85
				Comment	Template				Approve%	67
				Pool	LB# 123 Voters					
122	TGu	Technical TGu Draft 2.00	LB# 122	Draft	Draft P802.11u_D2.0.pdf	2008-02-14	2008-03-15	30	Pool	261
									Approve	125
				Redlined Doc	index.html				Disapprove	53
				Resolution Doc	index.html				Abstain	37
									Return%	82
				Comment	Template				Approve%	70
				Pool	LB# 122 Voters					
121	TGw	Recirculation TGw Draft 5.00	LB# 121	Draft	P802.11w_D5.0.pdf	2008-02-05	2008-02-20	15	Pool	427
									Approve	259
				Redlined Doc	index.html				Disapprove	14
				Resolution Doc	index.html				Abstain	55
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 121 Voters					
120	TGv	Procedural TGv Draft 1.04	LB# 120	Draft	Draft P802.11v_D1.04.pdf	2008-01-29	2008-02-13	15	Pool	297
									Approve	213
				Redlined Doc	index.html				Disapprove	13
				Resolution Doc	index.html				Abstain	27
									Return%	85
				Comment	Template				Approve%	94
				Pool	LB# 120 Voters					
119	TGu	Procedural TGu Draft 2.00	LB# 119	Draft	Draft P802.11u_D2.0.pdf	2008-01-27	2008-02-11	15	Pool	297
									Approve	203
				Redlined Doc	index.html				Disapprove	16
				Resolution Doc	index.html				Abstain	33
									Return%	85
				Comment	Template				Approve%	93
				Pool	LB# 119 Voters					
118	TGk	Technical TGk	LB# 118	Draft	11-07-2959-02-000k-11k-sponsor-ballot-recirc-2-comment-resolutions(1).xls	2007-12-13	2008-01-05	23	Pool	299
									Approve	175
				Redlined Doc	N/A				Disapprove	0
				Resolution Doc	N/A				Abstain	20
									Return%	65
				Comment	Template				Approve%	100
				Pool	LB# 118 Voters					
117	TGw	Recirculation TGw Draft 4.00	LB# 117	Draft	Draft P802.11w_D4.0.pdf	2007-12-12	2008-01-05	24	Pool	427
									Approve	245
				Redlined Doc	11-07-2943-00-000w-Redlined document D4.0-vs-3.0.pdf				Disapprove	21
				Resolution Doc	11-07-2697-07-000w-lb114-comment-resolutions.xls				Abstain	60
									Return%	76
				Comment	Template				Approve%	92
				Pool	LB# 117 Voters					
116	TGy	Recirculation TGy Draft 6.00	LB# 116	Draft	Draft P802.11y_D6.0.pdf	2007-11-23	2007-12-08	15	Pool	347
									Approve	271
				Redlined Doc	11-07-2902-00-000y Redlined Draft P802.11y_D6.0 Compared To Draft P802.11y_D5.0.pdf				Disapprove	2
				Resolution Doc	11-07-2623-05-000y-d5-comments.xls				Abstain	54
									Return%	94
				Comment	Template				Approve%	99
				Pool	LB# 116 Voters					
115	TGn	Recirculation TGn Draft 3.00	LB# 115	Draft	Draft P802.11n_D3.0.pdf	2007-10-07	2007-10-27	20	Pool	325
									Approve	240
				Redlined Doc	index.html				Disapprove	43
				Resolution	index.html				Abstain	27

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Doc					Return%	95
				Comment	Template				Approve%	85
				Pool	LB# 115 Voters					
114	TGw	Recirculation TGw Draft 3.00	LB# 114	Draft	Draft P802.11w_D3.0.pdf	2007-10-04	2007-10-19	15	Pool	427
									Approve	245
				Redlined Doc	11-07-2562-00-000w-D3.0-v-2.0-redline.pdf				Disapprove	21
				Resolution Doc	11-07-0714-13-000w-lb-102-comment-resolution-spreadsheet.xls				Abstain	59
									Return%	76
				Comment	Template				Approve%	92
				Pool	LB# 114 Voters					
112	TGy	Recirculation TGy Draft 5.00	LB# 112	Draft	Draft P802.11y_D5.0.pdf	2007-09-28	2007-10-13	15	Pool	347
									Approve	257
				Redlined Doc	11-07-2607-00-000y-tgy-redline-between-Draft-5.0-and-4.0.pdf				Disapprove	11
				Resolution Doc	11-07-2333-07-000y-d4-comments.xls				Abstain	59
									Return%	94
				Comment	Template				Approve%	96
				Pool	LB# 112 Voters					
111	TGk	Technical TGk	LB# 111	Draft	11-07-2289-05-000k-tgk-sponsor-ballot-comment-resolutions.xls	2007-08-27	2007-09-11	15	Pool	278
									Approve	196
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	N/A				Abstain	35
									Return%	91
				Comment	Template				Approve%	90
				Pool	LB# 111 Voters					
110	TGp	Technical TGp Draft 3.00	LB# 110	Draft	Draft P802.11p_D3.0.pdf	2007-08-13	2007-09-12	30	Pool	278
									Approve	143
				Redlined Doc	N/A				Disapprove	50
				Resolution Doc	N/A				Abstain	58
									Return%	90
				Comment	Template				Approve%	74
				Pool	LB# 110 Voters					
109	TGy	Recirculation TGy Draft 4.00	LB# 109	Draft	Draft P802.11y_D4.0.pdf	2007-08-06	2007-08-21	15	Pool	347
									Approve	250
				Redlined Doc	11-07-2268-00-000y-tgy-redline-between Draft 4.0 and 3.0.pdf				Disapprove	17
				Resolution Doc	11-07-2019-06-000y-d3-comments.xls				Abstain	60
									Return%	94
				Comment	Template				Approve%	94
				Pool	LB# 109 Voters					
108	TGv	Technical TGv Draft 1.00	LB# 108	Draft	Draft P802.11v_D1.0.pdf	2007-07-31	2007-08-30	30	Pool	278
									Approve	132
				Redlined Doc	N/A				Disapprove	77
				Resolution Doc	N/A				Abstain	38
									Return%	89
				Comment	Template				Approve%	63
				Pool	LB# 108 Voters					
107	TGu	Technical TGu Draft 1.00	LB# 107	Draft	Draft P802.11u_D1.0.pdf	2007-06-08	2007-07-08	30	Pool	299
									Approve	111
				Redlined Doc	index.html				Disapprove	62
				Resolution Doc	index.html				Abstain	48
									Return%	74
				Comment	Template				Approve%	64
				Pool	LB# 107 Voters					
106	TGy	Recirculation TGy Draft 3.00	LB# 106	Draft	Draft P802.11y_D3.0.pdf	2007-06-05	2007-06-20	15	Pool	347
									Approve	242
				Redlined Doc	index.html				Disapprove	24
				Resolution Doc	index.html				Abstain	60
									Return%	94
				Comment	Template				Approve%	91
				Pool	LB# 106 Voters					
105	TGr	Recirculation TGr Draft 6.00	LB# 105	Draft	Draft P802.11r_D6.0.pdf	2007-05-28	2007-06-13	16	Pool	518
									Approve	360
				Redlined Doc	index.html				Disapprove	11
				Resolution Doc	index.html				Abstain	65
									Return%	84
				Comment	Template				Approve%	97
				Pool	LB# 105 Voters					
104	TGy	Recirculation TGy Draft 2.00	LB# 104	Draft	Draft P802.11y_D2.0.pdf	2007-04-19	2007-05-05	16	Pool	347
									Approve	221
				Redlined Doc	index.html				Disapprove	41
				Resolution Doc	index.html				Abstain	62
									Return%	93
				Comment	Template				Approve%	84
				Pool	LB# 104 Voters					
103	TGk	Recirculation TGk Draft 7.00	LB# 103	Draft	Draft P802.11k_D7.0.pdf	2007-04-18	2007-05-05	17	Pool	514
									Approve	363
				Redlined Doc	index.html				Disapprove	29
				Resolution Doc	index.html				Abstain	39

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	84
				Comment	Template				Approve%	93
				Pool	LB# 103 Voters					
102	TGw	Recirculation TGw Draft 2.00	LB# 102	Draft	Draft P802.11w_D2.0.pdf	2007-04-07	2007-05-02	25	Pool	427
									Approve	227
				Redlined Doc	index.html				Disapprove	29
				Resolution Doc	index.html				Abstain	61
									Return%	74
				Comment	Template				Approve%	89
				Pool	LB# 102 Voters					
101	TGt	Technical TGt Draft 1.00	LB# 101	Draft	Draft-P802.11.2_D1.0.pdf	2007-04-16	2007-05-16	30	Pool	307
									Approve	163
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	57
									Return%	89
				Comment	Template				Approve%	76
				Pool	LB# 101 Voters					
99	TGt	Procedural TGt Draft 0.14	LB# 99	Draft	Draft P802.11.2_D0.14.pdf	2007-03-28	2007-04-12	15	Pool	323
									Approve	244
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	38
									Return%	92
				Comment	Template				Approve%	94
				Pool	LB# 99 Voters					
98	TGr	Recirculation TGr Draft 5.00	LB# 98	Draft	Draft P802.11r_D5.0.pdf	2007-03-20	2007-04-04	15	Pool	518
									Approve	350
				Redlined Doc	11-07-0471-00-000r-P802-11r-D5-0-redline.pdf				Disapprove	19
				Resolution Doc	11-06-1895-18-000r-d4-comments.xls				Abstain	67
									Return%	84
				Comment	Template				Approve%	95
				Pool	LB# 98 Voters					
97	TGn	Technical TGn Draft 2.00	LB# 97	Draft	Draft-P802.11n_D2.0.pdf	2007-02-07	2007-03-09	30	Pool	325
									Approve	231
				Redlined Doc	index.html				Disapprove	46
				Resolution Doc	N/A				Abstain	28
									Return%	94
				Comment	Template				Approve%	83
				Pool	LB# 97 Voters					
96	TGk	Recirculation TGk Draft 7.00	LB# 96	Draft	Draft P802.11k_D7.0.pdf	2007-01-29	2007-02-13	15	Pool	514
									Approve	361
				Redlined Doc	11-07-0119-00-000k-D7.0-Redlined-Changes-from-D6.0.pdf				Disapprove	30
				Resolution Doc	11-06-1739-18-000k-lb-90-EDITOR-comment-resolution-worksheet.xls				Abstain	38
									Return%	83
				Comment	Template				Approve%	92
				Pool	LB# 96 Voters					
95	TGn	Procedural TGn Draft 2.00	LB# 95	Draft	Draft P802.11n_D1.10.pdf	2007-01-22	2007-02-06	15	Pool	332
									Approve	293
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	N/A				Abstain	14
									Return%	94
				Comment	Template				Approve%	98
				Pool	LB# 95 Voters					
94	TGy	Technical TGy Draft 1.00	LB# 94	Draft	Draft P802.11y_D1.0.pdf	2006-12-08	2007-01-07	30	Pool	347
									Approve	182
				Redlined Doc	N/A				Disapprove	59
				Resolution Doc	N/A				Abstain	71
									Return%	90
				Comment	Template				Approve%	76
				Pool	LB# 94 Voters					
93	TGs	Technical TGs Draft 1.00	LB# 93	Draft	Draft P802.11s_D1.0.pdf	2006-12-07	2007-01-06	30	Pool	347
									Approve	128
				Redlined Doc	N/A				Disapprove	138
				Resolution Doc	N/A				Abstain	36
									Return%	87
				Comment	Template				Approve%	48
				Pool	LB# 93 Voters					
92	TGp	Technical TGp Draft 2.00	LB# 92	Draft	Draft P802.11p_D2.0.pdf	2006-12-06	2007-01-05	30	Pool	347
									Approve	166
				Redlined Doc	11-06-1885-00-000p-Draft P802.11p_D2.0-Redline.pdf				Disapprove	83
				Resolution Doc	11-06-0553-07-000p-lb81-11p-d1-0-comment-resolutions.xls				Abstain	62
									Return%	90
				Comment	Template				Approve%	67
				Pool	LB# 92 Voters					
91	TGr	Recirculation TGr Draft 4.00	LB# 91	Draft	Draft P802.11r_D4.0.pdf	2006-11-20	2006-12-04	14	Pool	518
									Approve	335
				Redlined Doc	11-06-1850-00-000r-P802.11r-D4.0-redline.pdf				Disapprove	30
				Resolution Doc	11-06-1576-11-000r-d3-comments.xls				Abstain	70

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	84
				Comment	Template				Approve%	92
				Pool	LB# 91 Voters					
90	TGk	Recirculation TGk Draft 6.00	LB# 90	Draft	P802.11k-D6.0.pdf	2006-11-01	2006-11-16	15	Pool	514
									Approve	354
				Redlined Doc	11-06-1583-00-000k-redlined-version-draft-d6.0.pdf				Disapprove	36
				Resolution Doc	11-06-1366-08-000k-tgk-lb86-comment-resolution-spreadsheet.xls				Abstain	39
									Return%	83
				Comment	Template				Approve%	91
				Pool	LB# 90 Voters					
89	TGk	Procedural TGk Draft 6.00	LB# 89	Draft	P802.11k-D6.0.pdf	2006-10-13	2006-10-30	17	Pool	424
									Approve	236
				Redlined Doc	11-06-1583-00-000k-redlined-version-draft-d6.0.pdf				Disapprove	14
				Resolution Doc	11-06-1366-08-000k-tgk-lb86-comment-resolution-spreadsheet.xls				Abstain	25
									Return%	65
				Comment	Template				Approve%	94
				Pool	LB# 89 Voters					
88	TGw	Technical TGw Draft 1.00	LB# 88	Draft	P802.11w-D1.0.pdf	2006-10-10	2006-11-19	40	Pool	427
									Approve	202
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	59
									Return%	69
				Comment	Template				Approve%	86
				Pool	LB# 88 Voters					
87	TGr	Recirculation TGr Draft 3.00	LB# 87	Draft	11-06-1540-00-000r-P802-11r-D3-0-redline.pdf	2006-09-29	2006-10-14	15	Pool	518
									Approve	318
				Redlined Doc	N/A				Disapprove	50
				Resolution Doc	11-06-0537-34-000r-d2-comments.xls				Abstain	65
									Return%	84
				Comment	Template				Approve%	86
				Pool	LB# 87 Voters					
86	TGk	Recirculation TGk Draft 5.00	LB# 86	Draft	P802.11k_D5.0.pdf	2006-09-01	2006-09-16	15	Pool	514
									Approve	325
				Redlined Doc	11-06-1311-00-0000-redlined-document-11k-draft-d5.0.doc				Disapprove	59
				Resolution Doc	11-06-0891-18-000k-LB83-may-to-jun-com-merge.xls				Abstain	44
									Return%	83
				Comment	Template				Approve%	85
				Pool	LB# 86 Voters					
85	TGk	Procedural TGk Draft 5.00	LB# 85	Draft	P802.11k_D5.0.pdf	2006-08-10	2006-08-26	16	Pool	452
									Approve	246
				Redlined Doc	11-06-1311-00-0000-redlined-document-11k-draft-d5.0.pdf				Disapprove	65
				Resolution Doc	11-06-0891-18-000k-LB83-may-to-jun-com-merge.xls				Abstain	46
									Return%	79
				Comment	Template				Approve%	79
				Pool	LB# 85 Voters					
84	TGn	Technical TGn Draft 1.00	LB# 84	Draft	P802.11n-D1.0.pdf	2006-03-19	2006-04-29	41	Pool	435
									Approve	149
				Redlined Doc	N/A				Disapprove	171
				Resolution Doc	N/A				Abstain	32
									Return%	81
				Comment	Template				Approve%	47
				Pool	LB# 84 Voters					
83	TGk	Recirculation TGk Draft 4.00	LB# 83	Draft	P802.11k-D4.0-changes.doc	2006-03-16	2006-03-31	15	Pool	514
									Approve	308
				Redlined Doc	N/A				Disapprove	73
				Resolution Doc	11-05-1049-69-000k-11k-lb78-comment-resolution-spreadsheet.xls				Abstain	44
									Return%	83
				Comment	Template				Approve%	81
				Pool	LB# 83 Voters					
82	TGr	Recirculation TGr Draft 2.00	LB# 82	Draft	P802.11r-D2.0-changes.pdf	2006-03-15	2006-04-04	20	Pool	518
									Approve	316
				Redlined Doc	N/A				Disapprove	44
				Resolution Doc	11-06-1284-29-000r-lb79-11r-d1-0-comment-resolutions.xls				Abstain	69
									Return%	83
				Comment	Template				Approve%	88
				Pool	LB# 82 Voters					
81	TGp	Technical TGp Draft 1.00	LB# 81	Draft	P802.11p_D1.0.pdf	2006-03-02	2006-04-11	40	Pool	486
									Approve	167
				Redlined Doc	N/A				Disapprove	117
				Resolution Doc	N/A				Abstain	63
									Return%	71
				Comment	Template				Approve%	59
				Pool	LB# 81 Voters					
80	TGp	Procedural TGp Draft 0.26	LB# 80	Draft	P802.11p_D0.26.pdf	2006-02-03	2006-02-18	15	Pool	486
									Approve	217
				Redlined Doc	N/A				Disapprove	72
				Resolution Doc	N/A				Abstain	56

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	71
				Comment	Template				Approve%	75
				Pool	LB# 80 Voters					
79	TGr	Technical TGr Draft 1.00	LB# 79	Draft	P802.11r-D1.0.pdf	2005-11-25	2006-01-04	40	Pool	518
									Approve	268
				Redlined Doc	N/A				Disapprove	64
				Resolution Doc	N/A				Abstain	72
									Return%	78
				Comment	Template				Approve%	81
				Pool	LB# 79 Voters					
78	TGk	Technical TGk Draft 3.00	LB# 78	Draft	P802.11k-D3.0.pdf	2005-10-03	2005-11-12	40	Pool	514
									Approve	295
				Redlined Doc	N/A				Disapprove	75
				Resolution Doc	N/A				Abstain	33
									Return%	78
				Comment	Template				Approve%	80
				Pool	LB# 78 Voters					
77	TGma	Technical TGma Draft 4.00	LB# 77	Draft	P802.11-REVma-D4.0.pdf	2005-09-09	2005-09-19	10	Pool	542
									Approve	411
				Redlined Doc	N/A				Disapprove	15
				Resolution Doc	N/A				Abstain	19
									Return%	82
				Comment	Template				Approve%	96
				Pool	LB# 77 Voters					
76	TGma	Technical TGma Draft 3.00	LB# 76	Draft	P802.11-REVma-D3.0.pdf	2005-08-08	2005-08-19	11	Pool	542
									Approve	397
				Redlined Doc	N/A				Disapprove	20
				Resolution Doc	N/A				Abstain	21
									Return%	81
				Comment	Template				Approve%	95
				Pool	LB# 76 Voters					
75	TGma	Technical TGma Draft 2.00	LB# 75	Draft	P802.11REV-ma-D2.0.pdf	2005-07-07	2005-07-17	10	Pool	542
									Approve	387
				Redlined Doc	N/A				Disapprove	26
				Resolution Doc	N/A				Abstain	19
									Return%	80
				Comment	Template				Approve%	94
				Pool	LB# 75 Voters					
74	TGma	Technical TGma Draft 1.00	LB# 74	Draft	P802.11REV-ma-D1.0.pdf	2005-03-29	2005-05-08	40	Pool	542
									Approve	348
				Redlined Doc	N/A				Disapprove	36
				Resolution Doc	N/A				Abstain	23
									Return%	75
				Comment	Template				Approve%	91
				Pool	LB# 74 Voters					
73	TGk	Technical TGk Draft 2.00	LB# 73	Draft	P802.11k-D2.0.pdf	2005-02-03	2005-03-15	40	Pool	493
									Approve	253
				Redlined Doc	N/A				Disapprove	42
				Resolution Doc	11-04-0964-37-000k-lb71-comment-spreadsheet.xls				Abstain	25
									Return%	65
				Comment	Template				Approve%	86
				Pool	LB# 73 Voters					
71	TGk	Technical TGk Draft 1.00	LB# 71	Draft	P802.11k-D1.0.pdf	2004-08-02	2004-09-11	40	Pool	412
									Approve	329
				Redlined Doc	N/A				Disapprove	18
				Resolution Doc	N/A				Abstain	27
									Return%	91
				Comment	Template				Approve%	95
				Pool	LB# 71 Voters					
68	TGj	Recirculation TGj Draft 1.40	LB# 68	Draft	P802_11j-D1.4-redlined.pdf	2004-04-05	2004-04-20	15	Pool	464
									Approve	273
				Redlined Doc	N/A				Disapprove	13
				Resolution Doc	11-04-0411-02-000j-tgj-comment-resolution-lb66.xls				Abstain	24
									Return%	67
				Comment	Template				Approve%	95
				Pool	LB# 68 Voters					
67	TGe	Recirculation TGe Draft 8.00	LB# 67	Draft	P802_11E-D8.0-redlined.pdf	2004-02-24	2004-03-10	15	Pool	321
									Approve	262
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	11-04-0181-05-000e-letter-ballot-65-comments.xls				Abstain	23
									Return%	94
				Comment	Template				Approve%	94
				Pool	LB# 67 Voters					
66	TGj	Recirculation TGj Draft 1.30	LB# 66	Draft	P802_11j-D1.3redlined.pdf	2004-02-04	2004-03-11	36	Pool	464
									Approve	258
				Redlined Doc	N/A				Disapprove	17
				Resolution Doc	11-04-0042-05-000j-tgj-comment-resolution-lb64.xls				Abstain	27

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	65
				Comment	Template				Approve%	94
				Pool	LB# 66 Voters					
65	TGe	Recirculation TGe Draft 7.00	LB# 65	Draft	P802_11E-D7.0-redlined.pdf	2004-01-31	2004-02-15	15	Pool	321
									Approve	258
				Redlined Doc	N/A				Disapprove	19
				Resolution Doc	11-04-1001-06-000e-letter-ballot-63-comments.xls				Abstain	24
									Return%	94
				Comment	Template				Approve%	93
				Pool	LB# 65 Voters					
64	TGj	Technical TGj Draft 1.20	LB# 64	Draft	P802_11j-D1.2.doc	2003-12-05	2004-01-14	40	Pool	463
									Approve	212
				Redlined Doc	N/A				Disapprove	27
				Resolution Doc	11-03-337r6-W-TGj_Letter_Ballot_Comment_Resolution_May_2003.xls				Abstain	24
									Return%	57
				Comment	Template				Approve%	89
				Pool	LB# 64 Voters					
63	TGe	Recirculation TGe Draft 6.00	LB# 63	Draft	P802_11E-D6.0-redlined.pdf	2003-12-04	2003-12-20	16	Pool	321
									Approve	248
				Redlined Doc	N/A				Disapprove	30
				Resolution Doc	11-03-0658-17-000e-letter-ballot-59-comments.xls				Abstain	23
									Return%	94
				Comment	Template				Approve%	89
				Pool	LB# 63 Voters					
62	TGi	Recirculation TGi Draft 7.00	LB# 62	Draft	802_11i-D7.0-redlined.doc	2003-10-20	2003-11-04	15	Pool	321
									Approve	264
				Redlined Doc	N/A				Disapprove	14
				Resolution Doc	11-03-0808-00-000i-LB61Comments.xls				Abstain	21
									Return%	93
				Comment	Template				Approve%	95
				Pool	LB# 62 Voters					
61	TGi	Recirculation TGi Draft 6.00	LB# 61	Draft	802.11i-D6.0-redlined.doc	2003-09-24	2003-10-09	15	Pool	321
									Approve	257
				Redlined Doc	N/A				Disapprove	21
				Resolution Doc	11-03-0659-04-000i-LB60-Comments.xls				Abstain	21
									Return%	93
				Comment	Template				Approve%	92
				Pool	LB# 61 Voters					
60	TGi	Recirculation TGi Draft 5.00	LB# 60	Draft	802.11i-D5.0-redlined.doc	2003-08-04	2003-08-19	15	Pool	321
									Approve	243
				Redlined Doc	N/A				Disapprove	36
				Resolution Doc	11-03-452r6-I-LB57-Comments.xls				Abstain	20
									Return%	93
				Comment	Template				Approve%	87
				Pool	LB# 60 Voters					
59	TGe	Recirculation TGe Draft 5.00	LB# 59	Draft	P802_11E-D5.0-changes-with-4.0-marked.pdf	2003-08-01	2003-08-22	21	Pool	321
									Approve	248
				Redlined Doc	N/A				Disapprove	7
				Resolution Doc	11-03-020r13-E-Merged_Letter_Ballot_51_Comments.xls				Abstain	8
									Return%	82
				Comment	Template				Approve%	97
				Pool	LB# 59 Voters					
57	TGi	Recirculation TGi Draft 4.00	LB# 57	Draft	802_11i-D4_0-redlined.doc	2003-05-22	2003-06-06	15	Pool	321
									Approve	218
				Redlined Doc	N/A				Disapprove	61
				Resolution Doc	11-03-033r10-I-LB52-Comments.xls				Abstain	19
									Return%	93
				Comment	Template				Approve%	78
				Pool	LB# 57 Voters					
56	TGj	Technical TGj Draft 1.00	LB# 56	Draft	P802_11j-D1_0.doc	2003-04-01	2003-05-12	41	Pool	394
									Approve	196
				Redlined Doc	N/A				Disapprove	93
				Resolution Doc	N/A				Abstain	5
									Return%	75
				Comment	Template				Approve%	68
				Pool	LB# 56 Voters					
54	TGg	Recirculation TGg Draft 6.10	LB# 54	Draft	802.11g-D6.1-tracking.doc	2003-01-20	2003-02-04	15	Pool	321
									Approve	184
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	11-03-068r12-G-LB50_Comment_Resolution.xls				Abstain	58
									Return%	82
				Comment	Template				Approve%	89
				Pool	LB# 54 Voters					
52	TGi	Technical TGi Draft 3.00	LB# 52	Draft	802.11i-D3.0.pdf	2002-12-02	2003-01-12	41	Pool	321
									Approve	209
				Redlined Doc	N/A				Disapprove	65
				Resolution Doc	N/A				Abstain	21

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	92
				Comment	Template				Approve%	76
				Pool	LB# 52 Voters					
51	TGe	Technical TGe Draft 4.00	LB# 51	Draft	P802_11E-D4_0.pdf	2002-11-28	2003-01-08	41	Pool	321
									Approve	228
				Redlined Doc	N/A				Disapprove	47
				Resolution Doc	N/A				Abstain	21
									Return%	92
				Comment	Template				Approve%	83
				Pool	LB# 51 Voters					
50	TGg	Technical TGg Draft 5.00	LB# 50	Draft	802.11g-D5.0.doc	2002-11-27	2003-01-08	42	Pool	321
									Approve	256
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	18
									Return%	96
				Comment	Template				Approve%	88
				Pool	LB# 50 Voters					
49	TGg	Recirculation TGg Draft 4.00	LB# 49	Draft	802.11g-D4.0.pdf	2002-10-17	2002-11-01	15	Pool	382
									Approve	217
				Redlined Doc	N/A				Disapprove	33
				Resolution Doc	2-535.zip				Abstain	25
									Return%	72
				Comment	Template				Approve%	87
				Pool	LB# 49 Voters					
48	TGh	Recirculation TGh Draft 2.20	LB# 48	Draft	802-11-h-D2.2.pdf	2002-10-17	2002-11-01	15	Pool	356
									Approve	241
				Redlined Doc	N/A				Disapprove	7
				Resolution Doc	11-02-515r7-H-Comments_form_LB42.xls				Abstain	17
									Return%	74
				Comment	Template				Approve%	97
				Pool	LB# 48 Voters					
42	TGh	Recirculation TGh	LB# 42	Draft	index.html	2002-07-23	2002-09-01	40	Pool	360
									Approve	208
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	39
									Return%	75
				Comment	Template				Approve%	90
				Pool	LB# 42 Voters					
41	TGg	Technical TGg	LB# 41	Draft	index.html	2002-07-23	2002-09-01	40	Pool	382
									Approve	194
				Redlined Doc	N/A				Disapprove	40
				Resolution Doc	N/A				Abstain	15
									Return%	65
				Comment	Template				Approve%	83
				Pool						
39	TGe	Technical TGe	LB# 39	Draft	P802_11E-D3_0.pdf	2002-05-23	2002-07-02	40	Pool	365
									Approve	106
				Redlined Doc	N/A				Disapprove	110
				Resolution Doc	N/A				Abstain	44
									Return%	71
				Comment					Approve%	49
				Pool						
38	TGf	Recirculation TGf	LB# 38	Draft	802.11f-D3.1.pdf	2002-05-08	2002-06-16	39	Pool	291
									Approve	221
				Redlined Doc	N/A				Disapprove	9
				Resolution Doc	N/A				Abstain	25
									Return%	88
				Comment	Template				Approve%	96
				Pool	LB# 38 Voters					
36	TGh	Technical TGh	LB# 36	Draft	P802_11H-D2_0.pdf	2002-03-26	2002-05-05	40	Pool	330
									Approve	165
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	53
									Return%	82
				Comment					Approve%	76
				Pool						
35	TGi	Technical TGi	LB# 35	Draft	P802_11i-D2_0.pdf	2002-03-25	2002-05-04	40	Pool	338
									Approve	143
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	N/A				Abstain	78
									Return%	78
				Comment					Approve%	77
				Pool						
33	TGg	Technical TGg	LB# 33	Draft		2002-01-31	2002-03-11	39	Pool	286
									Approve	86
				Redlined Doc	N/A				Disapprove	104
				Resolution Doc	N/A				Abstain	41

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	81
				Comment					Approve%	45
				Pool						
32	TGf	Technical TGf	LB# 32	Draft		2002-01-29	2002-03-10	40	Pool	290
				Redlined Doc	N/A				Approve	145
				Resolution Doc	N/A				Disapprove	31
									Abstain	19
									Return%	67
				Comment					Approve%	82
				Pool						
30	TGe	Technical TGe	LB# 30	Draft		2001-12-05	2002-01-16	42	Pool	266
									Approve	101
				Redlined Doc	N/A				Disapprove	84
				Resolution Doc	N/A				Abstain	33
									Return%	82
				Comment					Approve%	55
				Pool						
29	TGh	Technical TGh	LB# 29	Draft		2001-07-25	2001-09-03	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
28	TGf	Technical TGf	LB# 28	Draft		2001-07-25	2001-09-03	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
27	TGe	Technical TGe	LB# 27	Draft		2001-04-05	2001-05-15	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
26	TGf	Technical TGf	LB# 26	Draft		2001-04-05	2001-05-15	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
22	TGd	Recirculation TGd	LB# 22	Draft		2000-06-12	2000-06-26	14	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
21	TGd	Recirculation TGd	LB# 21	Draft		2000-03-27	2000-04-04	8	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
15	TGb	Technical TGb	LB# 15	Draft		1998-09-30	1998-11-09	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						

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APPENDIX BE

The Wayback Machine - https://web.archive.org/web/20161013111044/http://www.ieee802.or…

Status of Project IEEE 802.11ax

High Efficiency WLAN (HEW)

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

Background

In May 2013, the High Efficiency WLAN Study Group (HEW SG), a study group within IEEE 802.11 working group had started its activity to consider the improvement of spectrum efficiency to enhance the system throughput/area in high density scenarios of APs and/or STAs.

The study group was created based on the following straw poll and motion:
<Straw Poll>
Do you support starting a new study group called "high efficiency WLAN" to enhance 802.11 PHY and MAC in 2.4 and 5GHz with a focus on:

- Improving spectrum efficiency and area throughput
- Improving real world performance in indoor and outdoor deployments
  - in the presence of interfering sources, dense heterogeneous networks
  - in moderate to heavy user loaded APs

<Motion>
Request an approval by IEEE 802 LMSC to form an 802.11 Study Group to consider High-efficiency WLAN [as described in doc 11-13-0339r2] with the intent of creating a PAR and five criteria.

The HEW SG has successfully developed PAR and CSD documents and the project 802.11ax has started in May 2014.

Task Group Documents – the latest revisions (as of March 30th, 2015)

- 11-14-0165-01 PAR and 11-14-0169-01 CSD
- 11-14-0938-04 TGax Selection Procedure
- 11-14-0980-16 TGax Simulation Scenarios
- 11-14-0571-12 TGax Evaluation Methodology
- 11-14-0882-04 TGax Channel Models
- 11-14-1009-02 TGax Functional Requirements
- 11-15-0132-17 TGax Specification Framework

September 2016 – Warsaw, Poland

The TGax had 11 sessions during the week.
Six out of eleven sessions were assigned to the ad hoc group sessions.

	Tuesday		Wednesday		Thursday
			TGax (full)		
	TGax (MU)	TGax (MAC)			TGax (full)
			TGax (PHY)	TGax (MAC)	TGax (full)
Gax IAC)	TGax (PHY)	TGax (MAC)	TGax (MU)	TGax (MAC)	TGax (full)
Gax SR)					

Main documents

- TGax Agenda: 11-16-1077-06, TGax September 2016 Meeting Agenda
  - TGax PHY ad hoc agenda and motions: 11-16-1246-06, TGax PHY Ad Hoc Sep 2016 Meeting Agenda
    - TGax PHY ad hoc meeting minutes: 11-16-1276-00, September 2016 Warsaw PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc agenda: 11-16-1247-02, TGax MAC Ad Hoc September 2016 Meeting Agenda
    - TGax MAC ad hoc meeting minutes: 11-16-1252-01, September 2016 Warsaw TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc agenda: 11-16-1244-01, TGax MU Ad-hoc Agenda September 2016
    - TGax Multi-User ad hoc meeting minutes: 11-16-1275-00, IEEE 802.11 TGax, MU Ad hoc September 2016 TGax Meeting Minutes
  - TGax Spatial Reuse ad hoc agenda: 11-16-1245-02, TGax Spatial Reuse Ad-hoc Agenda September 2016 Meeting
    - TGax Multi-User ad hoc meeting minutes: 11-16-1300-00, TGax Spatial Reuse ad hoc group meeting minutes
- Closing report: 11-16-1284-00, TGax September 2016 Closing Report
- Draft TGax minutes: 11-16-1231-00, IEEE 802.11 TGax September 2016 Warsaw Meeting Minutes

Achievements

1. Work Completed

- **TGax received about 90 submissions.**
  - Number of submissions: PHY/MAC/MU/SR/TG = 28/43/12/9/6.

  The TG completed the discussion of all the submissions.
  Exact count of resolved CIDs will be published by the Editor.
- **The TG editor is planning to have draft revision D0.5 ready based on resolved comments.**

2. Technical Presentations

90 technical submissions were received.
Here is the list of submissions:

- **Submissions – MAC (43 submissions)**
  - 11-16-0864, "Comment Resolutions on Clause 6 & 8 comments," Yasuhiko Inoue (NTT)
  - 11-16-0869, "Misc. TWT comment resolution," Zhou Lan (Broadcom)
  - 11-16-0881, "Comment resolution on ROMI," Jayh Park (LG Electronics)
  - 11-16-0882, "Comment resolution on TOMI," Alfred Asterjadhi (Qualcomm)
  - 11-16-0883, "Comment resolution for CID152," JayhPark (LG Electronics)
  - 11-16-0884, "Spec. Text for HE Operation element and AID Assign Rule," Jianhan Liu (MediaTek)
  - 11-16-0913, "SU Multi-TID Rules," Jarkko Kneckt (Apple)
  - 11-16-0917, "Text for TID value of ALL ACK signaling," Woojin Ahn (WILUS)

- 11-16-0918, "Discussions on Partial BSS Color," Geonjung Ko (WILUS)
- 11-16-0924, "NAV resetting with RTS/MU-RTS," Weiming Xing (ZTE)
- 11-16-0925, "Spec text on NAV resetting with RTS/MU-RTS," Weiming Xing (ZTE)
- 11-16-0941, "CR HE Fragmentation - part 2," Ming Gan (Huawei)
- 11-16-0942, "CR Service Field," Ming Gan (Huawei)
- 11-16-0960, "AP access procedure for UL MU operation," Jinsoo Ahn (Yonsei Univ.)
- 11-16-0961, "Consideration on Multi-STA BlockAck Optimization," Hanseul Hong (Yonsei Univ.)
- 11-16-0962, "EDCA rules-follow up 1," Jing Ma (NICT)
- 11-16-0963, "EDCA rules-follow up 2," Jing Ma (NICT)
- 11-16-0998, "Rules for 2 EDCA parameters," Laurent Cariou (Intel)
- 11-16-1110, "Comment Resolution on subclause 10.22.2 and 10.22.4," Yongho Seok (Newracom)
- 11-16-1131, "Comment Resolution on MU Ack Policy," Yongho Seok (Newracom)
- 11-16-1154, "MAC CR for CID 966," Weiming Xing (ZTE)
- 11-16-1157, "Comment resolution on SU_MU ACK procedures," Jeongki Kim (LG Electronics)
- 11-16-1173, "Comment Resolution on Two NAVs - Part II," Po-Kai Huang (Intel)
- 11-16-1180, "Proposed text changes for MU EDCA parameters," Laurent Cariou (Intel)
- 11-16-1181, "CW value after UL MU procedure," Woojin Ahn (WILUS)
- 11-16-1182, "HE Sounding Feedback Segmentation," Liwen Chu (Marvell)
- 11-16-1183, "MU RTS CTS data rate comment," Liwen Chu (Marvell)
- 11-16-1184, "A-MPDU 25.10 25.10.2 comment resolution, " Liwen Chu (Marvell)
- 11-16-1185, "A-MPDU 25.10.3 comment resolution," Liwen Chu (Marvell)
- 11-16-1186, "A-MPDU Content Comment Resolution," Liwen Chu (Marvell)
- 11-16-1188, "MAC Capabilities in HE Capabilities IE," Alfred Asterjadhi (Qualcomm)
- 11-16-1189, "CC0-TWT operation," Alfred Asterjadhi (Qualcomm)
- 11-16-1195, "MAC Clarifications," Alfred Asterjadhi (Qualcomm)
- 11-16-1204, "Intra-PPDU Power Save for a Multiple BSSID Set Case," Geonjung Ko (Wilus)
- 11-16-1205, "Text for Intra-PPDU Power Save for a Multiple BSSID Set Case," Geonjung Ko (Wilus)
- 11-16-1210, "Comment Resolution on MU acknowledgement procedure," Junichi Iwatani (NTT)
- 11-16-1211, "CR_CID_122_576_972_2598," Huizao Wang (Quantenna)
- 11-16-1213, "CR TWT and HE element related," Matt Fischer (Broadcom)
- 11-16-1220, "MU mode EDCA control," Jinsoo Ahn (Yonsei Univ.)
- 11-16-1234, "Spec Text for TWT Protection field," Hanseul Hong (Yonsei Univ.)
- 11-16-1236, "Text for Partial BSS Color and AID Assignment Rule," Geonjung Ko (Wilus)
- 11-16-1237, "Setting Quiet Time Period," Chao-Chun Wang (MediaTek)
- 11-16-1238, "Setting Quiet Time Period - text," Chao-Chun Wang (MediaTek) – not available

- **Submissions – PHY (28 submissions)**
  - 11-16-1133, "11ax sounding modes reduction," Yan Zhang (Marvell)
  - 11-16-1134, "11ax spec text on sounding modes reduction," Yan Zhang (Marvell)
  - 11-16-1135, "11ax comment resolutions for clause 26.3.5," Yan Zhang (Marvell)
  - 11-16-1136, "11ax comment resolutions for clause 26.3.8," Yan Zhang (Marvell)
  - 11-16-1137, "11ax comment resolutions for clause 26.3.9," Yan Zhang (Marvell)
  - 11-16-1138, "11ax comment resolutions for clause 26.3.10," Yan Zhang (Marvell)
  - 11-16-1148, "CR HE-SIG-A part III," Ross Jian Yu (Huawei)
  - 11-16-1149, "CR HE-SIG-A part II," Ross Jian Yu (Huawei)
  - 11-16-1150, "CR Packet Extension part I," Ross Jian Yu (Huawei)
  - 11-16-1160, "Comment Resolution for CID 355," Eunsung Park (LG Electronics)

- 11-16-1167, "UL MU Clarifications," Ron Porat (Broadcom)
- 11-16-1168, "DCM TBDs," Sriram Venkateswaran (Broadcom)
- 11-16-1169, "CR Duplicate MU MIMO," Sriram Venkateswaran (Broadcom)
- 11-16-1170, "HE PHY Capabilities," Lochan Verma (Qualcomm)
- 11-16-1171, "PHY Miscellaneous Part-1," Lochan Verma (Qualcomm)
- 11-16-1176, "PHY CR Miscellaneous Part-2," Lochan Verma (Qualcomm)
- 11-16-1179, "PHY section editorial comments on D0.4," Sungeun Lee (Cypress)
- 11-16-1190, "Tx Quality Requirements," Daewon Lee (Newracom)
- 11-16-1191, "Comment Resolution for CIDs on PHY Transmit Spec," Daewon Lee (Newracom)
- 11-16-1192, "Comment Resolution for CID 1450," Daewon Lee (Newracom)
- 11-16-1193, "HE variant HT Control - HE Link Adaptation," Daewon Lee (Newracom)
- 11-16-1194, "Removal of Unnecessary PHY TBDs," Daewon Lee (Newracom)
- 11-16-1202, "CR HE-LTF," Ming Gan (Huawei)
- 11-16-1227, "cr-on-26-3-7," Shahrnaz Azizi (Intel)
- 11-16-1232, "Text change proposal of TXTIME in 26.3.19 and 26.4.3," Daewon Lee (Newracom)
- 11-16-1233, "CR for DCM related CID 503, 504 and 2750," Daewon Lee (Newracom)
- 11-16-1240, "Packet Extension Factor calculation fix," Yan Zhang (Marvell)
- 11-16-1242, "spec text for packet extension factor calculation fix," Yan Zhang (Marvell)

- **Submissions – Multi-User (12 submissions)**
  - 11-16-0773, "Comment Resolution Section 25.6 HE Sounding," Raja Banerjea (Qualcomm)
  - 11-16-0929, "CR - UL MU Operation," Simone Merlin (Qualcomm)
  - 11-16-1152, "DL OFDMA Ack rule for uplink trigger based PPDU," Ming Gan (Huawei)
  - 11-16-1158, "Comment resolution on OFDMA random access procedure," Jeongki Kim (LG Electronics)
  - 11-16-1162, "Comment Resolution on Retransmission of OFDMA Random Access," Yunbo Li (Huawei)
  - 11-16-1163, "Concluding OFDMA M-BA transmission," Zhou Lan (Broadcom)
  - 11-16-1177, "comment-resolution-TXOP-truncation," Young Hoon Kwon (Newracom)
  - 11-16-1199, "Proposed text changes for DL OFDMA Acknowledge rule for trigger based PPDU," Ming Gan (Huawei)
  - 11-16-1222, "Comment Resolution on UL OFDMA Random Access," Chittabrata Ghosh (Intel)
  - 11-16-1224, "Random Access Parameter Set (RAPS) element," Chittabrata Ghosh (Intel)
  - 11-16-1239, "Trigger Frame MU BAR part 1," Raja Banerjea (Qualcomm)
  - 11-16-1241, "Trigger Frame MU BAR part 2," Raja Banerjea (Qualcomm)

- **Submissions – Spatial Reuse (9 submissions)**
  - 11-16-0945, "Clarification for OBSS_PD-based SR parameters," Matt Fischer (Broadcom)
  - 11-16-0947, "Proposed text changes for OBSS_PD-based SR parameters," Laurent Cariou (Intel)
  - 11-16-1064, "Unified SR approach DSC, ATPC and Inter-BSS," Graham Smith (SR Technologies)
  - 11-16-1155, "SR Comment Resolution for CID994," Kaiying Lv (ZTE) – not available
  - 11-16-1161, "Simulation-based evaluation of OBSS_PD-based SR default parameters," Tanguy Ropitault (NIST)
  - 11-16-1178, "comment-resolution-SR-RSSI," Young Hoon Kwon (Newracom)
  - 11-16-1216, "SR Field SRP Table for HE-Trigger-Based PPDU," James Wang (MediaTek)
  - 11-16-1223, "CR for Section 25.9.2 OBSS_PD Spatial reuse," Laurent Cariou (Intel)
  - 11-16-1225, "Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA," Sean Coffey (RealTek)

- **Submissions – TG (6 submissions)**
  - 11-15-1095, "OFDMA performance in 11ax," Suhwook Kim (LG Electronics)
  - 11-16-1143, "11ax PAR Verification," Paul Cheng (MediaTek)
  - 11-16-1159, "Summary of Mandatory or Optional Features of 802.11ax," Joonsuk Kim (Apple)
  - 11-16-1166, "Meeting PAR requirements with UL OFDMA," Sriram Venkateswaran (Broadcom)
  - 11-16-1198, "Preliminary 11ax PAR Verification," Jiyong Pang (Huawei)
  - 11-16-1219, "Considerations on CR for 2665 and 2715," Jing Ma (NICT)

3. Timeline

Current Timeline	Modified Timeline
● May 2014: start of the TG	● May 2014: start of the TG
● Nov. 2014: First draft of the TG SFD was approved	● Nov. 2014: First draft of the TG SFD was approved
● Jan. 2016: proposed TG draft	● Jan. 2016: proposed TG draft
● March 2016: Draft D0.1 was approved and CC started	● March 2016: Draft D0.1 was approved and CC started
● September 2016: Draft 1.0 and WG letter ballot	● November 2016: Draft 1.0 and WG letter ballot
● March 2017: Draft 2.0 and recirculation	● May 2017: Draft 2.0 and recirculation
● July 2017: MDR (Mandatory Document Review)	● November 2017 : MDR (Mandatory Document Review)
● November 2017: Formation of SB pool	● January 2018: Formation of SB pool
● March 2018: Sponsor Ballot	● March 2018: Sponsor Ballot
● December 2018: RevCom	● December 2018: RevCom

Goals for November 2016

- **Continue with Comment Resolutions.**
- **Prepare draft D1.0 and start a WG LB**

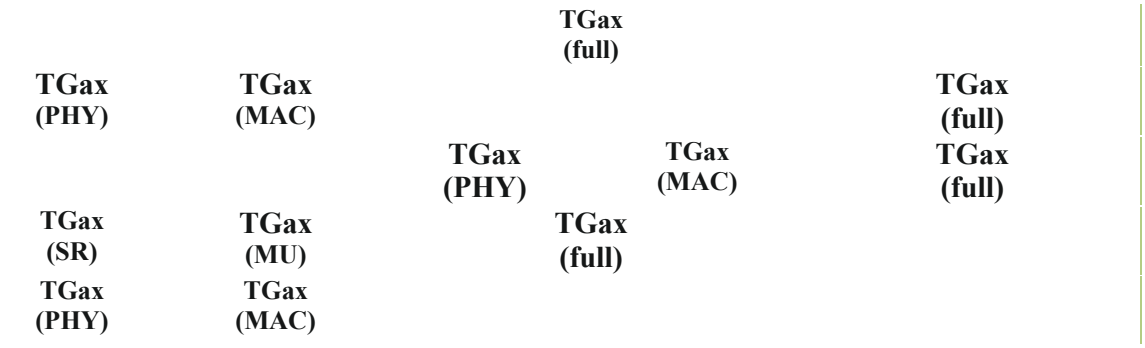
Teleconferences

- **Weekly teleconferences are planned after July 2016 session.**
  - **Thursday, September 29th, October 20th 10:00 – 12:00 (ET).**
  - **Thursday, October 13th: 20:00 – 22:00 (ET)**
  - **Thursday, October 27th and November 17th; 10:00 – 12:00 (ET)**

July 2016 – San Diego, CA

The TGax planned to have 10 sessions during the week.
Four out of ten sessions were assigned to the ad hoc group sessions.

Tuesday Wednesday Thursday



Main documents

- TGax Agenda: 11-16-0779-06, TGax July 2016 Meeting Agenda
  - TGax PHY ad hoc agenda and motions: 11-16-1007-03, TGax PHY Ad Hoc July 2016 Meeting Agenda
    - TGax PHY ad hoc meeting minutes: 11-16-1040-00, IEEE 802.11 TGax July 2016 San Diego PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc agenda: 11-16-0997-01, TGax MAC Ad Hoc July 2016 Meeting Agenda
    - TGax MAC ad hoc meeting minutes: 11-16-1000-02, IEEE 802.11 TGax, MAC Ad hoc July 2016 San Diego TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc agenda: 11-16-1012-00, TGax MU Ad-hoc Agenda July 2016 Agenda
    - TGax Multi-User ad hoc meeting minutes: 11-16-1027-00, IEEE 802.11 TGax, MU Ad hoc July 2016 TGax Meeting Minutes
  - TGax Spatial Reuse ad hoc agenda: 11-16-1016-01, TGax Spatial Reuse Ad-hoc Group Agenda
    - TGax Multi-User ad hoc meeting minutes: 11-16-1022-00, TGax Spatial Reuse ad hoc group meeting minutes

- Closing report: 11-16-1051-00, TGax July 2016 Closing Report
- Draft TGax minutes: 11-16-0967-00, IEEE 802.11 TGax July 2016 San Diego Meeting Minutes

Achievements

4. Work Completed

- **TGax received about 90 submissions.**
  - Number of submissions: PHY/MAC/MU/SR/TG = 26/34/12/10/8.

  Most of the submissions are proposed resolutions for the comments on the draft 0.1.
  A number of submissions were proposing new text to be added to the draft.
  - **A long list of submissions are yet to be considered.**
- **Approved the resolutions of about 230 comments discussed during telecons.**
- **Approved the resolutions of about 230 comments discussed during telecons.**
  - **Exact count of resolved CIDs will be published by the Editor.**
- **The TG editor is planning to have draft revision D0.3 ready based on resolved comments.**

5. Technical Presentations

90 technical submissions were received.
Here is the list of submissions:

- **Submissions – PHY (26 submissions)**
  - 11-16-0816, "Comment Resolution for CID 2183," Daewon Lee (Newracom)
  - 11-16-0872, "CR HE-SIG-A Part II," Ross Jian Yu (Huawei Technologies)
  - 11-16-0873, "CR HE-SIG-A Part I," Ross Jian Yu (Huawei Technologies)
  - 11-16-0891, "LDPC for 1024QAM," Hongyuan Zhang (Marvell)
  - 11-16-0892, "Spec Text on LDPC for 1024QAM," Hongyuan Zhang (Marvell)
  - 11-16-0893, "11ax Extended Range PPDU," Bin Tian (Qualcomm)

- 11-16-0894, "HE-LTF Capabilities," Hongyuan Zhang (Marvell)
- 11-16-0895, "Spec Text for HE-LTF Capabilities," Hongyuan Zhang (Marvell)
- 11-16-0896, "11ax Beamformee Capabilities," Hongyuan Zhang (Marvell)
- 11-16-0897, "Spec Text for Beamformee Capabilities," Hongyuan Zhang (Marvell)
- 11-16-0898, "BW Field in HE-MU Format," Hongyuan Zhang (Marvell)
- 11-16-0899, "Spec Text for BW Field in HE-MU Format," Hongyuan Zhang (Marvell)
- 11-16-0900, "PHY Comment Resolution for CID 1052 and 2519," Bin Tian (Qualcomm)
- 11-16-0903, "Gamma phase rotation for HE PPDU," Yujin Noh (Newracom)
- 11-16-0904, "Proposed text for gamma phase rotation for HE PPDU," Yujin Noh (Newracom)
- 11-16-0906, "RU restriction on 20MHz operating STAs," Joonsuk Kim (Apple)
- 11-16-0908, "CR - proposed text on RU restriction of 20MHz STAs," Joonsuk Kim (Apple)
- 11-16-0910, "Minimum Occupied Bandwidth," Ron Porat (Broadcom)
- 11-16-0914, "Bit field finalization of HE-SIG-A," Lochan Verma (Qualcomm)
- 11-16-0915, "Text for bit field finalization of HE-SIG-A," Lochan Verma (Qualcomm)
- 11-16-0920, "PHY comment resolution for CID 1659,493,494," Xiaogang Chen (Intel)
- 11-16-0922, "PHY CR 1024 QAM," Sriram Venkateswaran (Broadcom)
- 11-16-0923, "PHY CR DCM Constellation Mapping," Sriram Venkateswaran (Broadcom)
- 11-16-0928, "CR on Section 26.3.9.8 - HE-SIG-B," Kaushik Josiam
- 11-16-0937, "11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13," Rui Cao (Marvell)
- 11-16-0964, "Considerations on MAC-PHY interactions during SR operations," Jing Ma (NICT)

- **Submissions – MAC (34 submissions)**
  - 11-16-0828, "HE Fragmentation - part 1," Alfred Asterjadhi (Qualcomm)
  - 11-16-0829, "Comment Resolution for Section 10.24.10 Block Ack/GCR block ack," Reza Hedayat (Newracom)
  - 11-16-0844, "CC0-Intra_PPDU_PS," Alfred Asterjadhi (Qualcomm)
  - 11-16-0856, "Issue of Buffer Status reporting," Stephane Baron (Canon)
  - 11-16-0860, "comment resolution on A-MPDU format, » Yongho Seok (Newracom)
  - 11-16-0861, "comment resolution on mu acknowledgment procedure," Yongho Seok (Newracom)
  - 11-16-0862, "comment resolution on subclause 25.11," Yongho Seok (Newracom)
  - 11-16-0864, "d0.1 comment resolution on clause 6," Yasuhiko Inoue (NTT)
  - 11-16-0867, "CIDs for CIDs: Section 9.3.1.9.3 Compressed BA format," George Cherian (Qualcomm)
  - 11-16-0868, "CIDs for Section 9.3.1.9.7 Multi STA BAs, " George Cherian (Qualcomm)
  - 11-16-0869, "Comment resolution section 9.3 TWT," Zhou Lan (Broadcom)
  - 11-16-0871, "Trigger Frame Per User Info Order," Zhou Lan (Broadcom)
  - 11-16-0877, "Comment resolution on CID 783 (TXOP Duration field format)," Jeongki Kim (LG Electronics)
  - 11-16-0878, "Comment resolution on CID 782 (Intra-PPDU PS)," Jeongki Kim (LG Electronics)
  - 11-16-0881, "Comment resolution on ROMI," Jayh Park (LG Electronics)
  - 11-16-0882, "Comment resolution on TOMI," Jayh Park (LG Electronics)
  - 11-16-0883, "Comment resolution for CID 152," Jayh Park (LG Electronics)
  - 11-16-0884, "Spec. Text for HE Operation element and AID Assign Rule," Jianhan Liu (MediaTek)
  - 11-16-0890, "Comment Resolution on NAV Setting of Single and Multiple Protection and Control Response," Po-Kai Huang (Intel)
  - 11-16-0913, "SU Multi-TID Rules," Jarkko Kneckt (Apple)
  - 11-16-0916, "TID value of ALL ACK signaling," Woojin Ahn (Wilus Institute)
  - 11-16-0917, "Text for TID value of ALL ACK signaling," Woojin Ahn (Wilus Institute)

- ✧ 11-16-0918, “Discussions on Partial BSS Color,” Geonjung Ko (Wilus Institute)
- ✧ 11-16-0924, “NAV resetting with RTS/MU-RTS,” Weimin Xing (ZTE)
- ✧ 11-16-0925, "Spex text on NAV resetting with RTS/MU-RTS,” Weimin Xing (ZTE)
- ✧ 11-16-0941, “CR HE Fragmentation - part 2,” Ming Gan (Huawei technologies)
- ✧ 11-16-0942, “CR Service Field,” Ming Gan (Huawei Technologies)
- ✧ 11-16-0951, “Setting for TXOP Duration Field,” Po-Kai Huang (Intel)
- ✧ 11-16-0952, “Spec text trigger frame per user info order,” Zhou Lan (Broadcom)
- ✧ 11-16-0953, “Comment Resolution and Spec Text for Setting for TXOP Duration field,” Po-Kai Huang (Intel)
- ✧ 11-16-0960, “AP access procedure for UL MU operation,” Jinsoo Ahn (Yonsei Univ.)
- ✧ 11-16-0961, “Consideration on Multi-STA BlockAck Optimization,” Hanseul Hong (Yonsei Univ.)
- ✧ 11-16-0962, “EDCA rules follow up 1,” Jing Ma (NICT)
- ✧ 11-16-0963, “EDCA rules follow up 2,” Jing Ma (NICT)
- ✧ 11-16-0966, “CID 71 and CID 190 Resolutions,” Jarkko Kneckt (Apple)
- ✧ 11-16-0998, “2 sets of EDCA parameters,” Laurent Cariou (Intel)

- **Submissions – Multi-User (12 submissions)**
  - ✧ 11-16-0866, “Comment Resolution of Section 26.3.13 MU-MIMO,” Kome Oteri (InterDigital)
  - ✧ 11-16-0875, “CR for the section 10.3.2.8a CS Condition to Respond CTS,” Kiseon Ryu (LG Electronics)
  - ✧ 11-16-0876, “CR for the section 25.5.2.4 UL MU CS CCA and CS Required Bit,” Kiseon Ryu (LG Electronics)
  - ✧ 11-16-0880, “UL MU Transmission Rules - EDCA backoff,” Jayh Park (LG Electronics)
  - ✧ 11-16-0885, “Comment Resolution on UL MU CS NAV Consideration,” Po-Kai Huang (Intel)
  - ✧ 11-16-0886, “Comment Resolution for some UL MU CS TBD,” Po-Kai Huang (Intel)
  - ✧ 11-16-0887, “Spec Text for MU-RTS restriction on HE MU PPDU,” Po-Kai Huang (Intel)
  - ✧ 11-16-0926, “Soliciting UL_MU_ACK,” Raja Banerjea (Qualcomm)
  - ✧ 11-16-0929, “CR - UL MU Operation,” Simone Merlin (Qualcomm)
  - ✧ 11-16-0930, “CR - DL MU Operation,” Simone Merlin (Qualcomm)
  - ✧ 11-16-0938, “Comment Resolution for Sub-clause 25.10.4,” Chittabrata Ghosh (Intel)
  - ✧ 11-16-0958, “UL OFDMA for Unassociated STAs,” Leonardo Lanante (Kyushu Institute of Tech.)

- **Submissions – Spatial Reuse (10 submission)**
  - ✧ 11-16-0879, “Comment resolution on SR for VHT PPDUs,” Jeongki Kim (LG Electronics)
  - ✧ 11-16-0889, “Comment Resolution for Spatial Reuse (Intra BSS detection),” Young Hoon Kwon (Newracom)
  - ✧ 11-16-0901, “Clarification of SR Fields in HE Trigger Based PPDU,” Daewon Lee (Newracom)
  - ✧ 11-16-0902, “Proposed Text Changes for SR Fields in HE Trigger-Based PPDU,” Daewon Lee (Newracom)
  - ✧ 11-16-0905, “SR Fields Clarification,” Ron Porat (Broadcom)
  - ✧ 11-16-0919, “Discussions on SR Fields in HE Trigger-based PPDU,” Geonjung Ko (Wilus Institute)
  - ✧ 11-16-0310, “DSC Proposal Text,” Graham Smith (SR Technologies)
  - ✧ 11-16-0945, “Clarifications for OBSS_PD-based SR parameters,” Laurent Cariou (Intel)
  - ✧ 11-16-0947, “Proposed text changes for OBSS_PD-based SR parameters,” Laurent Cariou (Intel)
  - ✧ 11-16-0957, “Comment Resolutions on OBSS_PD Conditions in 25.9.3,” James Wang (MediaTek)

- **Submissions – TG (8 submissions)**
  - ✧ 11-15-1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
  - ✧ 11-16-0835, "EIFS," Alfred Asterjadhi (Qualcomm)
  - ✧ 11-16-0870, "Conclusing MAC Trigger Padding," Zhou Lan (Broadcom)
  - ✧ 11-16-0907, "20MHz HE devices," Joonsuk Kim (Apple)
  - ✧ 11-16-0909, "CR – proposed text on 20 MHz devices," Joonsuk Kim (Apple)
  - ✧ 11-16-0949, "MAC trigger frame padding follow up," Zhou Lan (Broadcom)
  - ✧ 11-16-0965, "On High Efficiency WLAN (HEW) TG PAR Scope," Osama Aboul-Magd (Huawei Technologies)

6. Timeline

- **May 2014: start of the TG**
- **Nov. 2014: First draft of the TG SFD was approved**
- **Jan. 2016: proposed TG draft**
- **March 2016: Draft D0.1 was approved and CC started**
- **September 2016: Draft 1.0 and WG letter ballot**
- **March 2017: Draft 2.0 and recirculation**
- **July 2017: MDR (Mandatory Document Review)**
- **November 2017: Formation of SB pool**
- **March 2018: Sponsor Ballot**
- **December 2018: RevCom**

Goals for September 2016

- **Continue with Comment Resolutions.**

Teleconferences

- **Weekly teleconferences are planned after July 2016 session.**
  - ✧ **Thursday, August 4th; 20:00 – 22:00 (ET) →Approved during May 2016 meeting.**
  - ✧ **Thursday, August 11th, 25th, and September 8th: 10:00 – 12:00 (ET)**
  - ✧ **Thursday, August 18rd, September 1st, and 22nd; 20:00 – 22:00 (ET)**

May 2016 – Waikoloa, HI

The TGax planned to have 10 sessions during the week.
Six out of ten sessions were assigned to the ad hoc group sessions.

	Tuesday		Wednesday		Thursday
	TGax (PHY)	TGax (MAC/SR)			TGax (full)
			TGax (PHY)	TGax (MAC/SR)	
Gax C/SR)	TGax (PHY)	TGax (MU)	TGax (MAC)	TGax (MAC/SR)	TGax (full)
Gax MU)		TGax (full)			

Main documents

- TGax Agenda: 11-16-0512-04, TGax May 2016 Meeting Agenda
  - TGax PHY ad hoc agenda and motions: 11-16-0693-03, TGax PHY Ad Hoc May 2016 Meeting Agenda
    - TGax PHY ad hoc meeting minutes: 11-16-0755-00, TGax May 2016 Waikoloa PHY Ad Hoc Meeting Minutes
  - TGax MAC and SR ad hoc agenda: 11-16-0698-04, TGax MAC and Spatial Reuse Ad Hoc Agenda May 2016 Meeting
    - TGax MAC and Spatial Reuse ad hoc meeting minutes: 11-16-0701-00, Combined Spatial Reuse & MAC ad hoc group meeting minutes
  - TGax Multi-User ad hoc agenda: 11-16-0697-02, TGax MU Ad-hoc Agenda May 2016 Agenda
    - TGax Multi-User ad hoc meeting minutes: 11-16-0716-00, May 2016 Waikoloa TGax MU Ad hoc Meeting minutes
- Closing report: 11-16-0739-00, TGax May 2016 Closing Report
- Draft TGax minutes: 11-16-0686-00, TGax May 2016 Waikoloa Meeting Minutes

Achievements

7. Work Completed

- **TGax received about 70 submissions.**
  - Number of submissions: PHY/MAC/MUSR/TG = 33/18/9/3/6.

  Majority of the submission were requesting changes to the TG Specification Framework.
  Few submissions were addressing comment resolution mainly of the PHY clause.
- **Agreed to terminate the Specification Framework process. The frame of reference is Draft D0.1**
  - Future submissions shall bring text to continue developing the TG draft
  - The TG Technical Editor is planning to generate draft D0.2 based on outcome of this meeting
- **Approved the resolutions of about 200 comments, most of them addressing the PHY clause**
- **Revisited and accepted a new modified timeline.**

8. Technical Presentations

70 technical submissions have been covered during the week.
A list of the submissions is also available in the agenda document.

- Submissions – PHY (33 submissions)
  - 11-16/0608, "Beamforming Feedback Report Structure," Sameer Vermani (Qualcomm)
  - 11-16/0610, "CR HE-SIG-A Part I," Ross Jian Yu (Huawei Technologies)
  - 11-16/0611, "Remaining Issues in Trigger Frame Design," Sameer Vermani (Qualcomm)
  - 11-16/0613, "SIG-B Related Issues," Lochan Verma (Qualcomm)
  - 11-16/0614, "Comment Resolution on Clause 26.1.1 Part 1," Lochan Verma (Qualcomm)
  - 11-16/0615, "Comment Resolution on Clause 26.3.12 Part 1," Lochan Verma (Qualcomm)
  - 11-16/0617, "Remaining Topics in Power Control," Bin Tian (Qualcomm)
  - 11-16/0618, "11ax CSD Design," Bin Tian (Qualcomm)
  - 11-16/0619, "PAPR Reduction of HE-SIGB," Bin Tian (Qualcomm)
  - 11-16/0620, "DCM PHY Parameters," Hongyuan Zhang (Marvell)
  - 11-16/0621, "DCM Interleaver," Tianyu Wu (MediaTek)
  - 11-16/0622, "16 QAM Napping for DCM," Sudhir Srinivasa (Marvell)
  - 11-16/0623, "CR on Section 26.3.10.12," Bin Tian (Qualcomm)
  - 11-16/0625, "CR on Section 26.3.6," Bin Tian (Qualcomm)
  - 11-16/0626, "Feedback Element Compression for 802.11ax," Kome Oteri (InterDigital Communications)
  - 11-16/0633, "Left over Issues in RU Signaling for HE-SIGB," Yan Zhang (Marvell)
  - 11-16/0634, "11ax Comment Resolutions for Clauses 26.3.2," Yan Zhang (Marvell)

- 11-16/0635, "BW indication for Non-contiguous Channel Bonding," Yunbo Li (Huawei Technologies)
- 11-16/0636, "TXOP Duration field in HE-SIG-A," Jeongki Kim (LG Electronics)
- 11-16/0637, "Load balancing indication for MU-MIMO over 484-tone and larger RU in OFDMA," Ming Gan (Huawei Technologies)
- 11-16/0638, "Discussions for Non-contiguous Channel Bonding," John Son (Wilus)
- 11-16/0639, "Follow-up on HE-SIG-B user-specific field," Jinsoo Choi (LG Electronics)
- 11-16/0649, "Feedback Tone Map and Quantization," Sriram Venkateswaran (Broadcom)
- 11-16/0652, "Power scaling of 4 extra tones," Xiaogang Chen (Intel)
- 11-16/0653, "CR on section 26.3.3," Xiaogang Chen (Intel)
- 11-16/0654, "CP and LTF Options and Signaling," Ron Porat (Broadcom)
- 11-16/0655, "On MCS0 DCM Modulation and DCM Capability," Jianhan Liu (MediaTek)
- 11-16/0656, "1024QAM Modulation," Jianhan Liu (MediaTek)
- 11-16/0658, "CR on 26.3.7.1," Jinsoo Choi (LG Electronics)
- 11-16/0659, "CR on 26.3.9.9 and 26.3.5," Eunsung Park (LG Electronics)
- 11-16/0663, "CR on Secition 26.2.2," Ke Yao (ZTE)
- 11-16/0681, "Comment Resolution CID 215 2486," Daewon Lee (Newracom)
- 11-16/0682, "CR CID on PHY data field other," Daewon Lee (Newracom)

- Submissions – MAC (18 submissions)
  - 11-16/0583, "Backoff Procedure Handling Upon TF Reception," Yu Wang (Ericsson)
  - 11-16/0584, "Need of SDU Fragmentation to Reduce Padding Ratio in UL-OFDMA Transmission," Yu Wang (Ericsson)
  - 11-16/0588, "Channel State Estimation based Bidirectional Initialized Random Access," Bo Li (Northwestern Polytechnical Univ.)
  - 11-16/0590, "Multi-BSS Association for Edge Users' Throughput Improvements," Mao Yang (Northwestern Polytechnical Univ.)
  - 11-16/0616, "BlockAck generation and selection rules," Alfred Asterjadhi (Qualcomm)
  - 11-16/0627, "ROM Recovery Rules," Jayh Hyunhee Park (LG Electronics)
  - 11-16/0628, "Buffer Status Report in HE Control field," Jayh Hyunhee Park (LG Electronics)
  - 11-16/0640, "BSS Color Collision," Geonjung Ko (Wilus Institute)
  - 11-16/0641, "Regarding HE fragmentation," Woojin Ahn (Yonsei Univ.)
  - 11-16/0643, "HE Control Scheduling," Liwen Chu (Marvell)
  - 11-16/0644, "SS Allocation in Trigger," Liwen Chu (Marvell)
  - 11-16/0645, "MU Minimum MPDU Start Spacing," Liwen Chu (Marvell)
  - 11-16/0646, "HE Beamforming Feedback," Liwen Chu (Marvell)
  - 11-16/0657, "In-device Multi-radio Coexistence and UL MU operation," Robert Stacy (Intel)
  - 11-16/0673, "Multi-User EDCA," Jinsoo Ahn (Yonsei Univ.)
  - 11-16/0674, "EIFS excess problem of Acknowledgement for UL MU procedure," Hanseul Hon (Yonsei Univ.)
  - 11-16/0675, "comment resolution for CID2383," Yonggang Fang (ZTE)
  - 11-16/0684, "Channel Access Efficiency," Evgeny Khorov (IITP)

- Submissions – Multi-User (9 submissions)
  - 11-16/0582, "Random Access RU Allocation in the Trigger Frame," Evgeny Khorov (IITP)
  - 11-16/0591, "Issues related to OCW management," Patrice Nezou (Canon)
  - 11-16/0592, "Follow up on Issue related to unused UL OFDMA RUs," Stephane Baron (Canon)
  - 11-16/0648, "MU-RTS/CTS PHY Format," Po-Kai Huang (Intel)
  - 11-16/0661, "Adaptive Random Access UL OFDMA," Leonardo Lanante (Kyushu Institute of Technology)

- ✧ 11-16/0662, "Further consideration on channel access rule to facilitate MU transmission opportunity," Jing Ma (NICT)
- ✧ 11-16/0664, "Consideration on backoff procedure for UL MU transmission," Jing Ma (NICT)
- ✧ 11-16/0665, "Some Notes on Interference Alignment for Downlink Multi-User MIMO," Dzevdan Kapetanovic (Ericsson)
- ✧ 11-16/0667, "Signaling of Multi-TID Aggregation Limit," Chittabrata Ghosh (Intel)

- Submissions – Spatial Reuse (3 submission)
  - ✧ 11-16/0581, "Proposed changes to SR clause," Soma Tayamon (Ericsson)
  - ✧ 11-16/0589, "Fractional-Backoff Procedure and Dynamic CCA," Bo Li (Northwestern Polytechnical University)
  - ✧ 11-16/0647, "Consideration of Spatial Reuse for Trigger Frame," Po-Kai Huang (Intel)

- Submissions – TG (6 submissions)
  - ✧ 11-16/0571, "QoS Handling of Trigger Frame," Yu Wang (Ericsson)
  - ✧ 11-16/0597, "TG ax Indoor Enterprise Scenarios, Color, DSC and TPC," Graham Smith (SR Technologies)
  - ✧ 11-16/0604, "Simulation-based evaluation of DSC in enterprise scenario," Tanguy Ropitault (NIST)
  - ✧ 11-16/0609, "HE NDPA frame format," Ross Jian Yu (Huawei)
  - ✧ 11-16/0612, "Mandatory/Optional Issues for 802.11ax," Sameer Vermani (Qualcomm)
  - ✧ 11-16/0629, "Box 5 Calibration Results," Marik Hsiao (MediaTek)

9. Timeline

Current Timeline	Modified Timeline
● **May 2014: start of the TG**	● **May 2014: start of the TG**
● **Nov. 2014: First draft of the TG SFD was approved**	● **Nov. 2014: First draft of the TG SFD was approved**
● **Jan. 2016: proposed TG draft**	● **Jan. 2016: proposed TG draft**
● **March 2016: Draft D0.1 was approved and CC started**	● **March 2016: Draft D0.1 was approved and CC started**
● **July 2016: Draft 1.0 and WG letter ballot**	● **September 2016: Draft 1.0 and WG letter ballot**
● **March 2017: Draft 2.0 and recirculation**	● **March 2017: Draft 2.0 and recirculation**
● **Jan 2018: Sponsor Ballot**	● **July 2017: MDR (Mandatory Document Review)**
	● **November 2017: Formation of SB pool**
	● **March 2018: Sponsor Ballot**
	● **December 2018: RevCom**

Goals for July 2016

- Continue with Comment Resolutions.

Teleconferences

- Weekly teleconferences are planned after May 2016 session.
  - ✧ Thursday, June 2nd, 16th, 30th, and July 14th: 10:00 – 12:00 (ET)
  - ✧ Thursday, June 23rd, July 7th, and August 4th 20:00 – 22:00 (ET)

March 2016 – Macau

The TGax planned to have 9 sessions during the week.
Five out of nine sessions were assigned to the ad hoc group sessions.

	Tuesday		Wednesday		Thursday
	TGax (PHY)	**TGax (MAC)**			**TGax (full)**
			TGax (PHY)	**TGax (MAC)**	
	TGax (SR)	**TGax (MAC)**	**TGax (MAC)**	**TGax (MU)**	**TGax (full)**
Gax MU)		**TGax (full)**			

Main documents

- TGax Agenda: 11-16-0235-07, TGax March 2016 Meeting Agenda
  - ➢ TGax PHY ad hoc agenda and motions: 11-16-0421-03, TGax PHY Ad Hoc March 2016 Meeting Agenda
    - ✧ TGax PHY ad hoc meeting minutes: 11-16-0509-00, TGax March 2016 Macau PHY Ad Hoc Meeting Minutes
  - ➢ TGax MAC ad hoc agenda: 11-16-0427-04, TGax MAC Ad Hoc March 2016 Meeting Agenda
    - ✧ TGax MAC ad hoc meeting minutes: 11-16-0439-01, Mar 2016 Macau TGax MAC Ad hoc Meeting Minutes
  - ➢ TGax Multi-User ad hoc agenda: 11-16-0419-02, TGax MU Ad-hoc Agenda March 2016 Agenda
    - ✧ TGax Multi-User ad hoc meeting minutes: 11-16-0466-00, March 2016 Macau TGax MU Ad hoc Meeting minutes
  - ➢ TGax Spatial Reuse ad hoc agenda and motions: 11-16-0422-02, 802.11ax Spatial Reuse Ad Hoc Group Agenda
    - ✧ TGax Spatial Reuse ad hoc minutes: 11-16-0537-00, Spatial Reuse ad hoc group March 2016 minutes
- Closing report: 11-16-0475-00, TGax March 2016 Closing Report
- Draft TGax minutes: 11-16-0415-00, TGax March 2016 Macau Meeting Minutes

Achievements

10. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - ✧ PHY – 22 motions passed.
  - ✧ MAC – 17 motions passed.
  - ✧ MU – 9 motions passed.
  - ✧ SR – 2 motions passes.
- **Latest revision of the Specification Framework is available at;**
  - ✧ https://mentor.ieee.org/802.11/dcn/15/11-15-0132-16-00ax-spec-framework.docx
- **Other TG documents**

- ✧ Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
- ✧ Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-12-00ax-evaluation-methodology.docx
- ✧ Channel Model https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
- ✧ Functional Requirements https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

11. Technical Presentations

48 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- Submissions – PHY (12 submissions)
  - ✧ 11-15/1354, "SIGA fields and Bitwidths," Ron Porat (Broadcom)
  - ✧ 11-16/0203, "Signalling Support for Full Bandwidth MU-MIMO Compressed SIG-B Mode," Lei Huang (Panasonic)
  - ✧ 11-16/0319, "I-Q Decoupled OFDM: A Solution To I/Q Imbalance," Shouxing Simon Qu (Blackberry)
  - ✧ 11-16/0335, "HE-STF sequences for 160/80+80MHz," Eunsung Park (LG Electronics)
  - ✧ 11-16/0343, "Spectral Mask Discussion," Hongyuan Zhang (Marvell)
  - ✧ 11-16/0344, "PHY Padding Related Issues," Hongyuan Zhang (Marvell)
  - ✧ 11-16/0346, "11ax Pilot Sequence," Bin Tian (Qualcomm)
  - ✧ 11-16/0349, "HE-SIG-B Compression Mode," Kaushik Josiam (Samsung)
  - ✧ 11-16/0367, "Power Scaling of L-LTF and L-STF," Yakun Sun (Marvell)
  - ✧ 11-16/0389, "Sounding Design," Sriram Venkateswaran (Broadcom)
  - ✧ 11-16/0395, "Preamble transmission for Uplink OFDMA," Ming Gan (Huawei)
  - ✧ 11-16/0397, "HE-SIG-B Signaling Discussions," John Son (WILUS Institute)

- Submissions – MAC (18 submissions)
  - ✧ 11-16/0297, "Results for beacon collisions," Evgeny Khorov (IITP RAS)
  - ✧ 11-16/0345, "Simultaneous NAK for MU GCR-BA," Jinsoo Ahn (Yonsei Univ.)
  - ✧ 11-16/0347, "Fragmentation for MU frames-Follow up on parameters," Alfred Asterjadhi (Qualcomm)
  - ✧ 11-16/0352, "Considerations on MU initial link setup," Woojin Ahn (Yonsei Univ.)
  - ✧ 11-16/0353, "MU-RTS/CTS for TWT Protection," Hanseul Hong (Yonsei Univ.)
  - ✧ 11-16/0358, "Maximal A-MPDU Size," Liwen Chu (Marvell)
  - ✧ 11-16/0359, "Management ACK," Liwen Chu (Marvell)
  - ✧ 11-16/0361, "Ack Policy of UL MU frame," Jeongki Kim (LG Electronics)
  - ✧ 11-16/0362, "Multi-TID Aggregation Limit," Chittabrata Ghosh (Intel)
  - ✧ 11-16/0365, "Multi-STA BA Design," Xiaofei Wang (InterDigital)
  - ✧ 11-16/0368, "MAC padding options for legacy trigger frame," Zhou Lan (Broadcom)
  - ✧ 11-16/0369, "M-BA aggregated trigger frame," Zhou Lan (Broadcom)
  - ✧ 11-16/0377, "Sounding Sequences Clarifications," Simone Merlin (Qualcomm)
  - ✧ 11-16/0378, "Extended BA Bitmap," Simone Merlin (Qualcomm)
  - ✧ 11-16/0383, "RU Signaling in Trigger Frame," Yunbo Li (Huawei)
  - ✧ 11-16/0396, "Issues on BSS Color Bits Collision," Geonjung Ko (WILUS Institute)
  - ✧ 11-16/0399, "Considerations on Trigger Frame for Random Access Procedure," Evgeny Khorov (IITP RAS)
  - ✧ 11-16/0404, "BlockAck Bitmap," Dengyu Qiao (Huawei)

- Submissions – Multi-User (6 submissions)
  - ✧ 11-16/0331, "Power Control for Multi-User Transmission in 802.11ax," Kome Oteri (InterDigital)
  - ✧ 11-16/0333, "Issue related to unused UL OFDMA RUs," Stephane Baron (Canon)

- ✧ 11-16/0340, "Random Access UL MU Resource Allocation and Indication," Leonardo Lanante (Kyushu Institute of Technology)
- ✧ 11-16/0371, "Further consideration for MU-RTS/CTS," Jin Ma (NICT)
- ✧ 11-16/0379, "Trigger Frame Format," Simone Merlin (Qualcomm)
- ✧ 11-16/0413, "Power Control for UL MU," Arjun Bharadwaj (Qualcomm)

- Submissions – Spatial Reuse (7 submission)
  - ✧ 11-16/0212, "Enterprise Scenario DSC and Color," Graham Smith (SR Technplogies)
  - ✧ 11-16/0310, "DSC Proposed Text," Graham Smith (SR Technplogies)
  - ✧ 11-16/0350, "Enterprise Scenario TPC and DSC," Graham Smith (SR Technplogies)
  - ✧ 11-16/0360, "Simulation results of spatial reuse with various MCSs," Junichi Iwatani (NTT)
  - ✧ 11-16/0382, "Discussion on Spatial Reuse Operations in 11ax," Yunbo Li (Huawei)
  - ✧ 11-16/0403, "Spatial Re-Use with Adaptive CCA and TPC Simulation," Frank Hsu (MediaTek)
  - ✧ 11-16/0414, "Adjustment Rules for Adaptive CCA and TPC," James Wang (MediaTek)

- Submissions – TG (5 submissions)
  - ✧ 11-15/1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
  - ✧ 11-16/0066, "Views on UL MU Features," Joonsuk Kim (Apple)
  - ✧ 11-16/0355, "Snapshot of Residential Use 2016," Carol Ansley (ARRIS Group)
  - ✧ 11-16/0364, "AID Assign Rules Based on BSS Color and HE Operation Element," Jianhan Liu (MediaTek)
  - ✧ 11-16/0394, "Achieving High Efficiency in Medium Access via Roster Mode," Sean Coffey (RealTek)

12. Draft Specification

- The TGax approved version 0.1 of the draft specification.
- **TG Motion:**
- **Move to accept document 11-16/0024r1 as the TG draft specification D0.1, and start a 21 day comment collection period.**
  - ➢ The submission is available at: https://mentor.ieee.org/802.11/dcn/16/11-16-0024-01-00ax-proposed-draft-specification.docx
  - ➢ **Move: Robert Stacey, Second: Simone Merlin**
  - ➢ **Y/N/A: 75/0/5, motion passes.**

Goals for May 2016

- Comment Resolution.
- Technical presentations.
- Revisit the timeline based on the number of comments received.

Teleconferences

- Four teleconferences are planned before the March 2016 session.
  - ✧ Thursday, April 14th, 10:00 – 12:00 (ET)
  - ✧ Thursday, April 21st, 20:00 – 22:00 (ET)
  - ✧ Thursday, April 28th, 10:00 – 12:00 (ET)
  - ✧ Thursday, May 5th, 20:00 – 22:00 (ET)

January 2016 – Atlanta, GA

The TGax planned to have 10 sessions during the week.
Four out of ten sessions were assigned to the ad hoc group sessions.

	Tuesday		Wednesday	Thursday
			TGax (full)	
	TGax (PHY)	TGax (MAC)		TGax (full)
	TGax (PHY)	TGax (MAC)	TGax (full)	
TGax MAC)			TGax (full)	TGax (full)
	TGax (MU)			

Main documents

- TGax Agenda: 11-15-1516-03, TGax January 2016 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-16-0108-02, TGax PHY Ad Hoc Jan 2016 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-16-0109-02, TGax MAC Ad Hoc January 2016 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-16-0147-01, TGax MU Ad-hoc January 2016 Agenda
- Closing report: 11-16-0187-00, TGax January 2016 Closing Report
- Draft TGax minutes: 11-16-0096-00, TGax January 2016 Atlanta Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-16-0119-00, January 2016 Atlanta PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-16-0110-00, Jan 2016 Atlanta TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-16-0150-00, January 2016 Atlanta TGax MU Ad hoc Meeting minutes

Achievements

13. TG Documents

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

14. Technical Presentations

48 technical submissions have been covered during the week.

A list of the submissions is available in the agenda document.

- Submissions – PHY (22 submissions)
  - 11-16/0030, "Maximum Tone Grouping Size for 802.11ax Feedback with MU-MIMO," Kome Oteri (InterDigital)
  - 11-16/0033, "1x HE-LTF for ULMUMIMO," Hongyuan Zhang (Marvell)
  - 11-16/0034, "Beamforming with HE-LTF Compression," Hongyuan Zhang (Marvell)
  - 11-16/0036, "CRC Generation for HE-SIG," Yakun Sun (Marvell)
  - 11-16/0037, "Continuous Puncturing for HE-SIGB Encoding," Yakun Sun (Marvell)
  - 11-16/0038, "Sequence for 1x LTF," Daewon Lee (Newracom)
  - 11-16/0039, "RU Allocation in SIG-B," Daewon Lee (Newracom)
  - 11-16/0040, "Issues with Compressed SIG-B Mode," Yujin Noh (Newracom)
  - 11-16/0041, "Link Adaptation for HE WLAN," Yujin Noh (Newracom)
  - 11-16/0044, "MCS Levels and TX EVM Requirement for 1024 QAM," Eunsung Park (LG Electronics)
  - 11-16/0045, "Flexible Wider Bandwidth Transmission," John Son (WILUS)
  - 11-16/0046, "Content for the extra tones in LSIG and RLSIG," Jiayin Zhang (Huawei)
  - 11-16/0047, "Discussion on the HE Extended Range SU PPDU," Jiayin Zhang (Huawei)
  - 11-16/0052, "Remaining HE-LTF Sequence Design," Le Liu (Huawei)
  - 11-16/0053, "Requirements for UL MU Transmissions," Arjun Bharadwaj (Qualcomm)
  - 11-16/0056, "On QPSK DCM Modulation and LDPC Tone Mapper for DCM," Jianhan Liu (MediaTek)
  - 11-16/0071, "Packet Extension Follow Up," Ron Porat (Broadcom)
  - 11-16/0079, "Allocation sizes for BCC in OFDMA," Ken Taniguchi (Toshiba)
  - 11-16/0080, "1x/2x/4x OFDM Symbol in HE SU PPDU with BCC," Heejung Yu (Yeungnam Univ./NEWRACOM)
  - 11-16/0088, "Ng for Compressed Beamforming feedback," Sriram Venkateswaran (Broadcom)
  - 11-16/0089, "Single Stream Pilots in UL MU MIMO," Sriram Venkateswaran (Broadcom)
  - 11-16/0104, "Rate Matching for HE-SIG-B," Daewon Lee (Newracom)

- Submissions – MAC (12 submissions)
  - 11-16/0015, "Explicit Block Ack Request in DL MU PPDU," Yongho Seok (Newracom)
  - 11-16/0017, "Beacon Collision Avoidance," Evgeny Khorov (IITP)
  - 11-16/0018, "TDMA for Eliminating Hidden Station Effect in Dense Networks," Evgeny Khorov (IITP)
  - 11-16/0028, "Follow Up for Multi-STA BA for SU Transmissions," Xiaofei Wang (InterDigital)
  - 11-16/0029, "TXOP Truncation Enhancement," Xiaofei Wang (InterDigital)
  - 11-16/0042, "BSS Color Settings for a Multiple BSSID Set," Geonjung Ko (WILUS)
  - 11-16/0050, "Fragmentation for MU frames-Follow up on acks," Alfred Asterjadhi (Qualcomm)
  - 11-16/0051, "Response Give Trigger Type," David Xun Yang (Huawei)
  - 11-16/0068, "BSS Color and Multiple BSSID," Liwen Chu (Marvell)
  - 11-16/0069, "Multi-TID A-MPDU in MU Transmission," Liwen Chu (Marvell)
  - 11-16/0087, "NAV cancellation issues on MU protection," Jinsoo Ahn (Yonsei Univ.)
  - 11-16/0102, "High Efficiency Medium Access via Rosters," Sean Coffey (RealTek)

- Submissions – Multi-User (9 submissions)
  - 11-16/0031, "Proposed UL MU CS Rules," Lei Wang (Marvell)
  - 11-16/0048, "Protection using MU RTS/CTS," Young Hoon Kwon (Newracom)
  - 11-16/0054, "UL MU CCA Response," Kaiying Lv (ZTE)
  - 11-16/0057, "Indication for UL MU Carrier Sensing," Kiseon Ryu (LG Electronics)
  - 11-16/0065, "Duration/ID field in UL-MU," Tomo Adachi (Toshiba)
  - 11-16/0066, "Views on UL-MU Features," Joonsuk Kim (Apple)

- 11-16/0067, "MAC Padding in Trigger Frame," Liwen Chu (Marvell)
- 11-16/0085, "Congestion control for UL MU random access," Woojin Ahn (Yonsei Univ.)
- 11-16/0091, "Regarding HE NDPA frame for DL Sounding Sequence," Narendar Madhavan (Toshiba)

- Submissions – Spatial Reuse (1 submission)
  - 11-16/0060, "Recipient-aware Spatial Reuse," Reza Hedayat (Newracom)

- Submissions – TG (4 submissions)
  - 11-15/1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
  - 11-16/0024, "Proposed draft specification," Robert Stacy (Intel)
  - 11-16/0043, "Clarification of SFD Texts," John Son (WILUS)
  - 11-16/0059, "Non-contiguous Channel Bonding in 11ax," Yunbo Li (Huawei)

15. Draft Specification

- Document 11-16/0024r0 was submitted by the TG Editor and it includes a "draft" draft specification.
- The submission was reviewed by the TG Editor and is available on mentor to be reviewed by TG members.
- The submission is available at: https://mentor.ieee.org/802.11/dcn/16/11-16-0024-00-00ax-proposed-draft-specification.docx

16. Plan for Progressing TG Draft

- Approve the TG draft specification during the March 2016 meeting.
  - Draft 0.1
- Start a comment collection (CC) for 30 days on draft 0.1 – Ends some time in April.
- Comment resolution (May and July)
- Draft 1.0 in July 2016 and start WG LB.

Goals for March 2016

- Discuss Proposals affecting the TG Specification Framework document
- Approve D0.1 of the TG Draft
- Approve a 30-day Comment Collection Process.

Teleconferences

- Three teleconferences are planned before the March 2016 session.
  - Thursday, February 4th, 10:00 – 12:00 (ET)
  - Thursday, February 18th, 20:00 – 22:00 (ET)
  - Thursday, March 3rd, 10:00 – 12:00 (ET)

November 2015 – Dallas, TX

The TGax planed to have 10 sessions during the week.
One more session was added during the WG opening week plenary session due to the large number of submissions.
Five out of eleven sessions were assigned to the ad hoc group sessions.

Tuesday	Wednesday	Thursday

TGax TGax

TGax (PHY) TGax (MAC) TGax

TGax (MU) TGax (SR) TGax (PHY) TGax (SR)

TGax (PHY) TGax (MU) TGax

TGax (PHY) TGax (MAC)

Main documents

- TGax Agenda: 11-15-1232-04, TGax November 2015 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-15-1385-03, TGax PHY Ad Hoc Nov 2015 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-15-1382-03, TGax MAC ad hoc Nov 2015 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-15-1418-02, TGax MU Ad-hoc November 2015 Agenda
  - TGax Spatial Reuse ad hoc agenda: 11-15-1403-06, 802.11ax Spatial Reuse Ad Hoc Group Agenda
- Closing report: 11-15-1457-00, TGax November 2015 Closing Report
- Draft TGax minutes: 11-15-1368-01, TGax November 2015 Dallas Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-15-1442-00, November 2015 Dallas PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-15-1414-00, Nov 2015 Dallas TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-15-1423-01, November 2015 Dallas TGax MU Ad hoc Meeting minutes
  - TGax Spatial Reuse ad hoc meeting minutes: 11-15-1421-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting – Dallas, November 2015

Achievements

17. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - PHY – 33 motions passed.
  - MAC – 16 motions passed.
  - MU – 12 motions passed.
  - SR – 1 motion passed.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-10-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-11-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

18. Technical Presentations

83 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- Submissions – PHY

- 11-15-1059, "SIG-B Encoding Structure Part II," Ron Porat (Broadcom)
- 11-15-1289, "Non-Uniform Constellations for 1024-QAM," Thomas Handte (Sony)
- 11-15-1303, "LTF Sequence Designs," Sungho Moon (Newracom)
- 11-15-1304, "Supported Resource Allocations in SIG-B," Sungho Moon (Newracom)
- 11-15-1305, "STBC and Padding Discussions" Hongyuan Zhang (Marvell)
- 11-15-1309, "Extended Range Support for 11ax," Sameer Vermani (Qualcomm)
- 11-15-1310, "11ax LDPC Tone Mapper for 160MHz," Bin Tian (Qualcomm)
- 11-15-1311, "11ax Spectral Mask," Bin Tian (Qualcomm)
- 11-15-1315, "HE-SIG-B Mapping and Compression," Kaushik Josiam (Samsung)
- 11-15-1320, "Maximum Tone Grouping Size for 802.11ax Feedback," Kome Oteri (InterDigital)
- 11-15-1321, "Reducing Explicit MIMO Compressed Beamforming Feedback Overhead for 802.11a," Kome Oteri (InterDigital)
- 11-15-1322, "Channel Estimation Enhancement and Transmission Efficiency Improvement Using Beam-Change Indication and 1x HE-LTF," Jianhan Liu (MediaTek)
- 11-15-1323, "HE-STF Sequence," Ensung Park (LG Electronics)
- 11-15-1324, "MCS for HE-SIG-B," Dongguk Lim (LG Electronics)
- 11-15-1327, "Diversity Mode in OFDMA," Yujin Noh (Newracom)
- 11-15-1329, "Link Adaptation for HE WLAN," Yujin Noh (Newracom)
- 11-15-1331, "PHY Padding Capability Signaling," Daewon Lee (Newracom)
- 11-15-1332, "Implicit Sounding for HE WLAN," Daewon Lee (Newracom)
- 11-15-1334, "HE-LTF Sequence Design," Le Liu (Huawei)
- 11-15-1335, "HE-SIG-B Contents," Le Liu (Huawei)
- 11-15-1347, "Strategies to reduce MIMO feedback overhead," Filippo Tosato (Toshiba)
- 11-15-1349, "Sounding for Uplink Transmission," Sungho Moon (Newracom)
- 11-15-1350, "Spatial Configuration And Signaling for MU-MIMO," Yakun Sun (Marvell)
- 11-15-1353, "Preamble Formats," Ron Porat (Broadcom)
- 11-15-1354, "SIGA fields and Bitwidths," Ron Porat (Broadcom)
- 11-15-1357, "Extra tones in the preamble," Xiaogang Chen (Intel)
- 11-15-1372, "L-LENGTH Equation Updates," Hongyuan Zhang (Marvell)

- Submissions – MAC
  - 11-15-1265, "RTSCTS for UL DL OFDMA Control," Cheeha Kim (POSTECH)
  - 11-15-1278, "HE MU Acknowledgment Procedure," Yongho Seok (Newracom)
  - 11-15-1300, "DL MU transmission sequence," Yong Hoon Kwon (Newracom)
  - 11-15-1318, "Fragmentation for MU frames-Follow up," Alfred Asterjadhi (Qualcomm)
  - 11-15-1319, "Scheduled Trigger frames-Follow up," Alfred Asterjadhi (Qualcomm)
  - 11-15-1330, "A method of transmitting Multi-STA Block frame," Jeongki Kim (LG Electronics)
  - 11-15-1341, "Reception Status of Frames Transmitted in Random Access RUs," Tomoko Adachi (Toshiba)
  - 11-15-1344, "Trigger Frame Format," Simone Merlin (Qualcomm)
  - 11-15-1345, "Trigger type specific information," Kiseon Ryu (LG Electronics)
  - 11-15-1346, "Ack Policy for UL MU Ack transmission," Kiseon Ryu (LG Electronics)
  - 11-15-1351, "Rate MCS Selection Rules for M-BA and DL OFDMA BA," Liwen Chu (Marvell)
  - 11-15-1352, "broadcast STAID in HE SIG B," Liwen Chu (Marvell)
  - 11-15-1355, "Considerations for TDLS transmission in 11ax," Yingpei Lin (Huawei)
  - 11-15-1359, "System Performance Evaluation of 802.11ae," Yu Wang (Ericsson)

- Submissions – Multi-User
  - 11-15-1280, "Traffic priority for random Multi User Uplink OFDMA," Stephane Baron (Canon)
  - 11-15-1301, "NAV Rule for UL MU Response," Yingpei Lin (Huawei)

- 11-15-1312, "MU BAR Frame Format," Reza Hedayat (Newracom)
- 11-15-1314, "I/Q Imbalance Impact to TGax OFDMA Uplink Reception," Rui Yang (InterDigital)
- 11-15-1325, "MU-RTS/CTS Follow Up," Po-Kai Huang (Intel)
- 11-15-1326, "NAV Consideration for UL MU Response Follow Up," Po-Kai Huang (Intel)
- 11-15-1328, "Scheduling information for UL OFDMA Acknowledgement,"Yujin Noh (Newracom)
- 11-15-1340, "NDP Announcement for HE Sequence," Narendar Madhavan (Toshiba)
- 11-15-1364, "Signaling Trigger Information for STAs in 11ax," Chittabrata Ghosh (Intel)
- 11-15-1369, "Random access based buffer status report," Woojin Ahn (Yunsei Univ.)
- 11-15-1370, "UL OFDMA Random Access Control," Jinsoo Ahn (Yonsei Univ.)
- 11-15-1374, "Consideration for protecting cascading MU DL/UL transmission with MU RTS/CTS," Jing Ma (NICT)

- Submissions – Spatial Reuse
  - 11-15-1259, "Use of TG ax Scenarios for Spatial Reuse," Graham Smith (SR Tecnologies)
  - 11-15-1284, "Simulation results for spatial reuse in 11ax," Jinmin Kim (LG Electronics)
  - 11-15-1313, "Considerations for Spatial Reuse," Reza Hedayat (Newracom)
  - 11-15-1316, "DSC calibration results with NS-3," M. Shahwaiz Afaqui (T.U. Catalonia)
  - 11-15-1336, "BSS Color Field Size Measurements," Chuck Lukaszewski (Aruba-HP)
  - 11-15-1337, "Secondary Channel CCA of HE STA," John Son (Willus Institute)
  - 11-15-1338, "Improving Spatial Reuse During OBSS UL MU Procedure," Geonjung Ko (Willus Institute)
  - 11-15-1348, "Multiple NAVs for Spatial Reuse," Sigurd Schelstraete (Quantenna)
  - 11-15-1427, "Drivers of the dynamic CCA adaptation," Eduard Garcia-Villegas (Technical Univ. of Catalonia)

- Submissions – TG
  - 11-15-1288, "An issue of wider bandwidth operation at real denser environment," Katsuo Yunoki (KDDI R&D Labs)
  - 11-15-1302, "System Level Simulator Evaluation with/without Capture Effect," Vida Ferdowsi (Newracom)
  - 11-15-1360, "Implications of wrap-around for TGax Scenario 3 and Scenario 4 – follow-up," Marcin Filo (Univ. of Surrey)
  - 11-15-1361, "Energy consumption with Scheduled PSP," Dmitry Akhmetov (Intel)
  - 11-15-1362, "On TGax Scenario 4 channel model – follow-up," Marcin Filo (Univ. of Surrey)
  - 11-15-1363, "Regulatory Landscape for Narrowband Transmissions in 11ax," Ilan Sutskover (Intel)
  - 11-15-1373, "Updated Box5 Calibration Results," Narendar Madhavan (Toshiba)
  - 11-15-1375, "11ax Support for IoT - Requirements and Technological Implications," Shimo Shilo (Huawei)

Goals for January 2016

- Continue to advance TG documents based on submissions.
  - Priority to the TG Specification Framework document.
- TG timeline indicates draft D0.1 will be available in January 2016.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the January 2016 session.
  - Thursday, December 10th, 10:00 – 12:00 (ET)

September 2015 – Bangkok, Thailand

Originally, TGax planned to have ten sessions during the week.
Two more sessions were added during the WG opening week plenary session due to the large number of submissions.
Six out of twelve sessions were assigned to the ad hoc sessions.

	Tuesday		Wednesday		Thursday
			TGax		TGax
	TGax (PHY)	TGax (MAC)			
Gax [AC)	TGax (MU)	TGax (SR)	TGax (PHY)	TGax (SR)	TGax
	TGax		TGax		
Gax [AC)	TGax (MU)	TGax (SR)			

Main documents

- TGax Agenda: 11-15-0987-06, TGax September 2015 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-15-1125-04, TGax PHY Ad Hoc September 2015 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-15-1126-03, TGax MAC ad hoc September 2015 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-15-1141-02, TGax MU ad-hoc September 2015 Agenda
  - TGax Spatial Reuse ad hoc agenda: 11-15-1143-03, TGax Spatial Reuse Ad Hoc September 2015 Meeting Agenda
- Closing report: 11-15-1190-00, TGax September 2015 Closing Report
- Draft TGax minutes: 11-15-1093-00, TGax September 2015 Bangkok Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-15-1205-00, September 2015 Bangkok PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-15-1130-02, September 2015 TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-15-1160-00, September 2015 TGax MU Ad hoc Meeting minutes
  - TGax Spatial Reuse ad hoc meeting minutes: 11-15-1206-00, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting – Bangkok, September 2015

Achievements

19. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - PHY – 29 motions passed.
  - MAC – 12 motions passed.
  - MU – 15 motions passed.
  - SR – 4 motions passed.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-09-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-14-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-10-00ax-evaluation-methodology.docx
- Other documents

- https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
- https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

20. Technical Presentations

83 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- PHY
  - 11-15-0579, "Preamble Design and Auto-detection," Hongyuan Zhang (Marvell)
  - 11-15-0580, "11ax Coding Discussion," Hongyuan Zhang (Marvell)
  - 11-15-0602, "HE-LTF squence for UL MU-MIMO," Xiaogang Chen (Intel)
  - 11-15-0810, "HE PHY Padding and Packet Extension," Hongyuan Zhang (Marvell)
  - 11-15-0823, "Preamble Design and Auto-Detection for 11ax," Sungho Moon (Newracom)
  - 11-15-0826, "HE-SIG-A Transmission for Range Extension," Jiayin Zhang (Huawei)
  - 11-15-0853, "Extensible Preamble Format Design," Leonardo Lanante (Kyutech)
  - 11-15-1031, "DL MU Signaling," Katsuo Yunoki (KDDI)
  - 11-15-1051, "HE NDP frame for sounding," Young Hoon Kwon (Newracom)
  - 11-15-1059, "SIG-B Encoding Structure Part II," Ron Porat (Broadcom)
  - 11-15-1066, "HE-SIG-B Contents," Kaushik Josiam (Samsung)
  - 11-15-1068, "Reliable Transmission Scheme for HE-SIG-B and Data," Jianhan Liu (MediaTek)
  - 11-15-1070, "1024 QAM Proposal," Eunsung Park (LG Electronics)
  - 11-15-1071, "Tone Grouping Factors and NDP format for 11ax," Sameer Vermani (Qualcomm)
  - 11-15-1075, "Number of BSS Color bits," Junichi Iwatani (NTT)
  - 11-15-1077, "HE-SIG-A Content," Jiayin Zhang (Huawei)
  - 11-15-1088, "LTF Design for Uplink MU-MIMO," Daewon Lee (Newracom)
  - 11-15-1089, "Considerations on PHY Padding and Packet Extension in 11ax," Yujin Noh (Newracom)
  - 11-15-1091, "Considerations on Range Extension with SIG-A Repetition," Yujin Noh (Newracom)
  - 11-15-1092, "Support of 1x/2x/4x OFDM Symbol in HE SU PPDU," Heejung Yu (Yeungnam Univ.)
  - 11-15-1106, "SIG-B Structure," Reza Hedayat (Newracom)
  - 11-15-1111, "SIG-B Resource Unit Allocation Coding," Amin Jafarian (Newracom)
  - 11-15-1119, "Discussions on HE SIG-A Structure," John Son (Wilus Institute)
  - 11-15-1122, "Identifiers in HE PPDUs for power saving," Alfed Asterjadhi (Qualcomm)

- MAC
  - 11-15-1013, "802.11ae & 802.11ax," Guido R. Hiertz (Ericsson)
  - 11-15-1014, "Multiple BSSID Element," Guido R. Hiertz (Ericsson)
  - 11-15-1015, "Proxy ARB in 802.11ax," Guido R. Hiertz (Ericsson)
  - 11-15-1033, "Data field in HE PPDU," Yongho Seok (Newracom)
  - 11-15-1034, "Notification of Operating Mode Changes," Yongho Seok (Newracom)
  - 11-15-1044, "Further Study of 11ax Multicast," Kazuyuki Sakoda (Sony)
  - 11-15-1052, "Bandwidth for UL MU transmission," Young Hoon Kwon (Newracom)
  - 11-15-1060, "Receive Operating Mode Indication for Power Save," Eric Wong (Apple)
  - 11-15-1063, "11ax Channel access procedure," Chao-Chun Wang (MediaTek)
  - 11-15-1067, "MU TXOP truncation," Jeongki Kim (LG Electronics)
  - 11-15-1096, "Recovery Procedures in Cascading Sequences," John Son (Wilus Institute)
  - 11-15-1098, "ACK/BA frame for UL MU under cascading structure," Narendar Madhavan (Toshiba)
  - 11-15-1114, "Airtime Analysis of EDCA," Sean Coffey (RealTek)
  - 11-15-1115, "High Efficiency in Accessing the Medium," Sean Coffey (RealTek)

- ✧ 11-15-1116, “Trigger Frame Channel Access,” Jinsoo Ahn (Yonsei Univ.)
- ✧ 11-15-1120, “Buffer Status Report,” Alfred Asterjadhi (Qualcomm)
- ✧ 11-15-1121, “HE A-Control field,” Alfred Asterjadhi (Qualcomm)
- ✧ 11-15-1137, “Triggered OFDMA Random Access Observations,” Russell Huang (MediaTek)

- Multi-User
  - ✧ 11-15-1043, “Overall Protocol of UL MU BA for Multicast Transmission,” Kazuyuki Sakoda (Sony)
  - ✧ 11-15-1047, “RU selection process upon TF-R reception,” Stephane Baron (Canon)
  - ✧ 11-15-1053, “Multiuser Block ACK Request (MU-BAR),” Guoqing Li (Apple)
  - ✧ 11-15-1057, “Multiple Resource Unit Allocation for TGax OFDMA,” Kome Oteri (InterDigital)
  - ✧ 11-15-1062, “NAV Consideration for UL MU Response to Trigger frame,” Po-Kai Huang (Intel)
  - ✧ 11-15-1065, “11ax uplink Multi-TID aggregation,” Chao-Chun Wang (MediaTek)
  - ✧ 11-15-1086, “Consideration on multi-STA BA frame indication,” Jing Ma (NICT)
  - ✧ 11-15-1097, “Reducing Channel Sounding Protocol Overhead for 11ax,” Narendar Madhavan (Toshiba)
  - ✧ 11-15-1102, “Fragmentation with MU Operation,” Chittabrata Ghosh (Intel)
  - ✧ 11-15-1103, “DL Sounding Sequence with UL MU Feedback,” Chittabrata Ghosh (Intel)
  - ✧ 11-15-1105, “UL OFDMA-based Random Access Procedure,” Chittabrata Ghosh (Intel)
  - ✧ 11-15-1107, “Power Save with Random Access,” Chittarata Ghosh (Intel)
  - ✧ 11-15-1117, “Regarding UL MU protection,” Woojin Ahn (Yonei Univ.)
  - ✧ 11-15-1123, “Acknowledgement to DL MU,” Liwen Chu (Marvell)
  - ✧ 11-15-1129, “Feedback overhead in DL-MU-MIMO,” Filippo Tosato (Toshiba)

- Spatial Reuse
  - ✧ 11-15-1045, “Dynamic CCA control and TPC Simulation Results with SS1-SS3,” Takeshi Itagaki (Sony)
  - ✧ 11-15-1058, “CCA consideration for UL MU transmission,” Kiseon Ryu (LG Electronics)
  - ✧ 11-15-1069, “Adaptive CCA and TPC,” James Wang (MediaTek)
  - ✧ 11-15-1081, “Further consideration on receive behaviour based on the cascading structure and the BSS color scheme,” Jing Ma (NICT)
  - ✧ 11-15-1082, “Analysis of BSS and ESS Structure During Concurrent SR Transmissions,” Chuck Lukaszewski (Aruba/HP)
  - ✧ 11-15-1083, “Cost/Benefit Analysis of SR Techniques,” Chuck Lukaszewski (Aruba/HP)
  - ✧ 11-15-1101, “DSC/DCCA Calibration with TGax Agreed Scenarios,” Masahito Mori (Sony)
  - ✧ 11-15-1104, “TXOP Considerations for Spatial Reuse,” Reza Hedayat (Newracom)
  - ✧ 11-15-1109, “OBSS NAV and PD Threshold Rule for Spatial Reuse,” Rossi Jun Luo (Huawei)
  - ✧ 11-15-1110, “BSS TXOP,” Amin Jafarian (Newracom)
  - ✧ 11-15-1118, “Discussions on Spatial Reuse Enhancement,” Geonjung Ko (WILUS)
  - ✧ 11-15-1138, “To DSC or not to DSC,” Filip Mestanov (Ericsson)

- Simulation and Calibration and others
  - ✧ 11-15/1039, “Spatial Reuse Measurements,” Chuck Lukaszewski (Aruba Networks, a HP company)
  - ✧ 11-15-1046, “MAC calibration results,” Stephane Baron (Canon)
  - ✧ 11-15-1048, “On TGax Scenario 4 channel model,” Marcin Filo (Univ. of Surrey)
  - ✧ 11-15-1049, “Implications of wrap-around for TGax Scenario 3 and Scenario 4,” Marcin Filo (Univ. of Surrey)
  - ✧ 11-15-1056, “Clarifying Link Level Simulator Assumptions,” Kome Oteri (InterDigital)
  - ✧ 11-15-1087, “MU BFee Interference channel feedback,” Sigurd Schelstraete (Quantenna)
  - ✧ 11-15-1095, “OFDMA performance in 11ax,” Suhwook Kim (LG Electronics)

- ✧ 11-15-1099, "Power Save Simulation Results," Hyeyoung Choi (LG Electronics)
- ✧ 11-15-1100, "Discussion on Deep and Shallow Sleep States," Chittabrata Ghosh (Intel)
- ✧ 11-15-1113, "Box5 Calibration results," Vida Ferdowsi (Newracom)
- ✧ 11-15-1134, "11ax Support for IoT," Shimi Shilo (Huawei)
- ✧ 11-15-1135, "Results for SS6 calibration case for single BSS and OBSS," Esa Tuomaala (Nokia)

Goals for November 2015

- Continue to advance TG documents based on submissions.
  - ➢ Priority to the TG Specification Framework document.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the November 2015 session.
  - ✧ Thursday, October 15th, 10:00 – 12:00 (ET)

July 2015 – Waikoloa, HI

Originally, TGax planned to have nine sessions during the week.
Two more sessions were added during the mid-week plenary session (marked red).
Four out of eleven sessions were ad hoc sessions.

Tuesday		Wednesday		Thursday
				TGax
TGax (PHY)	**TGax (MAC)**			**TGax**
TGax (Multi-User)	**TGax (Spatial Reuse)**	**TGax (PHY)**	**TGax (MAC)**	**TGax**
		TGax (PHY)	**TGax (Multi-User)**	**TGax**
	TGax			

Main documents

- TGax Agenda: 11-15-0735-05, TGax July 2015 Meeting Agenda
  - ➢ TGax PHY ad hoc agenda: 11-15-0898-03, TGax PHY Ad Hoc Jul 2015 Meeting Agenda
  - ➢ TGax MAC ad hoc agenda: 11-15-0888-02, TGax MAC ad hoc July 2015 Meeting Agenda
  - ➢ TGax Multi-User ad hoc agenda: 11-15-0899-02, TGax MU ad-hoc July 2015 Agenda
  - ➢ TGax Spatial Reuse ad hoc agenda: 11-15-0911-01, 802.11ax Spatial Reuse Ad Hoc Group
- Closing report: 11-15-0963-00, TGax July 2015 Closing Report
- Draft TGax minutes: 11-15-0884-00, TGax July 2015 Waikoloa Meeting Minutes
  - ➢ TGax PHY ad hoc meeting minutes: 11-15-0913-00, July 2015 Hawaii PHY Ad Hoc Meeting Minutes
  - ➢ TGax MAC ad hoc meeting minutes: 11-15-0922-01, July 2015 Hawaii TGax MAC Ad hoc Meeting Minutes
  - ➢ TGax Multi-User ad hoc meeting minutes: 11-15-0949-01, July 2015 Hawaii TGax MU Ad hoc Meeting minutes

- TGax Spatial Reuse ad hoc meeting minutes: 11-15-0971-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting

Achievements

21. TG Documents

- **Passed a number of PHY, MAC and MU motions affecting the TGax Specification Framework:**
  - PHY Motions: SIG-A, SIG-B, Pilots, etc.
  - MAC Motions: Trigger frame, etc.
  - MU Motions: Trigger frame for random access, MU CTS, etc.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-07-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-14-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-10-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

22. Technical Presentations

More than 70 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- PHY
  - 11-15-0579, "preamble design and autodetection," Hongyuan Zhang (Marvell)
  - 11-15-0580, "11ax coding discussion," Hongyuan Zhang (Marvell)
  - 11-15-0602, "HE-LTF sequence for UL MU-MIMO," Qinghua Li (Intel)
  - 11-15-0805, "SIG-B field for HEW PPDU," Young Hoon Kwon (Newracom)
  - 11-15-0810, "HE PHY Padding and Packet Extension," Hongyuan Zhang (Marvell)
  - 11-15-0812, "Pilot Design for Data Section," Sameer Vermani (Qualcomm)
  - 11-15-0813, "CP Indication for UL MU Transmission," Zhigang Rong (Huawei)
  - 11-15-0816, "Interleaver and Tone Mapper for OFDMA," Yakun Sun (Marvell)
  - 11-15-0817, "P Matrix for HE-LTF," Yakun Sun (Marvell)
  - 11-15-0819, "11ax OFDMA Tone Plan Leftover Tones and Pilot Structure," Bin Tian (Qualcomm)
  - 11-15-0821, "HE SIG-B Structure," Joonsuk Kim (Apple)
  - 11-15-0822, "SIG-A Structure in 11ax Preamble," Jianhan Liu (MediaTek)
  - 11-15-0823, "Preamble Design and Auto-Detection for 11ax," Sungho Moon (Newracom)
  - 11-15-0824, "Pilot Design for 11ax Downlink Transmissions," Yujin Noh (Newracom)
  - 11-15-0826, "HE-SIG-A transmission for range extension," Jiayin Zhang (Huawei)
  - 11-15-0827, "Considerations on HE-SIG-A and B," Katsuo Yunoki (KDDI Labs)
  - 11-15-0832, "Performance evaluation of SU/MU MIMO in OFDMA," Jiayin Zhang (Huawei)
  - 11-15-0845, "LTF Design for Uplink MU-MIMO," Daewon Lee (Newracom)
  - 11-15-0853, "Extensible Preamble Format Design," Leonardo Lanante (Kyushu Institute of Technology)
  - 11-15-0865, "Discussion of ACI performance and ACI requirements for IEEE 802.11ax," Leif Wilhelmsson (Ericsson AB)
  - 11-15-0868, "Impact of Frequency Selective Scheduling Feedback for OFDMA," Hakan Persson (Ericsson)

- 11-15-0873, "SIG-B Encoding Structure," Ron Porat (Broadcom)
- 11-15-0887, "Efficient padding for last OFDM symbol," Heejung Yu (Newracom)

- MAC
  - 11-15-0615, "DL OFDMA Bandwidth," Liwen Chu (Marvell)
  - 11-15-0803, "Frame Collision Information Management," Peng Shao (NEC Communication Systems)
  - 11-15-0831, "Broadcast and Unicast (Trigger) in DL MU," Liwen Chu (Marvell)
  - 11-15-0841, "Cascading Structure," David Xun Yang (Huawei Technologies)
  - 11-15-0851, "HE Trigger Frame Format," John Son (WILUS Institute)
  - 11-15-0856, "Compressed Uplink Trigger Frame," Vida Ferdowsi (Newracom)
  - 11-15-0871, "Efficiency enhancement for 802.11ax," Guido R. Hiertz (Ericsson)
  - 11-15-0872, "802.11ai and 802.11ax," Guido R. Hiertz (Ericsson)
  - 11-15-0874, "Minimal data rates management frame transmissions in 2.4 GHz," Guido R. Hiertz (Ericsson)
  - 11-15-0876, "Duration and MAC Padding for MU PPDU," Simone Merlin (Qualcomm)
  - 11-15-0877, "Trigger Frame Format," Simone Merlin (Qualcomm)
  - 11-15-0878, "Issues on Trigger Frame Retransmission," Jinsoo Ahn (Yonsei Univ.)
  - 11-15-0880, "Scheduled Trigger frames," Alfred Asterjadhi (Qualcomm)
  - 11-15-0914, "Enlarged minimal contention window size," Guido R. Hiertz (Ericsson)

- Multi-User
  - 11-15-0800, "Multiplexing of Acknowledgements for Multicast Transmission," Yusuke Tanaka (Sony)
  - 11-15-0806, "Protection for MU transmission," Young Hoon Kwon (Newracom)
  - 11-15-0818, "Further Analysis of Feedback and Frequency Selective Scheduling (FSS) for TGax OFDMA," Kome Oteri (InterDigital Communication)
  - 11-15-0829, "Uplink ACK and BA Multiplexing," Reza Hedayat (Newracom)
  - 11-15-0843, "UL MU OFDMA analysis," Yonggang Fang (ZTE)
  - 11-15-0852, "Transmission Interval of Trigger Frames," Leonardo Lanante (Kyushu Institute of Technology)
  - 11-15-0854, "DL OFDMA Signalling," Tomoko Adachi (Toshiba)
  - 11-15-0855, "How to collect STAs' Tx demands for UL MU," Tomoko Adachi (Toshiba)
  - 11-15-0858, "MU BFee Interference channel feedback," Sigurd Schelstraete (Quantenna)
  - 11-15-0859, "A mechanism for incremental updates to MU precoding," Sigurd Schelstraete (Quantenna)
  - 11-15-0867, "MU-RTS/CTS for DL MU," Po-kai Huang (Intel)
  - 11-15-0875, "Random Access with Trigger Frames using OFDMA," Chittabrata Ghosh (Intel)
  - 11-15-0881, "Regarding buffer status of UL-STAs in UL-OFDMA," Woojin Ahn (Yonsei Univ.)

- Spatial Reuse
  - 11-15-0797, "NAV Operation for Spatial Reuse," Yongho Seok (Newracom)
  - 11-15-0801, "DCCA/DSC Reference Simulation Results," Masahito Mori (Sony)
  - 11-15-0804, "Outdoor Enterprise Scenario and DSC," Graham Smith (SR Technologies)
  - 11-15-0807, "DSC Summary," Graham Smith (SR Technologies)
  - 11-15-0811, "Topics for Consideration for Spatial Reuse," Xiaofei Wang (InterDigital)
  - 11-15-0882, "DSC leveraging uplink RTS/CTS control," M. Shahwaiz Afaqui (Technical University of Catalonia)
  - 11-15-0883, "Follow Up Discussion on The Receiver Behavior," Yasuhiko Inoue (NTT)
  - 11-15-0886, "DSC Calibration Results," Chinghwa Yu (MediaTek)

- Simulation and Calibration and others

- ✧ 11-15-0754, "WLAN Packet traffic and efficiency analysis," Jim Lansford (CSR)
- ✧ 11-15-0781, "Summary of Power Save Calibration Results," Eric Wong (Apple)
- ✧ 11-15-0787, "Power Save Calibration Results," Eric Wong (Apple)
- ✧ 11-15-0788, "Box 1 and Box 2 calibration results," Takeshi Itagaki (Sony)
- ✧ 11-15-0789, "Proposed Changes to Evaluation Methodologies," Allan Jones (Activision)
- ✧ 11-15-0802, "Box5 Calibration Results of SS6," Jiyong Pang (Huawei)
- ✧ 11-15-0814, "Simulation Results for Box5 Calibration," Ke Yao (ZTE)
- ✧ 11-15-0833, "Calibration results for PSP and UAPSD for 20, 40 and 80MHz bands," Dmitry Akhmetov (Intel)
- ✧ 11-15-0680, "Reference Box5 Calibration Assumptions and Parameters," Jiyong Pang (Huawei)
- ✧ 11-15-0849, "Simulation Results for Box5 Calibration," Rongzhen Yang (Intel)
- ✧ 11-15-0869, "OFDMA and VoIP Capacity," Hakan Persson (Ericsson)
- ✧ 11-15-0870, "802.11ax in 2.4 GHz," Guido R. Hiertz (Ericsson)
- ✧ 11-15-0885, "Box 5 Calibration Results," ChingHwa Yu (MediaTek)

Goals for September 2015

- Continue to advance TG documents based on submissions.
  - ➢ Priority to the TG Specification Framework document.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the September 2015 session.
  - ✧ Thursday, August 20th, 10:00 – 12:00 (ET)

May 2015 – Vancouver, BC, Canada

TGax had eight sessions during the week. Four out of eight sessions were ad hoc sessions.

	Tuesday		Wednesday		Thursday
					TGax
	TGax (Multi-User)	**TGax (Spatial Reuse)**			
TGax (MAC)	**TGax (PHY)**	**TGax (Spatial Reuse)**	**TGax (PHY)**	**TGax (Multi-User)**	**TGax**
			TGax		

Main documents

- TGax Agenda: 11-15-0500-08, TGax May 2015 Meeting Agenda
  - ➢ TGax PHY ad hoc agenda: 11-15-0640-04, TGax PHY Ad Hoc May 2015 Meeting Agenda
  - ➢ TGax MAC ad hoc agenda: 11-15-0599-02, TGax MAC ad hoc May 2015 Meeting Agenda
  - ➢ TGax Multi-User ad hoc agenda: 11-15-0645-01, TGax MU ad-hoc May 2015 Agenda
  - ➢ TGax Spatial Reuse ad hoc agenda: 11-15-0650-02, 802.11ax Spatial Reuse Ad Hoc Group
- Closing report: 11-15-00692-01, TGax May 2015 Closing Report
- Draft TGax minutes: 11-15-0622-00, TGax May 2015 Vancouver Meeting Minutes
  - ➢ TGax PHY ad hoc meeting minutes: 11-15-0651-02, May 2015 Vancouver PHY Ad Hoc Meeting Minutes

- TGax MAC ad hoc meeting minutes: 11-15-0637-00, May 2015 Vancouver TGax MAC Ad hoc Meeting Minutes
- TGax Multi-User ad hoc meeting minutes: 11-15-0679-00, May 2015 Vancouver Multi-User ad hoc Meeting minutes
- TGax Spatial Reuse ad hoc meeting minutes: 11-15-0662-01, May 2015 Vancouver Spatial Reuse ad hoc Meeting Minutes

Achievements

23. TG Documents

- **Passed a number of PHY and MAC motions affecting the TGax Specification Framework:**
  - PHY Motions: Tone Plans, STF design, SIG-B, etc.
  - MAC Motions: Enhancing multi-STA BA and aspects of the trigger frame
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-05-00ax-spec-framework.docx
- **Approved new revisions of the TGax Evaluation Methodology documents.**
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0571-09-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0980-12-00ax-simulation-scenarios.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

24. Technical Presentations

More than 50 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- PHY
  - 11-15/0550, "L-preamble issues for UL-OFDMA," Katsuo Yunoki (KDDI Labs)
  - 11-15/0553, "Enhancing Performance of Hybrid-ARQ with Linear Constellation Precoding," Muhammad Mehboob Fareed (King Abdullah Univ. of Science and Technology)
  - 11-15/0569, "Performance of 1x, 2x, and 4x HE-LTF," Kome Oteri (InterDigital)
  - 11-15/0572, "Inefficiency of 256-FFT per 20MHz," Heejung Yu (Yeungnam Univ./Newracom)
  - 11-15/0574, "SIG structure for UL PPDU," Young Hoon Kwon (Newracom)
  - 11-15/0575, "Preamble Structure in 802.11ax," Yujin Noh (Newracom)
  - 11-15/0577, "Pilot Design for 11ax," Daewon Lee (Newracom)
  - 11-15/0579, "Preamble design and auto-detection," Hongyuan Zhang (Marvell)
  - 11-15/0580, "11ax coding discussion," Hongyuan Zhang (Marvell)
  - 11-15/0584, "Considerations on LTF Sequence Design," Sungho Moon (Newracom)
  - 11-15/0600, "Non Uniform Constellations for 1024QAM," Daniel Schneider (Sony)
  - 11-15/0602, "HE-LTF sequence for UL MU-MIMO," Qinghua Li (Intel)
  - 11-15/0621, "Design Principles for HE Preamble," John Son (WILUS)
  - 11-15/0381, "HE-STF Proposal," Yakun Sun (Marvell)

- MAC
  - 11-15/0567, "Multi-STA BA for SU Transmissions," Xiaofei Wang (InterDigital)
  - 11-15/0604, "Random Access with Trigger Frames using OFDMA," Chittabrata Ghosh (Intel)
  - 11-15/0611, "Multi-STA Block ACK Protection," Jinsoo Ahn (Yonsei Univ.)
  - 11-15/0615, "UL OFDMA Bandwidth," Liwen Chu (Marvell)
  - 11-15/0617, "Duration and MAC Padding for UL MU PPDUs," Gang Ding (Qualcomm)
  - 11-15/0626, "Further consideration for Multi-STA Block ACK frame," Jeongki Kim (LG)

- Multi-User
  - 11-15/0378, "Channel Sensing in UL OFDMA," Reza Hedayat (Newracom)
  - 11-15/0568, "Frequency Selective Scheduling (FSS) for TGax OFDMA," Kome Oteri (InterDigital)
  - 11-15/0586, "Frequency Diversity Options in OFDMA," Reza Hedayat (Newracom)
  - 11-15/0587, "Uplink ACK and BA Multiplexing," Reza Hedayat (Newracom)
  - 11-15/0597, "Beamformed HE PPDU," Yongho Seok (Newracom)
  - 11-15/0608, "Regarding trigger frame in UL MU," Tomo Adachi (Toshiba)
  - 11-15/0612, "Multi Channel availability for UL-OFDMA," Woojin Ahn (Yonsei Univ.)

- Spatial Reuse
  - 11-15/0543, "Simulation Scenario changes for Frequency Re-use," Graham Smith (SR Technologies)
  - 11-15/0544, "Proposed text additions to 14/980 for frequency re-use," Graham Smith (SR Technologies)
  - 11-15/0548, "Enterprise Scenario and DSC," Graham Smith (SR Technologies)
  - 11-15/0588, "CCA revisited II," Amin Jafarian (Newracom)
  - 11-15/0595, "Discussion on The Receiver Behavior for CCAC/DSC with BSS Color," Yasuhiko Inoue (NTT)

- Simulation and Calibration
  - 11-15/0551, "OBSS Preamble Detection," Suhwook Kim (LG Electronics)
  - 11-15/0552, "IEEE 802.11 performance in dense, cellular-like, outdoor deployments," Richard Edgar (Imagination Technologies)
  - 11-15/0330, "OFDMA Numerology and Structure," Sharnaz Azizi (Intel)
  - 11-15/0583, "OBSS Preamble Error Probability," Jiyong Pan (Huawei)
  - 11-15/0590, "Traffic Model Updates to Evaluation Methodology," Phil Barber (Huawei)

  - ~~11-14/1392, "Simulation results for Box-5 calibration," Suhwook Kin (LG Electronics)~~
  - 11-15/0674, "Joint submission for Box 5 Calibration," Suhwook Kin (LG Electronics)
  - 11-15/0581, "LSP Correlation Clarification for Scenario 4," Daewon Lee (Newracom)
  - 11-15/0582, "Clarifications to Box 2 MIMO simulation calibrations," Daewon Lee (Newracom)
  - 11-15/0373, "Mixed traffic configurations on simulation scenarios," Yingpei Lin (Huawei)
    - Not presented since the contents of this submission was merged into 11-15/0590.
  - 11-15/0610, "Simulation Results for Box 5 Calibration," Vida Ferdowsi (Newracom)
  - 11-15/0613, "Box 5 Calibration Result," Chinghwa Yu (MediaTek)
  - 11-15/0623, "TGax simulation scenario "Box 5" – calibration results," Guido Hiertz (Ericsson)

  - 11-15/0316, "Power Save Calibrations," Hyeyoung Choi (LG Electronics)
  - 11-15/0564, "802.11ax Calibration and Modeling Adjacent Channel Interference," Naveen Kakani (CSR)
  - 11-15/0576, "Latency and Power Consumption in State Transitions," Chittabrata Ghosh (Intel)
  - 11-15/0592, "More Power Save Calibration Results," Eric Wong (Apple)
  - 11-15/0598, "U-APSD Enhancement for HE," Jarkko Kneckt (Nokia)
  - 11-15/0603, "Calibration Results for PSP and U-APSD," Chittabrata Ghosh (Intel)

Goals for July 2015

- Continue to advance TG documents based on submissions.

- Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the July 2015 session.
  - Thursday, June 18th, 10:00 – 12:00 (ET)

March 2015 – Berlin, Germany

The original plan was to have nine sessions during the week, but one more session was added (Wednesday PM2).

Monday	Tuesday	Wednesday	Thursday
TGax (ad hoc)		**TGax (MU/Spatial Reuse)**	**TGax**
	TGax (PHY/MAC)		
TGax	**TGax**	**TGax**	**TGax**
		TGax	
	TGax		

Main documents

- Agenda: 11-15/0235r8, TGax March 2015 Meeting Agenda
- Closing report: 11-15/0465r0, TGax March 2015 Closing Report
- Minutes: 11-15/0309r1, TGax March 2015 Berlin Meeting Minutes

Achievements

25. Passed a number of motions affecting the TG specification framework:

- PHY motions related to LTF design and SIG-B.
- MAC motions related to Multi-User Block ACK and Multi-User Procedure
- MU motions related to ACK multiplexing
- Etc.

26. TG Documents.

- Approved new revisions of Simulation Scenarios and Evaluation Methodology TG documents.
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0571-08-00ax-evaluation-methodology.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0980-09-00ax-simulation-scenarios.docx
- Other TG documents.
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

27. Technical Presentations

Following technical submissions have been covered during the week.

- MAC
  - 11-15/0320, "GCR-BA with Measurement Report Performance in OBSS," Yuichi Morioka (SONY)

- 11-15/0336, "MAC Overhead Analysis of MU Transmissions," Xiaofei WANG (InterDigital)
- 11-15/0362, "Beacon Transmission Issues," Yonggang Fang (ZTE)
- 11-15/0365, "UL MU Procedure," Kiseon Ryu (LG Electronics)
- 11-15/0366, "Multi-STA BA," Simone Merlin (Qualcomm)
- 11-15/0376, "UL-MU MAC Throughput Under Non-Full Buffer Traffic," Tatsumi Uwai (Radrix Co. Ltd)

- Spatial Reuse
  - 11-15/0300, "Potential of Modified Signal Detection Thresholds," Gustav Wikstrom (Ericsson AB)
  - 11-15/0318, "CCA Regime Evaluation Revisited," Amin Jafarian (Newracom Inc.)
  - 11-15/0319, "Impact of TPC coupled to DSC for legacy unfairness issue," Masahito Mori (Sony)
  - 11-15/0338, "Discussions on the Definition of CCA Threshold," Akira Kishida (NTT)
  - 11-15/0367, "OBSS preamble detection," Gwen Barriac (Qualcomm)
  - 11-15/0371, "Proposal and simulatin based evaluation of DSC-AP Algorithm," Eduard Garcia-Villegas (UPC)
  - 11-15/0374, "Further Considerations on Legacy Fairness with Enhanced CCA," John Son (WILUS Institute)

- PHY
  - 11-15/0305, "Effective Subcarrier Assignment for DL-OFDMA," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-15/0330, "OFDMA Numerology and Structure," Shahrnaz Azizi (Intel Corporation)
  - 11-15/0344, "SIG field design principle for 11ax," Young Hoon Kwon (Newracom)
  - 11-15/0349, "HE-LTF Proposal," Hongyuan Zhang (Marvell)
  - 11-15/0358, "Numerology for 11ax," Daewon Lee (Newracom)
  - 11-15/0360, "Preamble Auto-Detection for 802.11ax," Sungho Moon (NEWRACOM)
  - 11-15/0364, "11ax Preamble design: training sequence," Sigurd Schelstraete (Quantenna)
  - 11-15/0375, "Minimum Resource Granularity in OFDMA," John Son (WILUS Institute)
  - 11-15/0378, "Channel Sensing in UL OFDMA," Reza Hedayat (Newracom)
  - 11-15/0380, "Discussion on OFDMA scheduling for 802.11ax," Le Liu (Huawei Technologies)
  - 11-15/0381, "HE-STF Proposal," Yakun Sun (Marvell)
  - 11-15/0383, "Impact of number of sub-channels in OFDMA," Leif Wilhelmsson (Ericsson)

- Multi-User
  - 11-15/0331, "Uplink Multi-User MIMO Protocol Design," Yongho Seok (NEWRACOM)
  - 11-15/0333, "Throughput Comparison of Some Multi-user Schemes in 802.11ax," Kome Oteri (InterDigital)
  - 11-15/0336, "MAC Overhead Analysis of MU Transmissions," Xiaofei WANG (InterDigital)
  - 11-15/0353, "OFDMA Non-contiguous Channel Utilization," Jinsoo Ahn (Yonsei univ.)
  - 11-15/0354, "Bandwidth granularity on UL-OFDMA data allocation," Woojin Ahn (Yonsei Univ.)
  - 11-15/0363, "UL MU Synchronization Requirements," Yonggang Fang (ZTE)
  - 11-15/0377, "Considerations on UL MU Resource Scheduling," Leonardo Lanante (Kyutech)
  - 11-15/0379, "DL OFDMA Performance and ACK Aggregation," Reza Hedayat (Newracom)
  - 11-15/0384, "Discussion on DL-OFDMA Sub-channel Indication Method," Yu Cai (Lenovo)

- Simulation and Calibration
  - 11-14/1392, "Simulation results for Box-5 calibration," Suhwook Kim (LG Electronics)
  - 11-14/1434, "SLS Box4 Calibration Results," Russell Huang (MediaTek Inc.)

- 11-15/0053, "Box5 Results of 11ac SS6," Jiyong Pang 'Huawei)
- 11-15/0072, "U-APSD power saving calibration results," Yanchun Li (Huawei)
- 11-15/0125, "Box 1 and Box 2 Calibration Results," Ron Porat (Broadcom)
- 11-15/0304, "Evaluating Power Save Performance," Joonsuk Kim (Apple)
- 11-15/0306, "Power Save Mode Calibration Results," Eric Wong (Apple)
- 11-15/0307, "MAC calibration results for Test 4," Ke Yao (ZTE Corp.)
- 11-15/0308, "Simulation results for box 5," Ke Yao (ZTE Corp.)
- 11-15/0314, "Sleep States in IEEE 802.11ax Simulation Scenarios," Chittabrata Ghosh (Intel)
- 11-15/0316, "Power Save Calibration," Hyeyoung Choi (LG)
- 11-15/0326, "U-APSD Enhancements for HE," Jarkko Kneckt (Nokia)
- 11-15/0327, "Microsleep for HE STA," Jarkko Kneckt (Nokia)
- 11-15/0343, "In Situ Frame Size Measurements," Chuck Lukaszewski (Aruba Networks)
- 11-15/0351, "Empirical Measurements of Channel Degradation Under Load," Chuck Lukaszewski (Aruba Networks)
- 11-15/0357, "Scenario 1 CCA Simulation," Knut Odman (Broadcom Corporation)
- 11-15/0359, "Clarification of MIMO Box2 calibration," Jaehyun Ahn (Newracom)
- 11-15/0368, "Box 5 results for Single BSS Calibration Case," Esa Tuomaala (Nokia)
- 11-15/0369, "MAC calibration test 4 simulation results," Enrico-Henrik Rantala (Nokia)
- 11-15/0370, "MAC Calibration Results," Guoqing Li (Apple)
- 11-15/0372, "Corrections on Reference Traffic Profile for Scenario 2 in Simulation Scenarios Document," Yingpei Lin (Huawei)
- 11-15/0373, "Mixed traffic configurations on simulation scenarios," Yingpei Lin (Huawei)
- 11-15/0382, "MAC calibration test 4 simulation results," Yanchun Li (Huawei)
- 11-15/0441, "Proposed text to TGax Simulation Scenarios MAC test 4," Enrico-Henrik Rantala (Nokia)

Goals for May 2015

- Continue to advance TG documents based on submissions.
  - Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

- Two teleconferences are planned before the May 2015 session.
  - Thursday, April 9th, 10:00 – 12:00 (ET)
  - Thursday, April 30th, 20:00 – 22:00 (ET)

January 2015 – Atlanta, GA

The original plan was to have nine sessions during the week, but one session was cancelled.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax**	**TGax**
AM2	**TGax**	**TGax**		
PM1	**TGax**	**TGax**	**TGax**	**TGax (canceled)**
PM2				
PM3	**TGax**			

Main documents

- Agenda: 11-14/1578r6, TGax January 2015 Meeting Agenda
- Closing report: 11-15/0186r0, TGax January 2015 Closing Report
- Draft minutes: 11-15/0090r0, TGax January 2015 Atlanta Meeting Minutes

Achievements

28. TG Structure

- Ad hoc chairs elected.

MAC	PHY	MU	Spatial Reuse
Eric Wong (Apple)	Bo Sun (ZTE)	Sigurd Schelstraete (Quantenna)	Laurent Cariou (Orange)
Reza Hedayat (NEWRACOM)	Jianhan Liu (MediaTak)	Kiseon Ryu (LG Electronics)	Guido Hiertz (Ericsson AB)
Brian Hart (Cisco)	Yakun Sun (Marvell)	Kaushik Josiam (Samsung)	Jae Seung Lee (ETRI)

29. TG Documents.

- Passed a number of motions affecting the TG specification Framework.
- Approved new revisions of Simulation Scenarios and Evaluation Methodology TG documents.
  - ✧ TGax Simulation Scenarios (11-14/0980r6)
  - ✧ TGax Evaluation Methodology (11-14/0571r7).

30. Technical Presentations

Following technical submissions have been covered during the week.

- DSA and CCA
  - ✧ 15/0025, "DSC and Roaming," Graham Smith (SR Technologies)
  - ✧ 15/0027, "Simulation Based Evaluation DSC in residential scenario," M. Shahwaiz Afaqui (UPC)
  - ✧ 15/0045, "Performance Analysis of BSS Color and DSC," Masahito Mori (Sony)
  - ✧ 15/0050, "Modeling components impacting throughput gain from CCAT adjustment," Yu Wang (Ericsson AB)
  - ✧ 15/0085, "Legacy Fairness Issues of Enhanced CCA," John Son (WILUS Institute)
  - ✧ 15/0105, "Dynamic CCA Management," Sean Coffey (RealTek)

- OFDMA
  - ✧ 15/0034, "DL-OFDMA Map Frame," Katsuo Yunoki (KDDI Labs)
  - ✧ 15/0066, "Downlink OFDMA Protocol Design," Yongho Seok (Newracom)
  - ✧ 15/0079, "OFDM Numerology for 11ax," Daewon Lee (Newracom)
  - ✧ 15/0091, "UL-OFDMA Procedure in IEEE 802.11ax," Woojin Ahn (Yonsei Univ.)
  - ✧ 15/0092, "DL-OFDMA Procedure in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ.)

- MU
  - ✧ 15/0010, "draft for integrated UL DL MU MIMO Frame Format," Tae-Yoon Kim (Korea Univ.) – Not presented
  - ✧ 15/0029, "Discussion on integrated UL/DL MU-MIMO," Tae-Yoon Kim (Korea Univ.) – Not presented
  - ✧ 15/0040, "Discussion on integrated UL-DL MU-MIMO-MAC," TaeYoon Kim (Korea Univ.)
  - ✧ 15/0064, "Consideration on UL-MU overheads," Tomoko Adachi (Toshiba)
  - ✧ 15/0086, "Uplink MU Transmission and Legacy Coexistence," Reza Hedayat (NEWRACOM)
  - ✧ 15/0089, "MAC Efficiency Gain of Uplink Multi-user Transmission," Leonardo Lanante Jr (Kyushu Inst. of Tech.)

- MAC
  - 15/0035, "Scalable Channel Utilization," Katsuo Yunoki (KDDI R&D Laboratories)
  - 15/0037, "Structural Format Change," Kyonggi University
  - 15/0046, "11aa GCR-BA Performance in OBSS," Yuichi Morioka (Sony)
  - 15/0059, "Uplink RTS/CTS Control," Sigurd Schelstraete (Quantenna)

- PHY
  - 15/0048, "Non-Uniform Constellations for Higher Order QAMs," Daniel Schneider (Sony)
  - 15/0068, "Support of outdoor environments," Young Hoon Kwon (NEWRACOM)
  - 15/0079, "OFDM Numerology for 11ax," Daewon Lee (NEWRACOM)
  - 15/0081, "Considerations on 11ax Auto-detection Methods," Jaeyoung Song (KAIST)
  - 15/0082, "Considerations on 11ax OFDMA Frequency Granularity," Young-bin Kim (KAIST)
  - 15/0097, "Performance Analysis of Frequency Selective Scheduling," Ningbo Zhang (BUPT)
  - 15/0099, "Payload Symbol Size for 11ax," Sriram Venkateswaran (Broadcom)
  - 15/0101, "Preamble structure for 11ax system," Jiayin Zhang (Huawei)

- Simulation Scenario and Evaluation Methodology
  - 14/1342, "MAC Calibration Results," Igor Kim (ETRI)
  - 14/1343, "Multicast Scenarios for MAC Calibration," Igor Kim (ETRI)
  - 14/1392, "Simulation Results for Box-5 Calibration," Suhwook Kim (LGE)
  - 14/1523, "Offline Discussion Minutes of SLS Calibration," Jiyong Pang (Huawei)
  - 14/1590, "Multi-wall penetration loss model for HEW system level simulation," Kejun Zhao et al. (National Engineering Research Center for Broadband Networks & Applications)
  - 14/1597, "PHY abstraction and performance for outdoor channel models," Kejun Zhao et al. (National Engineering Research Center for Broadband Networks & Applications)
  - 15/0022, "MAC Calibration Results," Xiaofei Wang (InterDigital)
  - 15/0044, "Proposed Changes to Simulation Scenarios," Masahito Mori (Sony)
  - 15/0051, "Box5 Calibration Results," Jiyong Pang (Huawei)
  - 15/0052, "Box5 Results of One BSS Case," Jiyong Pang (Huawei)
  - 15/0053, "Box5 Results of 11ac SS6," Jiyong Pang (Huawei)
  - 15/0061, "FPS Network Traffic Model," Allan Jones (Activision)
  - 15/0065, "11ax EMD Revision Straw Poll," Jiyong Pang (Huawei)
  - 15/0071, "MAC calibration test 4 results," Yanchun Li (Huawei)
  - 15/0072, "U-APSD power saving calibration results," Yanchun Li (Huawei)
  - 15/0073, "Simulation Results of Box5," Ke Yao (ZTE)
  - 15/0078, "Clarification on calibration test cases," Guoqing Li (Apple)
  - 15/0080, "MAC Calibration Results," Geonjung Ko (WILUS Institute)
  - 15/0093, "Text Update on PHY Abstraction and SP," Yakun Sun (Marvell)
  - 15/0103, "Power Save Calibration," Yarkko Kneckt (Nokia)
  - 15/0104, "SLS MAC Test 4 Results," Chinghwa Yu (MediaTek)

- Others
  - 15/0043, "In-band Full Duplex Radios and System Performance," Kapseok Chang (ETRI)
  - 15/0075, "Operating Rules for TGax Ad Hoc groups," Osama Aboul-Magd (TGax chair)
  - 15/0076, "Field Sample OBSS and Client Data," Carol Ansley (ARRIS Group)

Goals for March 2015

- Continue to advance TG documents.
  - Expectation is more submissions affecting the TG specification framework document will be considered.

- Technical Presentations.

Teleconferences

- One teleconference is planned before the March 2015 session.
  - ✧ Thursday, February 26th, 10:00 – 12:00 (ET)

November 2014 – San Antonio, TX

The original plan was to have nine sessions during the week, but one session was cancelled.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax (ad hoc)**			**TGax**
AM2		**TGax**		
PM1		**TGax**	**TGax**	**TGax**
PM2	**TGax**	**TGax**		
PM3		**TGax (cancelled)**		

Main documents

- Agenda: 11-14/1319r7, TGax November 2014 Meeting Agenda
- Closing report: 11-14/1536r0, TGax November 2014 Closing Report
- Draft minutes: 11-14/1460r0, TGax November 2014 Meeting Minutes

Achievements

31. Discussions on the TG Structure

- The TG approved a motion to create four ad hoc groups.
  - ✧ PHY, MAC, Multiuser and Spatial Reuse
- The TG approved a motion to have 3 co-chairs for each of the ad hocs.
- Ad hoc chairs election is scheduled for January 2015 meeting on Tuesday.
- Ad hoc meetings will start on March 2015
- Robert Stacy (Intel) was appointed as the technical editor of the TGax.

32. TG Documents – The group approved updated documents.

- The group approved the first version of TGax Specification Framework document (11-14/1453r2).
- The group approved new revisions of the following documents.
  - ✧ TGax Simulation Scenarios (11-14/0980r5)
  - ✧ TGax Evaluation Methodology (11-14/0571r6).

33. Technical Presentations

About 35 technical submissions covered during the week.

- Evaluation Methodology
  - ✧ 11-14/1388, "Consideration on PER Prediction for PHY Abstraction," Bo Sun (ZTE Corp)
  - ✧ 11-14/1418, "Further Study of Time Varying Interference and PHY Abstraction," Yakun Sun (Marvell)
  - ✧ 11-14/1420, "The Impact of Preamble Error on MAC System Performance," Po-Kai Huang (Intel)

- 11-14/1424, "Proposed Changes to Evaluation Methodology and Simulation Scenario," Yuichi Morioka (Sony)
- 11-14/1440, "A Few Corrections to Video Traffic Model," Guoqing Li (Apple)

- Simulation Scenarios and Calibration
  - 11-14/1177, "Discussion about Box5 Calibration," Jiyong Pang (Huawei)
  - 11-14/1342, "MAC Calibration Results," Igor Kim (ETRI)
  - 11-14/1343, "Multicast Scenarios for MAC Calibration," Igor Kim (ETRI)
  - 11-14/1392, "Simulation results for Box 5 calibration," Suhwook Kim (LG Electronics)
  - 11-14/1402, "Box1 and Box3 calibration results," Masahito Mori (Sony)
  - 11-14/1419, "SLS Box5 Calibration Results and Discussions," Yakun Sun (Marvell)
  - 11-14/1434, "TGax SLS Box4 Calibration Results," Russell Huang (MediaTek Inc.)
  - 11-14/1441, "Simulation Setting of Box5 Calibration," Jiyong Pang (Huawei)
  - 11-14/1444, "Energy Efficiency Evaluation and Simulation Model," Chinghwa Yu (MediaTek)
  - 11-14/1449, "MAC Calibration Results," Newracom
  - 11-14/1450," Box 0 calibration results," Hongsup Lee (Newracom)
  - 11-14/1451, "Box 1 and Box 2 Calibration Results," Jaehyun Ahn (Newracom)

- Technology/Others
  - 11-14/1228, "Issues on 256-FFT per 20MHz," Heejung Yu (NEWRACOM/YU)
  - 11-14/1380, "Efficiency Measurement for RTS/CTS," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1381, "Novel RTS/CTS Procedure," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1382, "Responses to the comments on doc.1169," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1397, "Discussion on Frame Structure for Future WLAN Systems with OFDMA," Myeong-Jin Kim (Korea University)
  - 11-14/1403, "Performance Analysis of BSS Color and DSC," Masahito Mori (Sony)
  - 11-14/1404, "11aa GCR-BA Performance in OBSS," Yuichi Morioka (Sony)
  - 11-14/1416, "Observed protocol violations caused by DSC with roaming STAs," Chuck Lukaszewski (Aruba Networks)
  - 11-14/1417, "HEW PPDU Transmission Discussion," Yongho Seok (NEWRACOM)
  - 11-14/1426, "DSC and legacy coexistence," Gustav Wikstrom et al. (Ericsson)
  - 11-14/1427, "DSC Performance," Gustav Wikstrom et al. (Ericsson)
  - 11-14/1428, "Clear Channel Assessment for OFDMA PHY," K. C. Chen (NTU) and D. J. Deng (NCUE)
  - 11-14/1431, "Issues on UL-OFDMA Transmission," Young Hoon Kwon (Newracom)
  - 11-14/1433, "Protocol and signaling framework for OFDMA," Sigurd Schelstraete (Quantenna)
  - 11-14/1435, "Considerations on OBSS Spatial Re-Use," Jianhan Liu (Mediatek Inc.)
  - 11-14/1436, "Overhead Analysis for Simultaneous Downlink Transmissions," Pengfei Xia (interdigita)
  - 11-14/1437, "Efficient Wider Bandwidth Operation in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
  - 11-14/1439, "Preamble Considerations in Large Channel Delay Spread Scenarios," Daewon Lee (Newracom)
  - 11-14/1442, "Considerations on DL OFDMA control mechanism," Woojin Ahn (Yonsei Univ.)
  - 11-14/1443, "Adapting CCA and Receiver Sensitivity," Esa Tuomaala (Nokia)
  - 11-14/1446, "Analysis of frequency and power requirements for UL-OFDM," Leif Wilhelmsson (Ericsson)
  - 11-12/1448, "Considerations for Adaptive CCA," Reza Hedayat (Newracom)
  - 11-14/1452, "Frequency selective scheduling in OFDMA," Leif Wilhelmsson (Ericsson)

- Specification Framework
  - ✧ 11-14/1429, "Proposed 802.11ax specification framework document," Minho Cheong (Newracom)
  - ✧ 11-14/1432, "Proposed 802.11ax specification framework – background," Minho Cheong (Newracom)
  - ✧ 11-14/1447, "Proposed Spec Framework Document for 11ax considering potential tech features," John Son (WILUS Institute), Young Doo Kim (SK Telecom)
  - ✧ 11-14/1453, "Spec Framework Proposal," Robert Stacey (Intel)

Goals for January 2015

- Elect ad hoc chairs – 3 co-chairs/ad hoc group as agreed.
- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the January 2015 session.
  - ✧ Thursday, December 4th, 10:00 – 12:00 (ET)
    - ➢ Chair had sent out call for submissions on the TGax reflector.

September 2014 – Athens, Greece

TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**TGax**
AM2	**TGax**	**TGax**		
PM1		**TGax**	**TGax**	**TGax**
PM2	**TGax**	**TGax**		
PM3	**TGax**			

Main documents

- Agenda: 11-14/1033r5, TGax September 2014 Meeting Agenda
- Closing report: 11-14/1304r0, TGax September 2014 Closing Report
- Draft minutes: 11-14/1159r1, TGax September 2014 Meeting Minutes

Achievements

34. The group elected two vice chairs and discussed about the TG structure.

- Election of Vice Chairs took place during this meeting. The TG Vice Chairs are:
  - ✧ Simone Merlin (Qualcomm)
  - ✧ Ron Porat (Broadcom)
- The group started discussion on the Ad Hoc groups. Discussion will continue in future meetings.

35. The group approved minutes from the July 2014 San Diego meeting.

- 11-14/0864r0, July 2014 San Diego Meeting Minutes

36. TG Documents – The group approved updated documents.

- The TGax Simulation Scenarios (11-14/0980r4) and the TGax Evaluation Methodology (11-14/0571r5).
- The TGax Channel Model document (11-14-0882r4).
- The TGax Functional Requirements document (11-14-1009r2).

37. Technical Presentations

54 submissions were uploaded on the server and 52 of them were covered during the week.

- Functional Requirements
  - 11-14/0636, "Discussion on Functional Requirements," David Xun Yang (Huawei Technologies)
  - 11-14/0920, "Considerations of Functional Requirements Documents," David Xun Yang (Huawei Technologies)
  - 11-14/1009, "Proposed 802.11ax Functional Requirements," Lei Wang (Marvell)
  - 11-14/1164, "Meaningful 11ax Functional Requirements," Joe Kwak (InterDigital)
  - 11-14/1167, "TGax Functional Requirement Discussion," Yonggang Fang (ZTE)
  - 11-14/1170, "Functional Requirements Discussions on Coex with Legacy STAs," Masahito Mori (Sony)
  - 11-14/1234, "Requirements Discussion," Joseph Levy (InterDigital)

- Simulation Scenarios and Calibration
  - 11-14/0800, "Box 1 and Box 2 Calibration Results," Nihae Jindal (Broadcom)
  - 11-14/1147, "MAC Simulator Calibration Results," Shoko Shinohara, Akira Kishida (NTT)
  - 11-14/1175, "MAC Calibration results," Suhwook Kim (LG Electronics)
  - 11-14/1177, "Discussion about Box5 Calibration," Jiyong Pang (Huawei Technologies)
  - 11-14/1187, "The Effect of Preamble Error Model on MAC Simulator," Po-Kai Huang (Intel)
  - 11-14/1191, "MAC calibration results," Zhou Lan (Huawei Technologies)
  - 11-14/1192, "MAC calibration results comparison," Zhou Lan (Huawei Technologies)
  - 11-14/1198, "Additional Test Cases for MAC calibration," Gwen Barriac (Qualcomm)
  - 11-14/1217, "MAC Calibration Results for Test 1 and 2," Esa Tuomaala (Nokia)
  - 11-14/1223, "Stadium Measurements," Brian Hart (Cisco Systems)
  - 11-14/1226, "SLS Box 1&2 Calibration Results," Russell Huang (MediaTek)
  - 11-14/1230, "MAC Calibration Result," Chinghwa Yu (MediaTek)

- Evaluation Methodology
  - 11-14/1161, "Parameters for Power Save Mechanisms," Eric Wong (Apple)
  - 11-14/1162, "Energy Efficiency Evaluation Methodology Follow Up," Eric Wong (Apple)
  - 11-14/1174, "PHY Abstraction with Time Varying Interference," Yakun Sun (Marvell)
  - 11-14/1176, "PHY abstraction tables for 11ax system level simulation," Jiayin Zhang (Huawei Technologies)
  - 11-14/1221, "Traffic Generator for OBSS Calibration Case," Chao-Chun Wang (MediaTek)

- Channel Model
  - 11-14/1214, "Impact of correlated shadowing in 802.11ax system evaluations," Leif Wilhelmsson (Ericsson AB)
  - 11-14/1222, "Doppler Effect Evaluation for 11ax," Jianhan Liu (MediaTek)

- Technology/Others
  - 11-14/1106, "WLAN Frame Collision Information," Peng Shao (NEC Communication Systems)
  - 11-14/1148, "Consideration of asynchronous interference in OBSS environment," Koichi Ishihara (NTT)
  - 11-14/1168, "802.11 TGax PHY Frame Structure Discussion for Enabling New Contention Mechanism," Yonggang Fang (ZTE)
  - 11-14/1169, "DL-FDMA considerations," Katsuo Yunoki (KDDI R&D Labs.)
  - 11-14/1171, "DSC Simulation Results for Scenario 3," Masahiro Mori (Sony)
  - 11-14/1172, "Multicast Performance in OBSS," Yuichi Morioka (Sony)
  - 11-14/1178, "Inter-BSS interference in WLANs," Hyunduk Kang (ETRI)

- 11-14/1179, "Considerations for Partial Band Interference between WLAN Systems," Gwangzeen Ko (ETRI)
- 11-14/1180, "Discussions on Interference between TD-LTE & WLAN around 2.4GHz Band," Meng Yang (CATR)
- 11-14/1181, "Measurements on A-MPDU performances under various channel conditions," John Sun (WILUS Institute)
- 11-14/1186, "Comparisons of Simultaneous Downlink Transmissions," Pengfei Xia (InterDigital)
- 11-14/1190, "Frame Exchange Control for Uplink Multi-user transmission," Kaying Lv (ZTE)
- 11-14/1199, "Effect of CCA in residential scenario part 2," Gwen Barriac (Qualcomm)
- 11-14/1207, "OBSS reuse mechanism which preserves fairness," Laurent Cariou (Orange)
- 11-14/1208, "MAC considerations on 802.11ax OFDMA," Jinsoo Ahn (Yonsei Univ.)
- 11-14/1209, "Multiple RF operation for 802.11ax OFDMA," Woojin Ahn (Yonsei Univ.)
- 11-14/1210, "HEW PPDU Format for Supporting MIMO-OFDMA," Yongho Seok (NEWRACOM)
- 11-14/1211, "ACK Procedure for OFDMA," Yongho Seok (NEWRACOM)
- 11-14/1216, "Consideration on Coexistence between LTE-U and 802.11 WLAN," Jae Seung Lee (ETRI)
- 11-14/1224, "Link-Aware CCA," Brian Hart (Cisco Systems)
- 11-14/1225, "Considerations on CCA for OBSS Opearation in 802.11ax," Luo Jun (Huawei Technologies)
- 11-14/1227, "OFDMA Performance Analysis," Tianyu Wu (MediaTek)
- 11-14/1128, "Issues on 256-FFT per 20MHz," Heejung Yu (NEWRACOM)
- 11-14/1229, "Dynamic OFDM Symbol Duration," Alan Jauh (MediaTek)
- 11-14/1232, "On MU Aggregation Mechanisms for 11ax," Reza Hedyat (NEWRACOM)
- 11-14/1233, "Adaptive CCA for 11ax," Reza Hedyat (NEWRACOM)

Goals for November 2014

- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the November 2014 session.
  - Thursday, October 9th, 10:00 – 12:00 (ET)
    - Chair had sent out call for submissions on the TGax reflector.

July 2014 – San Diego, CA

TGax had ten sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax**		**TGax**	**TGax**
AM2		**TGax**		
PM1			**TGax**	**TGax**
PM2	**TGax**	**TGax**	**TGax**	
PM3		**TGax**		

Main documents

- Agenda: 11-14/0748r6, TGax July 2014 Meeting Agenda

- Closing report: 11-14/0984r1, TGax July 2014 Closing Report
- Draft minutes: 11-14/0864r0, July 2014 Meeting Minutes

Achievements

38. The group discussed on the TG structure.

- The group will have two vice chairs to be election during the initial meeting slot of TGax in September 2014.
  - ✧ Chair has sent out the call for nominations to the reflector.
- The group will have some ad hoc groups in the future, however, the discussion on the ad hoc structure was deferred.

39. The group approved minutes from the May 2014 Waikoloa meeting and Teleconference on July 2nd, 2014.

- 11-14/0655r3, May 2014 Waikoloa Meeting Minutes
- 11-14/0788r2, Minutes from the teleconference on July 2nd, 2014

40. TG Documents – The group discussed and approved following documents as current TG documents.

- The group approved new version of the Simulation Scenarios (11-14/0980r1) and Evaluation Methodology (11-14/0571r3) documents.
- The group approved the initial version of the TGax Channel Model document (11-14-0882r3).
- The group adopted the initial version of the TGax Selection Procedure (11-14-0938r4).
- The group had discussion on the Functional Requirements document.

41. Technical Presentations

More than 40 submissions were covered during the week.

- Simulation Scenarios and Calibration
  - ✧ 11-14/0799, "Modifications to Simulation Scenarios and Calibration Process," Nihar Jindal (Broadcom)
  - ✧ 11-14/0800, "Box 1 and Box 2 Calibration Results," Nihar Jindal (Broadcom)
  - ✧ 11-14/0803, "Packet Length for Box 0 Calibration," Wookbong Lee (LG Electronics)
  - ✧ 11-14/0850, "Clarification for MAC Calibration," Gwen Barriac (Qualcomm)
  - ✧ 11-14/0851, "Proposed Rate Control for MAC Simulator," Gwen Barriac (Qualcomm)
  - ✧ 11-14/0859, "Proposing a Stadium Scenario," Hakan Persson (Ericsson)
  - ✧ 11-14/0860, "Text proposal of a Stadium scenario to ax," Hakan Persson (Ericsson)
  - ✧ 11-14/0869, "MAC calibration results," Zhou Lan (Huawei)
  - ✧ 11-14/0871, "Further Calibration Results towards Integrated System Level Simulation," Jiyong Pang (Huawei)
  - ✧ 11-14/0892, "MAC Calibration Text to Simulation Scenarios," Jarkko Kneckt (Nokia)
  - ✧ 11-14/0894, "Calibration of System Level Simulators," Sayantan Choudhury (Nokia)
  - ✧ 11-14/0895, "Calibration of MAC simulator with OBSS Network Scenario," Chao-CHun Wang (MediaTek)

- Evaluation Methodology
  - ✧ 11-14/0571, " Evaluation Methodologies," Ron Porat (Broadcom)
  - ✧ 11-14/0810, "RBIR-based PHY Abstraction with Channel Estimation Error," Yukun Sun (Marvell)
  - ✧ 11-14/0811, "Overview on RBIR-based PHY Abstraction," Yukun Sun (Marvell)
  - ✧ 11-14/0827, "Energy Efficiency Evaluation Methodology," Eric Wong (Apple)
  - ✧ 11-14/0865, "ACI and AACI for 802.11ax System Simulations," Yu Cai (Huawei)
  - ✧ 11-14/0866, "Traffic modeling and system capacity performance measure," Johan Soder (Ericsson)
  - ✧ 11-14/0873, "PHY Abstraction Table for 11ax System Level Simulations," Jiayin Zhang (Huawei).
  - ✧ 11-14/0874, "Unified Traffic Model on Enterprise Scenario," Phillip Barber (Huawei)

- 11-14/0875 "VoIP Traffic Model Content for 11ax TG Simulation Scenarios & Evaluation Methodology," Phillip Barber (Huawei)

- Channel Models
  - 11-14/0882, "IEEE 802.11ax Channel Model Document," Jianhan Liu (Mediatek inc.)
  - 11-14/0904 "In-Cabin WiFi Channel Channel: Preliminary Ray Tracing Simulations," Fan Bai (General Motors)

- Functional Requirements
  - 11-14/0567, "Proposed 802.11ax Functional Requirements," Lei Wang (Marvell)
  - 11-14/0818, "Synchronization Requirements," Yonggang Fang (ZTE)
  - 11-14/0821, "Coexistence Requirements of 802.11 WLAN and LTE in Unlicensed Spectrum," Alireza Babaei (CableLabs).
  - 11-14/0835, "Functional Requirements Discussion," Joe Kwak (InterDigital)

- Technology/Others
  - 11-14/0779, "Dynamic Sensitivity Control Practical Usage," Graham Smith (DSP Group)
  - 11-14/0801, "Envisioning 11ax PHY Structure - Part II," Dongguk Lim(LG Electronics)
  - 11-14/0802, "Consideration on UL MU transmission," Jinyoung Chun (LG Electronics)
  - 11-14/0804, "Envisioning 11ax PHY Structure – Part I," Jinsoo Choi (LG Electronics)
  - 11-14/0832, "Performance Evaluation of OBSS Densification," Po-Kai Huang (Intel)
  - 11-14/0833, "Residential Scenario Sensitivity and Transmit Power Control Simulation Results," Ron Murias (InterDigital)
  - 11-14/0838, "Discussion on dual-link STR in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
  - 11-14/0839, "Discussion on OFDMA in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
  - 11-14/0846, "Changing CCA in the Residential Environment," Gwen Barriac (Qualcomm)
  - 11-14/0847, "Further Considerations on Enhanced CCA for 11ax," John Son (WILUS Institute)
  - 11-14/0854, "DSC and Legacy Coexistence," Yuichi Morioka (SONY)
  - 11-15/0855, "Techniques for Short Downlink Frames," Brian Hart (Cisco Systems)
  - 11-15/0856, "Evaluating Dynamic CCA/Receiver Sensitivity Algorithms," Brian Hart (Cisco Systems)
  - 11-14/0858, "Analysis on Multiplexing Schemes exploiting frequency selectivity," Kaushik Josiam (Samsung)
  - 11-14/0861, "Impact of CCA adaptation on spatial reuse in dense residential scenario," Sayantan Choudhury (Nokia)
  - 11-14/0868, "UL & DL DSC and TPC MAC simulations," Johan Soder (Ericsson)
  - 11-14/0872, "A Protocol Framework for Dynamic CCA," Sean Coffey (Realtek)
  - 11-14/0880, "Increased Network Throughput with Channel Width Related CCA and Rules," James Wang (Mediatek)
  - 11-14/0889, "Performance Gains from CCA Optimization," Nihar Jindal (Broadcom)

42. Timeline: There are no changes in the timeline.

- TGax initial timeline approved during the May 2014 Waikoloa session.
  - May 2014 - TG kick off
  - Nov. 2014 - start working on the Specification Framework
  - Jul. 2016 - Draft 1.0 to be ready
  - Mar. 2017 - Draft 2.0 to be ready
  - 1H/2019 - publication of the IEEE 802.11ax amendment

Goals for September 2014

- TG vice-chairs election.
- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the September 2014 session.
  - ✧ Thursday, August 14th, 10:00 – 12:00 (ET)
    - ➢ Chair had sent out call for submissions on the TGax reflector.

May 2014 – Waikoloa, Big Island, HI

TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax**	**TGax**
AM2	**TGax**	**TGax**		
PM1				**TGax**
PM2	**TGax**	**TGax**		
PM3	**TGax**	**TGax**		

Main documents

- Agenda: 11-14/0478r5, TGax May 2014 Meeting Agenda
- Closing report: 11-14/0702r0, TGax May 2014 Closing Report
- Draft minutes: 11-14/0655r1, May 2014 Waikoloa Meeting Minutes

Achievements

43. The group elected the chairperson and the secretary.

- Chairperson: Osama Aboul-Magd (Huawei Technologies)
- Secretary: Yasuhiko Inoue (NTT)
- Other officer positions and TG structure will be discussed during the July 2014 meeting.

44. The group approved minutes from the March 2014 Beijing meeting and Teleconference on April 17th 2014.

- 11-14/0380r1, March 2014 Beijing Meeting Minutes
- 11-14/0530r0, Minutes from the teleconference on April 17th, 2014

45. TG Documents

- The group approved initial version of the Simulation Scenarios (11-14/0621r4) and Evaluation Methodology (11-14/0571r2) documents.
- The group started the discussion related to Functional Requirements document. Expectation is to approve the initial revision of the document in July.
- Discussion related to Channel Model document is expected to start in July.

46. Technical Presentations

40 submissions were covered during the week.

- 11-14/0527, "PHY Abstraction for TGax System Level Simulations", Pengfei Xia (InterDigital)
- 11-14/0546, "IEEE 802.11ax High Efficiency WLAN Packet measurements around Boulder Colorado", Jim Lansford (CSR)
- 11-14/0567, "Proposed 802.11ax Functional Requirements", Lei Wang (Marvell)
- 11-14/0571, "11ax Evaluation Methodologies", Ron Porat (Broadcom)
- 11-14/0577, "Path Loss Model for Scenario 1," Nihar Jindal (Broadcom)
- 11-14/0578, "Residential Scenario CCA/TPC Simulation Discussion," Frank La Sita (InterDigital)
- 11-14/0581, "Further Discussions on PHY Abstraction," Yakun Sun (Marvell)

- 11-14/0582, “Calibrating MAC Simulator Through Function Test,” Jinjing Jiang (Marvell)
- 11-14/0583, “Further Discussions on Instantaneous SINR Calibration for System Simulation,” Yakun Sun (Marvell)
- 11-14/0584, “System Level Simulations on Beamforming and Link Adaptation,” Yan Zhang (Marvell)
- 11-14/0585, “PHY Abstractions for and IEEE 11ax PHY System Simulation and Integrated System Level Simulation,” Jianhan Liu (MediaTek)
- 11-14/0586, “Automotive Considerations for the Simulation Scenarios,” Igal Kotzer (General Motors)
- 11-14/0594, “Insert Virtual Desktop Infrastructure (VDI) Traffic Model Content for HEW Simulation Scenarios,” Yingpei Lin (Huawei)
- 11-14/0595, “Edits on Some Traffic Content for HEW SG Simulation Scenarios,” Yingpei Lin (Huawei)
- 11-14/0598, “Uplink multi-user MAC protocol for 11ax,” Tran Thi Thao Nguyen (Kyushu Inst. of Tech.)
- 11-14/0600, “Proposed Calibration For MAC simulator,” Gwen Barriac (Qualcomm)
- 11-14/0604, “Modeling and Evaluating Variable Bit rate Video Streaming for 802.11ax,” Chao-Chun Wang (MediaTek)
- 11-14/612, “Calibration Procedures towards Integrated System Level Simulation,” Jiayin Zhang (Huawei)
- 11-14/0613, “Discussions on adaptive frame length in MAC based on block ACK,” Ningbo Zhang (BUPT)
- 11-14/0614, “Joint Coding and Modulation Diversity with LRA MMSE VP by QR precoding MIMO,” Ningbo Zhang (BUPT)
- 11-14/0616, “CSMA/CA Enhancement Suggestion,” Yonggang Fang (ZTE)
- 11-14/0617, “Discussion on timeline for 802.11ax,” Laurent Cariou (Orange)
- 11-14/0620, “Link Adaptation for PHY SLS calibration,” Jinyoung Chun (LG Electronics)
- 11-14/0621, “TGax Simulation Scenarios,” Simone Merlin (Qualcomm)
- 11-14/0624, “Investigation on 1024 QAM feasibility in 11ax,” Eunsung Park (LG Electronics)
- 11-14/0625, “Multi-channel operation in Simulation scenarios,” Suhwook Kim (LG Electronics)
- 11-14/0626, “IEEE 802.11ax Functional Requirements,” SangHyun Chang (Samsung)
- 11-14/0627, “Outdoor Channel Models for System Level Simulations,” Kaushik Josiam (Samsung)
- 11-14/0628, “Measurements on CCA Thresholds in OBSS Environment,” John Son (WILUS Institute), Young Doo Kim (SK Telecom)
- 11-14/0634, “Consideration on MAC system calibration,” Zhou Lan (Huawei)
- 11-14/0635, “Dynamic Sensitivity Control Implementation,” Graham Smith (DSP Group)
- 11-14/0636, “Consideration on functional requirements,” Zhou Lan (Huawei)
- 11-14/0637, “Spatial Reuse and Coexistence with Legacy Devices,” James Wang (MediaTek)
- 11-14/0647, “PHY abstraction method comparison,” Tianyu Wu (MediaTek)
- 11-14/0648, “Performance Observation of a Dense Campus Network,” Chinghwa Yu (MediaTek)
- 11-14/0649, “802.11ax Timeline Scenarios,” Rolf de Vegt (Qualcomm)
- 11-14/0656, “How to Describe 802.11ax Functional Requirements,” Minho Cheong
- 11-14/0660, “802.11ax Timeline,” Minho Cheong (NEWRACOM)
- 11-14/0677, “Comparison of Calibration Methodology for MAC Simulation,” Chinghwa Yu (MediaTek)
- 11-14/0682, “In Situ Spectrum Reuse Measurements in Indoor 20,000 Seat Arena,” Chuck Lukaszewski (Aruba Networks)

47. Timeline

- The group approved initial timeline.
  - ✧ May 2014 - TG kick off
  - ✧ Nov. 2014 - start working on the Specification Framework

- ✧ Jul. 2016 - Draft 1.0 to be ready
- ✧ Mar. 2017 - Draft 2.0 to be ready
- ✧ 1H/2019 - publication of the IEEE 802.11ax amendment

Goals for July 2014

- Continue to advance simulation scenarios (11-14/0621) and Evaluation Methodologies (11-14/0571) documents.
- Approve an initial Functional Requirements documents
- Approve an initial Channel Model document.
- Discuss and approve TG structure and process.
- Technical Presentations.

Teleconferences

- Three teleconferences are planned before the July 2014 session.
  - ✧ Wednesday, June 4th, 10:00 – 12:00 (ET)
  - ✧ Wednesday, June 18th, 20:00 – 22:00 (ET)
  - ✧ Wednesday, July 2nd, 10:00 – 12:00 (ET)

  Details of the meeting information will be announced on the reflector.

March 2014 – Beijing, China

HEW study group had seven sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		
PM1				**HEW**
PM2	**HEW**	**HEW**		
PM3		**HEW**		

Main documents

- Agenda: 11-14/0219r4, HEW SG March 2014 Meeting Agenda
- Closing report: 11-14/0457r0, HEW SG March 2014 Closing Report
- Draft minutes: 11-14/0380r0, March 2014 Beijing Meeting Minutes

Achievements

48. The group approved minutes from the January 2014 Los Angeles meeting and teleconferences on February 6th 2014 and February 13th 2014.

- 11-14/0199r0, January 2014 Los Angeles Meeting Minutes
- 11-14/0229r2, Minutes from the teleconference on February 6th, 2014
- 11-14/0242r0, Minutes from the teleconference on February 13th, 2014

49. Addressed comments related to the PAR and CSD received from individuals and other IEEE 802 WGs. Resolutions of comments are contained in the following document:

- https://mentor.ieee.org/802.11/dcn/14/11-14-0424-00-0hew-hew-sg-par-and-csd-comments-and-resolutions.pptx

50. Updated the PAR and the CSD documents based on received comments:

- https://mentor.ieee.org/802.11/dcn/14/11-14-0165-01-0hew-802-11-hew-sg-proposed-par.docx
- https://mentor.ieee.org/802.11/dcn/14/11-14-0169-01-0hew-ieee-802-11-hew-sg-proposed-csd.docx

51. The group passed motions to approve revised PAR and CSD documents, and SG extension.

- Revised PAR (11-14/0165r1): Y/N/A = 94/0/1, Pass
- Revised CSD (11-14/0169r1): Y/N/A = 97/0/1, Pass
- SG extension: Y/N/A = 105/0/0, Pass
- **HEW SG has completed its work and the IEEE standard board approved 802.11ax project.**

52. The group received more than 30 submissions in the categories of simulation scenarios, evaluation methodologies, channel models, functional requirements, technologies and selection procedure. Following submissions have been presented and discussed during the week.

- 11-13/1359r1, "HEW-Evaluation-Methodology" Ron Porat (Broadcom)
- 11-14/0112r1, "Wi-Fi interference measurements in Korea - part II", Minho Cheong (NEWRACOM)
- 11-14/0113r1, "Modeling of additional channel loss in dense WLAN environments", Minho Cheong (NEWRACOM)
- 11-14/0294r2, "DSC Channel Selection and Legacy Sharing" Graham Smith (DSP Group)
- 11-14/0301r0, "Multicast Considerations for HEW", Eisuke Sakai (Sony Corporation)
- 11-14/0306r0, "Discussions on HEW Functional Requirements", Lei Wang (Marvell)
- 11-14/0307r0, "PHY Calibration Results", Nihar Jindal (Broadcom)
- 11-14/0328r2, "Dense Apartment Complex Throughput Calculations", Graham Smith (DSP Group)
- 11-14/0329r0, "Channel Models for different links in Simulations", Kaushik Josiam (Samsung)
- 11-14/0330r3, "HEW PHY Abstraction", Sameer Vermani (Qualcomm)
- 11-14/0335r0, "Instantaneous SINR Calibration for System Simulation", Yakun Sun (Marvell)
- 11-14/0336r0, "Calibration of Long-Term SINR for System Simulator" Yakun Sun (Marvell)
- 11-14/0339r0, "A simplified STR Mechanism", Raja Banerjea (CSR)
- 11-14/0340r0, "A simplified STR Mechanism – MAC", Raja Banerjea (CSR)
- 11-14/0342r0, "Short Packet Optimizations", Naveen Kakani (CSR, Inc)
- 11-14/0345r1, "Joint Coding and Modulation Diversity with RBD pre-coding for next generation WLAN", Zhanji Wu (BUPT)
- 11-14/0350r0, "Suggestion on Evaluation Methodology", Jinyoung Chun (LG Electronics)
- 11-14/0352r0, "Discussion on power save mode for real time traffic", Giwon Park (LG Electronics)
- 11-14/0353r0, "Suggestion on PHY Abstraction for Evaluation Methodology", Dongguk Lim (LG Electronics)
- 11-14/0355r0, "Simulation Scenario 1 Revised", Simone Merlin (Qualcomm)
- 11-14/0356r0, "Calibration of System Level Simulators", Jarkko Kneckt (Nokia)
- 11-14/0357r0, "Utilizing Unused Resources for Simultaneous Transmissions", Jarkko Kneckt (Nokia).
- 11-14/0365r0, "Extended Intra-Vehicle Channel Model", Igal Kotzer (General Motors)
- 11-14/0372r2, "System level simulations on increased spatial reuse", Liwen Chu (Marvell)
- 11-14/0373r1, "Energy Efficiency in HEW", Pingping Xu, Wei Wang (Southeast University)
- 11-14/0381r0, "Stadium scenario for HEW", Johan Soder, Filip Mestanov (Ericsson AB)
- 11-14/0383r0, "Considerations on evaluation methodology for candidate HEW PHY&MAC techniques", Le Liu (Huawei)
- 11-14/0385r0, "Simulation Methodology and Calibration", Gwen Barriac (Qualcomm)
- 11-14/0386r0, "Discussions on MCS selection" , Tianyu Wu (MediaTek)
- 11-14/0392r0, "Traffic Separation Scheme for Optimizing WLANs using PHY and MAC options", Takayuki Nishio (Kyoto University)
- 11-14/0393r0, "Possible Indoor Channel Models for HEW System Simulations", Leif Wilhelmsson (Ericsson AB).

- 11-14/0419r0, "802.11ax Spec Development Process Proposal", Rolf de Vegt (Qualcomm)

Goals for May 2014

- Meet as a new TG and will have officer elections.
- Continue the work on simulation scenarios, evaluation methodologies, channel models, and function requirements.

Teleconferences

- One teleconference planned before the May 2014 session.
  - ✧ Thursday, April 17th, 10:00 – 12:00 (ET)
  - ✧ Details to be announced.

January 2014 – Los Angeles, CA

HEW study group had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**
AM2	**HEW**	**HEW**		
PM1				**HEW**
PM2	**HEW**	**HEW**	**HEW**	
PM3	**HEW**	**HEW**		

Main documents

- Agenda: 11-13/1506r5, HEW SG January 2014 Meeting Agenda
- Closing report: 11-14/0187r0, HEW SG January 2014 Closing Report
- Draft minutes: 11-14/0199r0, January 2014 Los Angeles Meeting Minutes

Achievements

1. **The group approved minutes from the November 2013 Dallas meeting and teleconferences on December 4th 2013, December 18th 2013 and January 8th, 2014..**
   - 11-13/1465r1, November 2013 Dallas Meeting Minutes
   - 11-13/1495r0, Minutes from the teleconference on December 4th, 2013
   - 11-13/1532r1, Minutes from the teleconference on December 18th, 2013
   - 11-14/0024r1, Minutes from the teleconference on January 8th, 2014

2. **The group resolved open issues related to the PAR and CSD.**

3. **The group received 28 submissions that were categorized into (1) PAR and 5 Criteria related submissions, and (2) Best Effort submissions. Best Effort submissions basically related to simulation scenario and evaluation methodology.**
   - **PAR and 5 Criteria related submissions**
     - ✧ 11-13/1410r6, "802.11 HEW Draft PAR and 5C", Osama Aboul-Magd and All
     - ✧ 11-13/1489r5, "Airport Capacity Analysis", Graham Smith (DSP Group)
     - ✧ 11-14/0026r1, "thoughts on hew par", Yong Liu (Apple)
     - ✧ 11-14/0045r2, "E-Education Analysis", Graham Smith (DSP Group)
     - ✧ 11-14/0058r1, "Pico Cell Use Case Analysis ", Graham Smith (DSP Group)
     - ✧ 11-14/0061r0, "Some findings from real world measurement", Katsuo Yunoki (KDDI Labs)

- 11-14/0065r1, “Comments on Draft HEW PAR”, Bill Carney (SONY)
- 11-14/0101r2, “Comments on 802.11 HEW Draft PAR & 5C”, Rakesh Taori (Samsung Electronics)
- 11-14/0106r0, “Discussion on HEW PAR”, Kiseon Ryu (LG Electronics)
- 11-14/0119r2, “Suggested PAR Changes”, James Yee (MediaTek)
- 11-14/0163r1, “Raising the PAR”, Mat Fischer (Broadcom)

- **Best Effort submissions**
  - 11-14/0043r2, “PHY abstraction in system level simulation for HEW study”, Fei Tong (Samsung)
  - 11-14/0051r0, “Wireless Office with Interference”, David Xun Yang (Huawei)
  - 11-14/0053r0, “Further Considerations on Calibration of System Level Simulation”, Jiayin Zhang (Huawei)
  - 11-14/0056r1, “Traffic Model on Virtual Desktop Infrastructure”, Yingpei Lin (Huawei)
  - 11-14/0059r1, “Integrated System Level Simulation”, Jun Luo (Huawei)
  - 11-14/0063r0, “Design Challenges for 802.11 HEW Radios”, Yu Cai (Huawei)
  - 11-14/0070r0, “Joint MAC/PHY Evaluation Methodology”, Kaushik Josiam (Samsung)
  - 11-14/0082r0, “Improved Spatial Reuse Feasibility – Part I”, Ron Porat (Broadcom)
  - 11-14/0083r0, “Improved Spatial Reuse Feasibility – Part II”, Ron Porat (Broadcom)
  - 11-14/0086r2, “Outdoor AP Measurement in Tokyo”, Tsugu Aoki (Toshiba)
  - 11-14/0088r0, “Intra-Vehicular Channel Model”, Igal Kotzer (General Motors)
  - 11-14/0095r0, “OFDM-IDMA Uplink Communication”, Leonardo Lanante (Kyushu Inst. Of Tech)
  - 11-14/0107r0, “HEW Evaluation Metrics”, Yonggang Fang (ZTETX)
  - 11-14/0116r1, “Long-Term SINR Calibration for System Level Simulation”, Yakun Sun (Marvell)
  - 11-14/0117r0, “PHY Abstraction for HEW System Level Simulation”, Yakun Sun (Marvell)
  - 11-14/0118r0, “Consideration on System Level Simulation”, Jinsoo Chio (LG Electronics)

4. **The group passed motions to approve PAR and CSD.**
   - PAR: 11-14/0165r0, IEEE 802.11 HEW SG Proposed PAR
   - CSD: 11-14/0169r0, IEEE 802.11 HEW SG Proposed CSD

Goals for the March 2014 Meeting

- Resolve comments expected from EC members and other IEEE 802 WGs
- Continue with presentations relevant to the SG topics.
  - Simulation scenarios
  - Evaluation Methodologies
  - Channel Models
  - Technology
  - etc.

Teleconferences

The group agreed to have four teleconferences before the March 2014 meeting.

- Thursday, February 6th, 2014: 20:00 – 22:00 (ET)
- Thursday, February 13th, 2014: 10:00 – 12:00 (ET)
- Thursday, February 20th, 2014: 10:00 – 12:00 (ET)
- Thursday, February 27th, 2014: 20:00 – 22:00 (ET)

November 2013 – Dallas, TX

HEW study group had ten sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		
PM1		**HEW**	**HEW**	**HEW**
PM2	**HEW**	**HEW**	**HEW**	**HEW**

Main documents

- Agenda: 11-13/1263r5, HEW SG November 2013 Meeting Agenda
- Closing report: 11-13/1476r1, HEW SG November 2013 Closing Report
- Draft minutes: 11-13/1465r1, November 2013 Dallas Meeting Minutes

Achievements

1. **The group approved minutes from the September 2013 Nanjing meeting and teleconferences on October 3rd and October 30th, 2013.**
   - 11-13/1117r1, September 2013 Nanjing Meeting Minutes
   - 11-13/1275r1, Minutes from the teleconference on October 3rd , 2013
   - 11-13/1303r0, Minutes from the teleconference on October 30th, 2013

2. **The group received more than 40 submissions that were categorized into three categories, i.e., (1) Channel Mode/Simulation Scenarios and Evaluation Methodologies, (2) MAC/PHY technologies and (3) PAR proposals. Following submissions were presented during the week.**
   - **Channel Models, Simulation Scenarios and Evaluation Methodologies**
     - 11-13/1001r5, "HEW SG Simulation Scenarios", Simone Merlin (Qualcomm)
     - 11-13/1305r0, "Simplification on HEW traffic models", Bill Carney (Sony)
     - 11-13/1334r5, 11-13/1335r4, "Video Traffic Modeling", Guiqing Li (Intel)
     - 11-13/1359r0, "HEW Evaluation Methodology", Ron Porat (Broadcom)
     - 11-13/1370r0, "LTE OOB Interference to 2.4 GHz Band", Yonggang Fang (ZTE TX)
     - 11-13/1376r3, "Discussions on Penetration Loss", Jianhan Liu (MediaTek)
     - 11-13/1380r0, "Outdoor Channel Model Simulation Follow-up", Hongyuan Zhang (Marvell)
     - 11-13/1383r0, "System Level Simulation Parameters", Wookbong Lee (LG Electronics)
     -
     - 11-13/1387r1, "HEW channel modeling for system level simulation", Yan Zhang (Marvell)
     - 11-13/1390r0, "PHY Abstraction for HEW System Level Simulations", Yakun Sun (Marvell)
     - 11-13/1391r0, "About SINR conversion for PHY Abstraction", Yakun Sun (Marvell)
     - 11-13/1392r0, "Methodology of Calibrating System Level Simulation Results", Yakun Sun (Marvell)
     - 11-13/1401r0, "System Level Assessments for Outdoor HEW Deployments", Kaushik Josiam (Samsung)
     - 11-13/1406r0, "Traffic Modeling for HEW Simulations", Huai-Rong Shao (Samsung)
     - 11-13/1407r0, "Simulation based study of QoE", Chao-Chun Wang (MediaTek)
     - 11-13/1412r0, "How to use simulation scenarios in HEW", Minho Cheong (ETIR)
     - 11-13/1419r1, "Modifications to ITU Channel Model to Support 160MHz bandwidth of operation", Shahrnaz Azizi (Intel)
     - 11-13/1420r1, "HEW Considerations for the Vehicular Environment", Igal Kotzer (General Motors)
     - 11-13/1438r0, "Traffic Observation and Study on Virtual Desktop Infrastructure", Phillip Barber (Huawei Technologies)
     - 11-13/1456r1, "Considerations on WFA feedback", Simone Merlin (Qualcomm)

- **MAC/PHY Technologies**
  - 11-13/1325r5, "IEEE 802.11ai overview", Hiroshi Mano (ATRD), chair of TGai
  - 11-13/1349r0, "Access Control Enhancement", Katsuo Yunoki (KDDI)
  - 11-13/1375r1, "Summary and Discussions of Proposals on Potential PHY Technologies in HEW", Jianhan Liu (MediaTek)
  - 11-13/1377r0, "DL efficiency enhancement in high density network", Kiseon Ryu (LG Electronics)
  - 11-13/1382r0, "Discussion on OFDMA in HEW", Jinsoo Choi (LG Electronics)
  - 11-13/1386r2, "Improving WLAN Efficiency and QoE – A Top Down Approach", Veli-Pekka Kentonen (7 Signals)
  - 11-13/1388r0, "UL MU-MIMO transmission", Jinyoung Chun (LG)
  - 11-13/1395r2, "Simultaneous Transmission Technologies for HEW", Koichi Ishihara (NTT)
  - 11-13/1409r0, "Dual Wi-Fi: Dual Channel Wi-Fi for Congested WLANs with Asymmetric Traffic Loads", Adriana Flores (Rice University)
  - 11-13/1421r1, "STR Radios and STR Media Access", Phillip Levis (Stanford University)
  - 11-13/1440r0, "Argos | Practical Masive-MIMO", Clayton Shepard (Rice University)

- **PAR proposals**
  - 11-13/1331r2, "Proposed direction and priorities for HEW", Guido R. Hiertz (Ericsson)
  - 11-13/1333r0, "Power Efficiency PAR Requirements", Chris Hansen (Covariant)
  - 11-13/1366r3, "Some propositions to progress towards the PAR definition", Laurent Cariou (Orange)
  - 11-13/1361r0, "Discussion to derive HEW Functional Requirements", Yasunao Misawa (KDDI)
  - 11-13/1389r1, "Discussion on HEW PAR", HanGyu Cho (LG Electronics)
  - 11-13/1397r0, "Renewing 2.4 GHz", Brian Hart (Cisco Systems)
  - 11-13/1398r0, "Requirements for HEW", Akira Yamada (NTT DOCOMO)
  - 11-13/1404r0, "Some Thoughts on PAR", and 11-13/1405r0, "HEW PAR", Eldad Perahia (Intel)
  - 11-13/1450r0, "Summary of PAR Discussions", Osama Aboul-Magd (HEW SG chair)
  - 11-13/1470r1 and 11-13/1471r1, "802.11 HEW proposed basis for PAR discussion", Laurent Cariou (Orange)

3. **Discussed the WFA feedback on prioritization of the usage cases and approved a liaison letter back to WFA.**
   - Feedback from Wi-Fi Alliance:
     - 11-13/1443r0, Liaison from Wi-Fi Alliance - HEW Use Cases
   - Approved a liaison document to Wi-Fi Alliance:
     - 11-13/1446r0, IEEE 802.11 Liaison to WFA on Prioritization of High Efficiency WLAN (HEW) Usage Scenarios

4. **Started the discussion on the PAR.**
5. **The group passed a motion to extend the study group by 136/0/2.**

Goals for the January 2014

- Progress the work on the PAR and 5C.

Teleconferences

The group agreed to have three teleconferences before the January 2014 meeting.

- Wednesday, December 4th, 2013: 10:00 – 12:00 (ET)
- Wednesday, December 18th, 2013: 20:00 – 22:00 (ET)
- Wednesday, January 8th, 2014: 10:00 – 12:00 (ET)

September 2013 – Nanjing, China

HEW study group had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**
AM2		**HEW**		
PM1			**HEW**	**HEW**
PM2	**HEW**	**HEW**	**HEW**	
Evening	**HEW**	**HEW**		

Main documents

- Agenda: 11-13/0951r7
- Closing report: 11-13/1231r1
- Draft minutes: 11-13/1117r1

Achievements

1. **The group approved minutes from the Geneva meeting and teleconference on August 28th, 2013.**
   - 11-13/0861r1, Minutes from face-to-face meeting in Geneva, July 2013
   - 11-13/1003r0, Minutes from the teleconference on August 28th, 2013
2. **50 submissions in the following categories were received and presented during the week.**
   - **Channel Models (CM)**
     - 11-13/0996r2, "Outdoor Channel Model Candidates for HEW", Kaushik Josiam (Samsung)
     - 11-13/1113r0, "Channel Modeling for Dense Wi-Fi Environments", Minho Cheong (ETRI)
     - 11-13/1125r3, "HEW Outdoor Channel Model Discussions", Hongyuan Zhang (Marvell)
     - 11-13/1135r4, "Summary of HEW Channel Models", Jianhan Liu (MediaTek)
     - 11-13/1146r1, "Update on HEW Channel Model", Shahrnaz Azizi (Intel Corp)
   - **Simulation Scenarios/Simulation Methodologies (SS/SM)**
     - 11-13/1000r2, "Simulation Scenarios", Simone Merlin (Qualcomm)
     - 11-13/1001r2, "Simulation Scenarios Document Template", Simone Merlin (Qualcomm)
     - 11-13/1079r0, "Outdoor Stadium Simulation Details Discussion", Joseph Levy (InterDigital)
     - 11-13/1080r0, "Markov Modeling of the Channel for HEW System Level Simulations", Joseph Levy (InterDigital)
     - 11-13/1081r0, "HEW Simulation Methodology", Sayantan Choudhury (Nokia).
     - 11-13/1083r0, "HEW SG Unified Simulation Scenarios", David Xun Yang (Huawei)
     - 11-13/1114r1, "Simulation Scenario for unplanned Wi-Fi Network", Jae Seung Lee (ETRI)
     - 11-13/1123r1, "Capacity Simulation of High Density Indoor WLAN Systems", Filip Mestanov (Ericsson AB)
     - 11-13/1133r0, "Virtual Desktop Infrastructure (VDI)", Yingpei Lin (Huawei Technologies)
     - 11-13/1153r0, "Simulation Scenario Proposal", Laurent Cariou (Orange)
     - 11-13/1159r1, "Video Performance Requirements and Simulation Parameters", Guoqing Li (Intel)
     - 11-13/1162r1, "Video Application Categories and Characteristics", Guoqing Li (Intel)
     - 11-13/1176r0, "Some Simulation Scenarios for HEW", Reza Hedayat (Cisco)
   - **Evaluation Methodologies (EM)**
     - 11-13/1051r1, "Evaluation Methodology", Ron Porat (Broadcom)
     - 11-13-1054r1, "HEW Evaluation Metrics Suggestions", Yonggang Fang (ZTETX)

- ✧ 11-13/1059r0, “PHY Abstraction for HEW Evaluation Methodology”, Dongguk Lim (LG Electronics)
- ✧ 11-13/1131r0, “PHY Abstraction for HEW System Level Simulation”, Jiayin Zhang (Huawei Technologies)
- ✧ 11-13/1137r2, “The Definition of Performance Metrics for HEW”, Haui-Rong Shao (Samsung)
- ✧ 11-13/1144r1, “Simplified Traffic Model Based on Aggregated Network Statistics”, William Carney (Sony)
- ✧ 11-13/1158r0, “Video Traffic and Applications for HEW”, William Carney (Sony)

- **Functional Requirements (FR)**
  - ✧ 11-13/1097r0, “Functional Requirements for HEW PAR”, Minho Cheong (ETRI)
  - ✧ 11-13/1116r0, “Discussion on HEW Functional Requirements”, Jinsoo Choi (LG Electronics)

- **MAC/PHY Technologies (TECH)**
  - ✧ 11-13/1046r2, “Discussion for Massive MIMO for HEW”, Zhigang Wen (BUPT)
  - ✧ 11-13/1056r1, “Enhancement on resource utilization in OBSS environment”, Giwon Park (LG Electronics)
  - ✧ 11-13/1058r0, “Efficient wider bandwidth operation”, Kiseon Ryu (LG Electronics)
  - ✧ 11-13/1061r0, “Multicast Transmission for HEW”, Jeongki Kim (LG electronics)
  - ✧ 11-13/1073r1, “Access Control Enhancement“, Katsuo Yunoki (KDDI Labs)
  - ✧ 11-13/1074r0, “Occupied air time calculation for doc.1073r0”, Katsuo Yunoki (KDDI R&D Laboratories)
  - ✧ 11-13/1077r1, “EDCA Enhancements for HEW”, Hui Zhao (BUPT)
  - ✧ 11-13/1089r1, “D2D Technology for HEW”, Xiang Gao (BUPT)
  - ✧ 11-13/1090r2, “Non-linear pre-coding MIMO Scheme for next generation WLAN”, Xiang Gao (BUPT)
  - ✧ 11-13/1105r0, “Discussion on Access Mechanism for HEW”, Meng Yang (CATR)
  - ✧ 11-13/1122r1, “Considerations for In-Band Simultaneous Transmit and Receive (STR) feature in HEW”, Rakesh Taori (Samsung Electronics)
  - ✧ 11-13/1126r0, “Beamforming under OBSS Interference”, Hongyuan Zhang (Marvell)
  - ✧ 11-13/1168r0, “Requirements on WLAN Ad Push”, Hui Tian (BUPT)
  - ✧ 11-13/1169r0, “WLAN Cellular Offload in High Speed Moving Environment”, Hui Tian (BUPT)
  - ✧ 11-13/1154r0, “DL-MU-MIMO Transmission with Unequal Bandwidth”, Yongming Huang (Southeast University)
  - ✧ 11-13/1155r0, “Space Division Multiplex for OBSS Interference Suppression”, Yongming Huang (Southeast University)
  - ✧ 11-13/1156r0, “TXOP Redundancy NAV Clear”, Yongming Huang (Southeast University)
  - ✧ 11-13/1157r3, “Feasibility of Coordination Transmission for HEW”, Yunzhou Li (Tsunghua University)

- **General (GEN)**
  - ✧ 11-13/1057r0, “Legacy support on HEW frame structure”, Wookbong Lee (LG electronics)
  - ✧ 11-13/1100r0, “HEW SG Progress Review”, Osama Aboul-Magd (HEW SG)
  - ✧ 11-13/1115r0, “Possible vision of the HEW-driven Wi-Fi 2020”, Minho Cheong (ETRI)
  - ✧ 11-13/1163r0, “PAR and 5C: Comments based on 11n”, Sean Coffey (RealTek)
  - ✧ 11-13/1164r1, “Some PAR and 5C Requirements”, Paul Lambert (Marvell)

3. Straw Polls

Several straw polls were conducted to sense the group consensus on topics related to simulation scenarios, evaluation methodologies and channel models.

4. Timeline

The group reviewed the timeline. No changes.

5. Teleconferences

The HEW SG agreed to have three teleconferences before the November 2013 session.

- Wednesday, October 9th, 2013: 10:00 – 12:00 (ET)
- Wednesday, October 17th, 2013: 00:01 – 02:00 (ET)
- Wednesday, October 30th, 2013: 10:00 – 12:00 (ET)

Goals for the November 2013

- Hear presentations addressing SS/SM/EM/FR/CM/TECH
  - Attempt to consolidate documents related to the above areas of discussion.
  - Priority will be given to presentations with consolidated views
- Start discussion on PAR related issues
- Motion for SG extension
- WFA feedback on the usage cases

July 2013 – Geneva, Switzerland

HEW study group had nine sessions during the week.

Main documents

- Agenda: 11-13/0664r5
- Closing report: 11-13/0922r0
- Draft minutes: 11-13/0861r0

Achievements

1. **The group approved minutes from the face-to-face meeting in Waikoloa, HI and teleconferences held on June 5th and June 19th.**
   - 11-13/0560r2, May 2013 Waikoloa meeting minutes
   - 11-13/0663r1, Teleconference minutes 20130605
   - 11-13/0704r0, Teleconference minutes 20130619
2. **The group received over 35 submissions in areas of (1) Usage Models/Use Cases, (2) Functional Requirements, (3) Simulation Scenarios and Evaluation Methodology, (4) MAC/PHY techniques as listed below.**
   - **Usage Models/Use Cases**
     - 11-13/0657r3, "HEW SG usage models and requirements - Liaison with WFA" Laurent Cariou (Orange)
     - 11-13/0795r0, "HEW Usage Scenarios Categorization", Eldad Perahia (Intel)
     - 11-13/0802r1, "Proposed re-categorization of the HEW usage models", Yasuhiko Inoue (NTT)
     - 11-13/0761r0, "Interference Control Use Case for HEW", Fang Xie (CMCC)
     - 11-13/0836r0, "HEW Usage Models for Backhauls and Floor Automation", Minho Cheong (ETRI)
   - **Functional Requirements**
     - 11-13/0787r0, "Follow up requirements", Wu Tianyu (Huawei)
     - 11-13/0850r0, "Quantitative QoE Requirements for HEW", Huai-Rong Shao (Samsung)
     - 11-13/0798r1, "Functional Requirements in HEW", Jinsoo Choi (LG Electronics)
     - 11-13/0840r1, "HEW Functional Requirements Follow-up (Preliminary Version for Study Group discussions)", Minho Cheong (ETRI)
   - **Simulation Scenarios and Evaluation Methodology**
     - 11-13/0723r1, "HEW SG Evaluation Methodology Overview", Minyoung Park (Intel)

- 11-13/0756r1, "HEW Channel Model", Vinko Erceg (Broadcom)
- 11-13/0858r0, "Enhanced Channel Model for HEW", Shahrnaz Azizi (Intel)
- 11-13/0728r1, "Network Optimization for Expected HEW Traffic Patterns", Bill Carney (Sony)
- 11-13/0869r0, "Simulation scenarios and metrics for HEW", Thomas Derham (Orange)
- 11-13/0872r1, "Clarifications on outdoor deployments", Laurent Cariou (Orange)
- 11-13/0847r1, "Evaluation Criteria and Simulation Scenarios" Klaus Doppler (Nokia)
- 11-13/0786r0, "Discussion on System Level Simulation Methodology" Wu Tianyu (Huawei)
- 11-13/0757r1, "Evaluation Methodology and Simulation Scenarios" Nihar Jindal (Broadcom)
- 11-13/0805r2, "On Definition of Dense Networks and Performance Metric", Jianhan Liu (MediaTek)
- 11-13/0800r1, "HEW Study Group Documentation", Hemanth Sampath (Qualcomm)
- 11-13/0837r0, "Consideration for HEW Evaluation Methodology", Minho Cheong (ETRI)

- **MAC/PHY techniques**
  - 11-13/0768r0, "TD-*u*CSMA", Riccard Scopigno (ISMB)
  - 11-13/0843r0, "Further Evaluation on outdoor Wi-Fi", Wookbong Lee (LG Electronics)
  - 11-13/0852r0, "Potential approach to improve WLAN BSS edge performance", Juho Pirskanen (Renesas Mobile)
  - 11-13/0871r0, "Discussion on Potential Techniques for HEW", Timo Koskela (Renesas Mobile)
  - 11-13/0877r0, "HEW Beamforming Enhancements", James Wang (MediaTek)
  - 11-13/0764r1, "Full-duplex Technology for HEW", Andre Bourdoux (IMEC)
  - 11-13/0765r2, "Full-duplex is an emerging radio paradigm that has the potential to improve the efficiency of future WLANs", Hongliang Bian (China Telecom)
  - 11-13/0712r1, "A Brief Time of History", Larry Taylor (DTC)
  - 11-13/0801r1, "Issues of Low Rate Transmissions", Akira Kishida (NTT)
  - 11-13/0758r0, "Possible Approaches for HEW", Katsuo Yunoki (KDDI Labs)
  - 11-13/0849r1, "New Techniques: Enabling Real World Improvement By Exposing Internal MAC state", Brian Hart (Cisco)
  - 11-13/0854r1, "Consideration on Efficiency Enhancement", SangHyun Chang (Samsung)
  - 11-13/0865r2, "Video Data Rate for HEW", Huai-Rong Shao (Samsung)
  - 11-13/0878r0, "Efficiency enhancement for dense WLAN environment", Jeongki Kim (LG Electronics)

3. **The group approved document 11-13/0657r6 as HEW SG initial draft of Usage Models and to send it to Wi-Fi Alliance asking for prioritization of the use cases and additional feedbacks.**

4. **The group also approved a liaison letter to the Wi-Fi Alliance contained in the document 11-13/902r1.**

5. **The group passed motion to extend the SG.**

6. **The group discusses the timeline.**
   - May 2013: Initial meeting
   - July 2013: Presentations, SG extension
   - September 2013: Presentations
   - November 2013: Presentations, Initial PAR & 5C, SG extension
   - January 2014: Presentations, Final version of PAR and 5C, WG approval
   - March 2014: Presentations, EC approval of PAR and 5C
   - May – June 2014: NesCom approval
   - July 2014: TG starts

7. **Teleconferences**
   The group agreed to have two teleconferences before the September 2013 meeting.

- Wednesday, August 7th, 2013: 10:00 – 12:00 (ET)
- Wednesday, August 28th, 2013: 20:00 – 22:00 (ET)

Next steps

During the September 2013 meeting, the HEW SG continues discussions on issues related to:

- Usage Models/Use Cases
- Functional Requirements
- Feasibility
- Scope and Process

May 2013 – Waikoloa, HI

Main documents

- Agenda: 11-13/0400r4
- Closing report: 11-13/0624r0
- Draft minutes: 11-13/0560r2

Achievements

1. **The group decided leadership structure to have one chairperson and one secretary.**
   - Osama Aboul-Magd (Huawei Technologies) was elected as the chair of the HEW SG.
   - Yasuhiko Inoue (NTT) was elected as the recording secretary of the HEW SG.

2. **The group received 22 submissions as listed below.**
   - **Usage Models/Use Cases:**
     - 11-13/0514r0, "HEW Usage Scenarios and Applications", Eldad Perahia (Intel)
     - 11-13/0538r0, "Dense apartment building use case for HEW", Klaus Doppler (Nokia)
     - 11-13/0554r0, "Use Cases", Minho Cheong (ETRI)
     - 11-13/0567r0, "Proposed HEW Usage Models", Yasuhiko Inoue (NTT)
     - 11-13/0527r2, "Usage Models for Next Generation", David Xun Yang (Huawei) and James Wang (MediaTek)
     - 11-13/0534r1, "Direction and Use Cases for HEW", HanGyu Cho (LG Electronics)
     - 11-13/0563r0, "D2D Technology for HEW", Zhanji Wu (BUPT) – not presented
   - **Problem Statements:**
     - 11-13/0505r0, "MAC Efficiency Analysis for HEW SG", Minyoung Park (Intel)
     - 11-13/0545r1, "WLAN QoE, End User Perspective Opportunities to Improve", Veli-Pekka Ketonen (7 signals)
     - 11-13/0523r2, "Understanding Current Situation of Public Wi-Fi Usage – Possible Requirements for HEW –", Katsuo Yunoki (KDDI Labs)
     - 11-13/0539r0, "Efficient Frequency Spectrum Utilization", Yongho Seok (LG Electronics)
     - 11-13/0544r3, "Discussions on 11ac PHY efficiency", Jianhan Liu (MediaTek)
     - 11-13/0536r0, "HEW SG PHY Considerations For Outdoor Environment", Wookbong Lee (LG Electronics)
     - 11-13/0576r3, "Performance Evaluation for 11ac", Wu Tianyu (Huawei Technologies)
     - 11-13/0556r1, "Wi-Fi interference measurements in Korea – Part 1", Minho Cheong (ETRI)
     - 11-13/0549r0, "A perspective on what any High Efficiency Wireless TG should and should not do", Brian Hart (Cisco Systems)
   - **Requirements:**
     - 11-13/0524r2, "HEW Finctional Requirements", Wu Tianyu (Huawei Technologies)

- ✧ 11-13/0555r2, “Considerations on Functional Requirements for HEW”, Minho Cheoung (ETRI)

Ÿ **Scenarios and Metrics**
- ✧ 11-13/0503r0, “Discussion on Basic Technical Aspects for HEW”, Juho Pirskanen (Renesas Mobile)
- ✧ 11-13/0542r0, “HEW Scenarios and Goals”, Simone Merlin (Qualcomm)
- ✧ 11-13/0486r1, “HEW – Metrics, Targets and Simulation Scenarios”, Ron Porat (Broadcom)
- ✧ 11-13/0520r1, “HEW scenarios and evaluation metrics”, Thomas Derham (Orange)

Ÿ **Technical Feasibility**
- ✧ 11-13/0558r1, “Coexistence and Optimization of Wireless LAN: Time, Frequency, Space, Power, and Load”, Jim Lansford (CSR)

3. Liaison to the Wi-Fi Alliance

Ÿ The group agreed to ask the Wi-Fi Alliance for input about priority of the use cases.

Ÿ Laurent Cariou (Orange) volunteers to develop the use case document.

4. Project planning

Ÿ The group discussed about the project plan based on the submission 11-13/0616r2 by Phil Barber (Huawei)

Ÿ Discussion to be continued in the July meeting.

5. Teleconferences

Ÿ The group agreed to have two teleconferences before the July 2013 Plenary to develop a use case document to be shared with the Wi-Fi Alliance.
- ✧ June 5th: 10:00 – 12:00 (ET)
- ✧ June 19th: 20:00 – 22:00 (ET)

Next Steps

- During July 2013 session, the HEW SG will continue discussions on:
  - ➢ Usage Cases
  - ➢ Functional Requirements
  - ➢ Feasibility
  - ➢ Scope and Process

Related documents

Documents referenced in the motion that led to the creation of the study group
- https://mentor.ieee.org/802.11/dcn/13/11-13-0339-10-0wng-high-efficiency-wlan-straw-poll.ppt

Press release document
- https://mentor.ieee.org/802.11/dcn/13/11-13-0418-02-0000-proposed-edits-to-hew-press-release.doc

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USEFUL LINKS TO OTHER SITES:

IEEE P802.11 WLANs RELATED

- Home
- IEEE 802.11 WiKi

- E-mail Reflectors Archives (Members Only)

OTHER SITES

- IEEE P802 LAN/MAN Standards Committee (LMSC)

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APPENDIX BF

TGax July 2016 Meeting Agenda

Date: 2016-06-15

Authors:

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

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IEEE 802.11 TGax: High Efficiency WLAN Task Group

San Diego, USA

July 24-29, 2016

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

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Meeting Protocol

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

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Attendance

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

1. Register

2. Indicate attendance

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Attendance, Voting & Document Status

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

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Patent Policy

- **Following 5 slides**

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Instructions for the WG Chair

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

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

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

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Participants, Patents, and Duty to Inform

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

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

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Slide #1

Patent Related Links

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

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

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

IEEE-SA Standards Board Operations Manual

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

Material about the patent policy is available at

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

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

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

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Slide #2

Call for Potentially Essential Patents

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

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Slide #3

Other Guidelines for IEEE WG Meetings

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

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

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Slide #4

Agenda Items for the Week

- Approve TG and Telecons minutes since May meeting.
- Resolution of comments received on draft D0.1
- Ad Hoc group meetings
- Technical Presentations and related straw polls and/or motions
- Schedule Telecon times.

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General Flow of the Meeting

- **Monday July25, 08:00 – 10:00**
  - Call Ad Hoc Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - AD hoc meeting Agenda setting
  - Approval of ad hoc meeting agenda
  - Call for submissions
  - Presentations
  - Adjourn
- **Monday July 25, 16:00 – 18:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Review from November 2014 meeting
  - Call for submissions
  - Agenda setting and approval
  - TG Motions
  - Presentations
  - Recess
- **Tuesday July 26, 10:30 – 12:30**
  - Ad Hoc Group Meetings
- **Tuesday July 26, 16:00 – 18:00**
  - Ad Hoc Group Meetings
- **Tuesday July 26, 19:30 – 21:30**
  - Ad Hoc Group Meetings
- **Wednesday July 27, 08:00 – 10:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Progress Review
  - Presentations
- **Wednesday July 27, 13:30 – 15:30**
  - Ad Hoc Group Meetings
- **Wednesday July 27, 16:00 – 18:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Recess
- **Thursday July 28, 10:30 – 12:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Recess
- **Thursday July 28, 13:30 – 15:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Goals for March 2016
  - Telecon Schedule
  - Adjourn

1695

TGax Schedule in a Glance

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

*** Ad Hoc group is tbd**

1696

Submissions (PHY)

DCN	Title	Author	ad hoc
11-16/0816	Comment Resolution for CID 2183	Daewon Lee	PHY
11-16/0872	CR HE-SIG-A Part II	Ross Jian Yu	PHY
11-16/0873	CR HE-SIG-B Part I	Ross Jian Yu	PHY
11-16/0891	LDPC for 1024QAM	Hongyuan Zhang	PHY
11-16/0892	Spec Text on LDPC for 1024QAM	Hongyuan Zhang	PHY
11-16/0893	11ax Extended Range PPDU	Bin Tian	PHY
11-16/0894	HE-LTF Capabilities	Hongyuan Zhang	PHY
11-16/0895	Spec Text for HE-LTF Capabilities	Hongyuan Zhang	PHY
11-16/0896	11ax Beamformee Capabilities	Hongyuan Zhang	PHY
11-16/0897	Spec Text for Beamformee Capabilities	Hongyuan Zhang	PHY
11-16/0898	BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0899	Spec Text for BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0900	PHY Comment Resolution for CID 1052 and 2519	Bin Tian	PHY
11-16/0903	Gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0904	proposed text for gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0906	RU restriction on 20MHz operating STAs	Joonsuk Kim	PHY
11-16/0908	CR - proposed text on RU restriction of 20MHz STAs	Joonsuk Kim	PHY
11-16/0910	Minimum Occupied Bandwidth	Ron Porat	PHY
11-16/0914	Bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0915	Text for bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0920	PHY comment resolution for CID 1659,493,494	Xiaogang Chen	PHY
11-16/0922	PHY CR 1024 QAM	Sriram Venkateswaran	PHY
11-16/0923	PHY CR DCM Constellation Mapping	Sriram Venkateswaran	PHY
11-16/0928	CR on Section 26.3.9.8 - HE-SIG-B	Kaushik Josiam	PHY
11-16/0937	11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13	Rui Cao	PHY
11-16/0964	Considerations on MAC-PHY interactions during SR operations	Jing Ma	PHY

26 submissions

1697

Submissions (MAC)

34 submissions

DCN	Title	Author	ad hoc
11-16/0828	HE Fragmentation - part 1	Alfred Asterjadhi	MAC
11-16/0829	Comment Resolution for Section 10.24.10 Block Ack/GCR block ack	Reza Hedayat	MAC
11-16/0844	CC0-Intra_PPDU_PS	Alfred Asterjadhi	MAC
11-16/0856	Issue of Buffer Status reporting	Stephane Baron	MAC
11-16/0860	comment resolution on A-MPDU format	Yongho Seok	MAC
11-16/0861	comment resolution on mu acknowledgment procedure	Yongho Seok	MAC
11-16/0862	comment resolution on subclause 25.11	Yongho Seok	MAC
11-16/0864	d0.1 comment resolution on clause 6	Yasuhiko Inoue	MAC
11-16/0867	CIDs for CIDs: Section 9.3.1.9.3 Compressed BA format	George Cherian	MAC
11-16/0868	CIDs for Section 9.3.1.9.7 Multi STA BAs	George Cherian	MAC
11-16/0869	Comment resolution section 9.3 TWT	Zhou Lan	MAC
11-16/0871	Trigger Frame Per User Info Order	Zhou Lan	MAC
11-16/0877	Comment resolution on CID 783 (TXOP Duration field format)	Jeongki Kim	MAC
11-16/0878	Comment resolution on CID 782 (Intra-PPDU PS)	Jeongki Kim	MAC
11-16/0881	Comment resolution on ROMI	Jayh Park	MAC
11-16/0882	Comment resolution on TOMI	Jayh Park	MAC
11-16/0883	Comment resolution for CID152	Jayh Park	MAC
11-16/0884	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu	MAC
11-16/0890	Comment Resolution on NAV Setting of Single and Multiple Protection and Control Response	Po-Kai Huang	MAC
11-16/0913	SU Multi-TID Rules	Jarkko Kneckt	MAC
11-16/0916	TID value of ALL ACK signaling	Woojin Ahn	MAC
11-16/0917	Text for TID value of ALL ACK signaling	Woojin Ahn	MAC
11-16/0918	Discussions on Partial BSS Color	Geonjung Ko	MAC
11-16/0924	NAV resetting with RTS/MU-RTS	Weimin Xing	MAC
11-16/0925	Spex text on NAV resetting with RTS/MU-RTS	Weimin Xing	MAC
11-16/0941	CR HE Fragmentation - part 2	Ming Gan	MAC
11-16/0942	CR Service Field	Ming Gan	MAC
11-16/0951	Setting for TXOP Duration Field	Po-Kai Huang	MAC
11-16/0952	Spec text trigger frame per user info order	Zhou Lan	MAC
11-16/0953	Comment Resoluaton and Spec Text for Setting for TXOP Duration field	Po-Kai Huang	MAC
11-16/0960	AP access procedure for UL MU operation	Jinsoo Ahn	MAC
11-16/0961	Consideration on Multi-STA BlockAck Optimization	Hanseul Hong	MAC
11-16/0962	EDCA rules-follow up 1	Jing Ma	MAC
11-16/0963	EDCA rules-follow up 2	Jing Ma	MAC
11-16/0966	CID71 and CID190 Resolutions	Jarkko Kneckt	MAC

1698

11-16/998 Laurent cariou

Submissions (MU)

DCN	Title	Author	ad hoc
11-16/0866	Comment Resolution of Section 26.3.13 MU-MIMO	Kome Oteri	MU
11-16/0875	CR for the section 10.3.2.8a CS Condition to Respond CTS	Kiseon Ryu	MU
11-16/0876	CR for the section 25.5.2.4 UL MU CS CCA and CS Required Bit	Kiseon Ryu	MU
11-16/0880	UL MU Transmission Rules - EDCA backoff	Jayh Park	MU
11-16/0885	Comment Resolution on UL MU CS NAV Considerstion	Po-Kai Huang	MU
11-16/0886	Comment Resolution for some UL MU CS TBD	Po-Kai Huang	MU
11-16/0887	Spec Text for MU-RTS restriction on HE MU PPDU	Po-Kai Huang	MU
11-16/0926	Soliciting UL_MU_ACK	Raja Banerjea	MU
11-16/0929	CR - UL MU Operation	Simone Merlin	MU
11-16/0930	CD - DL MU Operation	Simone Merlin	MU
11-16/0938	Comment Resolution for Sub-clause 25.10.4	Chittabrata Ghosh	MU
11-16/0958	UL OFDMA for Unassociated STAs	Leonardo Lanante	MU

1699

12 submissions

Submissions (SR)

DCN	Title	Author	ad hoc
11-16/0879	Comment resolution on SR for VHT PPDUs	Jeongki Kim	SR
11-16/0889	comment-resolution-SR-Intra-BSS-detection	Young Hpoon Kown	SR
11-16/0901	Clarification of SR Fields in HE Trigger Based PPDU	Daewon Lee	SR
11-16/0902	Proposed Text Changes for SR Fields in HE Trigger-Based PPDU	Daewon Lee	SR
11-16/0905	SR Fields Clarification	Ron Porat	SR
11-16/0919	Discussions on SR Fields in HE Trigger-based PPDU	Geonjung Ko	SR
11-16/0310	DSC Proposal Text	Graham Smith	SR
11-16/0945	Clarifications for OBSS_PD-based SR parameters	Laurent Cariou	SR
11-16/0946	Proposed text changes for OBSS_PD-based SR parameters	Laurent Cariou	SR
11-16/0957	Comment Resolutions on OBSS_PD Conditions in 25.9.3	James Wang	SR

10 submissions

1700

Submissions (TG)

DCN	Title	Author	ad hoc
11-16/0835	EIFS	Alfred Asterjadhi	TG
11-15/1095	OFDMA Performance in 11ax	Suhwook Kim	TG
11-16/0870	Conclusing MAC Trigger Padding	Zhou Lan	T G
11-16/0907	20MHz HE devices	Joonsuk Kim	TG
11-16/0909	CR - proposed text on 20MHz devices	Joonsuk Kim	TG
11-16/0949	MAC trigger frame padding follow up	Zhou Lan	TG
11-16/0965	On High Efficiency WLAN (HEW) TG PAR Scope	Osama Aboul-Magd	TG

9 submissions adding Ke Yao comment resolution

1701

Agenda for Monday July 25, 08:00 – 10:00

- Call meeting to order
- Patent policy, etc.
- Ad Hoc meeting (No motions)
- Call for submissions.
- Set up agenda for the ad hoc meeting.
- Presentations
- Adjourn

1702

Agenda for Monday July 25, 16:00 – 18:00

- **Call meeting to order**
- **Patent policy, etc.**
- **Call for submissions**
- **Set Ad Hoc Groups schedule and approve agenda**
- **Comment Resolution Tutorial – Adrian Stephens**
- **Summary from May 2016 meeting**
- **TG motions**
  - Approve TG meeting and Telecon minutes since May meeting.
  - Approve resolutions of comments, if needed.
- **Comment Resolution Status – Robert Stacey**
- **Timeline**
- **Presentations and Comment Resolution**
  - TXOP Duration Issues (Jeongki Kim and Bo Sun)
  - 11-16/0965; On HEW TG PAR Scope
  - 11-15/1095; OFDMA Performance in 11ax
  - …..
- **Recess**

1703

Summary from May 2016 Meeting

- **Received about 70 submissions. Majority of the submission were requesting changes to the TG Specification Framework document. Few submissions were addressing comment resolution mainly ofor the PHY clause.**
- **Agreed to terminate the Specification Framework process. The frame of reference is Draft D0.1.**
  - Future submissions shall bring text to continue developing the TG draft
- **Approved the resolutions of about 200 comments, most of them addressing the PHY clause**
- **Revisited the timeline and accepted a new modified timeline – next slide.**
- **The TG had a series of telecons where resolutions of about 227 comments were discussed.**

1704

Submissions Covered During Telecons

- https://mentor.ieee.org/802.11/dcn/16/11-16-0725-03-00ax-comment-resolution-on-9-3-1-23.docx (6 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0773-02-00ax-comment-resolution-section-25-6-he-sounding.docx (15 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0774-01-00ax-comment-resolution-on-9-3-1-23-ruallocation.docx (14 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0780-01-00ax-comment-resolution-on-9-3-1-23-phy-tbd.docx (31 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0775-01-00ax-comment-resolution-on-section-26-3-12-4-phy-mu-mimo-power-pre-correction.docx (7 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0766-00-00ax-he-variant-ht-control-ul-mu-response.docx (28 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0798-00-00ax-he-variant-ht-control-general.docx (33 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0815-02-00ax-comment-resolution-mu-rts-scrambler-seed.docx (5 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0819-01-00ax-cids-for-section-9-3-1-9-blockack-frame-format.docx (9 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0806-00-00ax-he-variant-ht-control-buffer-status-report.docx (24 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0807-00-00ax-comment-resolution-on-mu-rts-cts-procedure.docx (27 CIDs)
- Note: A new revision is expected to accommodate Mark's comments
- https://mentor.ieee.org/802.11/dcn/16/11-16-0808-00-00ax-comment-resolution-on-trigger-frame-format-mu-rts-variant.docx (14 CIDs)
- Note: A new revision is expected to accommodate Mark's comments
- https://mentor.ieee.org/802.11/dcn/16/11-16-0813-00-00ax-cr-on-secition-26-2-2-txrxvector-parameters.doc (4 CIDs)
- Note: We need to revisit this document again to try to cose a couple of TBDs
- https://mentor.ieee.org/802.11/dcn/16/11-16-0836-00-00ax-comment-resolution-on-section-9-4-1-phy-mu-mimo-compressed-beamforming-report.docx (10 CIDs)
- Note: Adds significant amount of text and introduces new frame.

1705

Approval of TG Minutes (March 2016 Meeting and Telecon Minutes)

- **Approve TGax minutes of meetings and teleconferences from May 2016 interim meeting to today:**
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0686-00-00ax-tgax-may-2016-waikoloa-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0768-05-00ax-tgax-teleconference-minutes-from-june-to-july-2016.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0755-00-00ax-tgax-may-2016-waikoloa-phy-ad-hoc-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0716-00-00ax-mu-ad-hoc-meeting-minutes-may-2016.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0701-00-00ax-combined-spatial-reuse-mac-ad-hoc-group-meeting-minutes.docx

- **Move: Bo Sun** **Second: Robert Stacey**
- **Approved with no objection**

1706

Comment Resolution Status (Editor Report)

- **Robert Stacey (Technical Editor)**

1707

From IEEE 802.11 Operation Manual

- https://mentor.ieee.org/802.11/dcn/14/11-14-0629-14-0000-802-11-operations-manual.docx

Motions modifying drafts may be made at appropriate times during meetings.
Complex technical changes to a draft shall be in a submission that has been accepted by document control according to document formats specified in section 3.7 of this document and has been made available electronically for a **period of not less than four active 802.11 WG session hours**. The TG chair determines if a technical change is sufficiently complex to require a submission.

When a CRC is following the "Accelerated process" for completion of a WG letter ballot, and is not meeting during an 802.11 WG session, any submission containing changes to the draft shall be on the server and announced to the appropriate TG reflector no less than 72 hours before any motion is made related to that submission.
NOTE – when a CRC is meeting coincident with an 802.11 session, it is subject to the four hour rule described in the previous paragraph.

1708

Timeline

- May 2014: start of the TG
- Nov. 2014: First draft of the TG SFD was approved
- Jan. 2016: proposed TG draft
- March 2016: Draft D0.1 was approved and CC started
- September 2016: Draft 1.0 and WG letter ballot
- March 2017: Draft 2.0 and recirculation
- July 2017: MDR (Mandatory Document Review)
- November 2017: Formation of SB pool
- March 2018: Sponsor Ballot
- December 2018: RevCom

1709

Agenda for Tuesday July 26, 10:30 – 12:30

- **Ad Hoc Group Meetings**
  - PHY: Seaport DE
  - MAC: Seaport G

1710

Agenda for Tuesday July 17, 16:00 – 18:00

- **Ad Hoc Group Meetings**
  - MU : Seaport DE
  - SR: Seaport G

1711

Agenda for Tuesday July 17, 19:30 – 21:30

- **Ad Hoc Group Meetings**
  - PHY: Seaport DE
  - MAC: Harbor EF

1712

Agenda for Wednesday July 27, 08:00 – 10:00

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Progress from Ad Hocs**
- **Presentations**
  - 11-16/0907: 20 MHz HE Devices – Joonsuk kim
  - 11-16/0909: Text for 20 MHz - Joonsuk Kim
  - 11-16/0870 and 11-16/0949 – Zhou Lan
  - 11-16/0971 – Graham Smith
  - 11-16/0957 – James Wang
  - 11-16/0947 – Laurent Cariou
- **Recess**

1713

Agenda for Wednesday July 27, 13:30 – 15:30

- **Ad Hoc Group Meetings**
  - PHY: Seaport DE
  - MAC: Seaport G

1714

Agenda for Wednesday July 27, 16:00 – 18:00

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Presentations**
  - 11-16/0947 – Laurent Cariou
  - 11-16/0957 – James Wang (??)
- **TG Motions**
- **Recess**

1715

SR Motion #9

- **Move to include the text in doc 11-16/0971r2 related to DSC in the next revision of the TG draft**

- **Move: Graham Smith**
- **Second: Sean Coffey**

- **Motion withdrawn**

1716

SR Motion #10

- **Move to accept the proposed text changes in document "11-16/0947r4, for OBSS_PD-based SR parameters" and include the changes in the next revision of the TG draft**

- **Move: Laurent Cariou**
- **Second: Ron Porat**
- **Y: 59, N:20, A: 29**
- **Motion fails**

Agenda for Thursday July 28, AM2 and PM1

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **TG Motions**
- **Presentations (if time allows)**
  - George
  - Wojin
  - Chitto
  - Jerrko
  - Kaushik
- **Telecon**
- **adjourn**

1718

SR Motion #11

- **Move to accept the proposed text changes in document 11-16/0902r3 and include the changes in the next revision of the TG draft**

1719

- **Move: Daewon Lee**
- **Second: Ron Porat**
- **Accepted with no objection**

PHY Motion #158

- **Move to include the spec text change as shown in doc 11/16-0892r0 to the next revision of the TG draft**

- **Move: Hongyuan Zhang**
- **Second: Bo Sun**
- **Y/N/A**
- **Accepted with no objection**

PHY Motion #159

- **Move to include the spec text changes as shown in doc 11/16-0895r0 in the next revision of the TG draft, which reflects Straw Polls 1~3 in doc 11-16/0894r0**

1721

- **Move: Hongyuan Zhang**
- **Second: Bo Sun**
- **Accepted with no objection**

PHY Motion #160

- **Move to include the spec text changes as shown in doc 11/16-0897r1 in the next revision of the TG draft.**

- **Move: Hongyuan Zhang**
- **Second: Bo Sun**
- **Accepted with no objection**

- **Y/N/A**

1722

PHY Motion #161

- **Move to include the spec text changes as shown in doc 11/16-0899r0 (reflects the content of SP1 in doc 11-16/0898r0) to the next revision of the TG draft**

1723

- **Move: Hongyuan Zhang**
- **Second: Bo Sun**
- **Y/N/A**
- **Accepted with no objection**

PHY Motion #162

- Move to add the spec text changes to D0.2 on Table 26-20 – Fields in the HE-SIG-A for an HE SU PPDU and HE Extended Range SU PPDU as shown in doc 11/16-0915r0

1724

- Move: Bin Tian
- Second:
- Y/N/A

PHY Motion #163

- **Move to include the spec text change as shown in doc 11/16-0909r2 in the next revision of the TG draft.**

- **Move: Joonsuk Kim**
- **Second: Bo Sun**
- **Y/N/A**
- **Approved with no objection**

PHY Motion #164

- **Move to include the spec text changes in doc 11-16/0915r2 in the next revision of the TG draft.**

- **Move: Brian Hart**
- **Second: Bo Sun**
- **Accepted with no objection**

PHY Motion #165

- **Move to add to the next revision of the TG draft:**
  - Add at the end of section 26.3.7.1 the following sentence:

    - In a HE MU PPDU transmission, at least Nx4x26 tones (contiguous or non-contiguous), where N is the number of 20MHz channels' legacy preambles present, shall be occupied throughout the signaled BW
- **Move: Ron Porat**
- **Second: Bo Sun**
- **Y/N/A**
- **Accepted with no objection**

1727

MU Motion #57

- **Move to add the following to the next revision of the TG draft:**
  - *Insert the following at the end of 10.22.2.2:*
  - When an HE STA successfully receives the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown

1728

  - *Insert the following at the end of 10.22.2.2:*
  - When an HE STA does not receive the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown

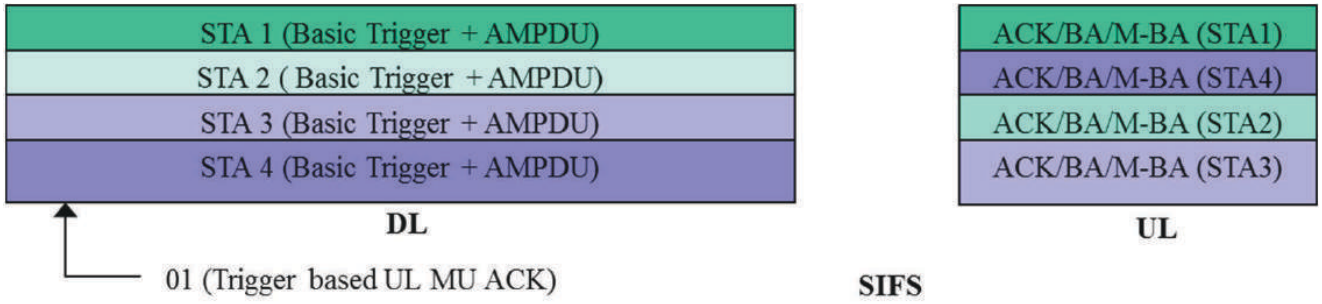
- *Insert the following at the end of 10.22.2.2:*
- If an HE STA does not successfully receive the corresponding acknowledgement frame in response to the MPDU sent in an HE trigger based PPDU, the short retry counters and long retry counters for the associated EDCAF are not changed

1729

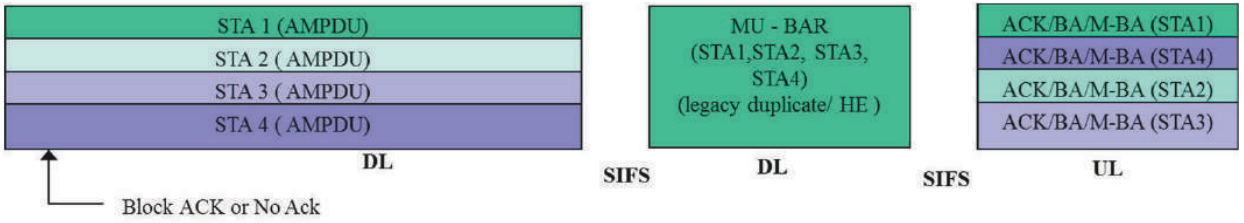
- **Move: Kiseon Ryu**
- **Second: Simone Merlin**
- **Accepted with no objection**

MU Motion

- **Move to add the following text to the next revision of the TG draft**
- **Section 25.5.1**
  - It is mandatory at the non AP HE STA to support reception of Trigger in the DL MU PPDU aggregated with Data and respond with an ACK/BA/M-BA if the QoS ACK Policy in the DL A-MPDU is set to 01 (Trigger based UL MU ACK) and the STA has not set the UL MU Disable to 1.



- It is mandatory at the non AP HE STA to support reception of DL MU PPDU with QoS ACK Policy set to Block Ack or No ACK followed by a MU-BAR within SIFS followed by transmission of the ACK/BA/M-BA appropriately if the STA has not set the UL MU Disable to 1.



- **Move: Simone Merlin**
- **Second: Alfred**
- **Ttable till PM1**

MAC Motion #85

- **Move to add the following text to the TG draft:**
  - The Queue Size subfield is an 8-bit field that indicates the amount of buffered traffic, for a given TC or TS at the STA sending this frame.
  - *An HE non-AP STA uses the Queue Size subfield to indicate the amount of buffered traffic intended for the STA identified by the receiver address of the frame containing the QoS Control field.*
- **Move: Pascal Viger Second:**
- **Y/N/A: Stephane Baron**
- **Accepted with no objection**

1732

MAC Motion #86

- **Move to add the following text to the TG draft:**
  - Add to clause #9.3.1.23
  - "Per User Info fields with AID = 0 shall be allocated only after Per User Info fields with AID not equals to 0, if any, and before the MAC padding field, if present."

1733

  - Move: Zhou Lan
  - Second: Reza Hedayat
  - Accepted with no objection

MAC Motion #87

- **Move to include the spec text change as shown in doc 11/16-0917r1 in the TG draft**

- **Move: Woojin Ahn**
- **Second: John Son**

- **Accepted with no objection**

CR Motion #15

- Move to approve resolutions of CIDs, 9, 228
- 2219, 2422, 2691, 2900 in doc 11-16/0725r3.

- Move: Raja Banerjea
- Second: Simone Merlin
- Y/N/A
- Accepted with no objection

CR Motion #16

- **Move to approve resolutions to CIDs, 55, 1000, 1221, 1915, 2234, 802,1695, 1222, 182, 971,2713, 702, 1916, 2233, 223 in doc 11-16/0773r2.**

1736

- **Move: Raja Banerjea**
- **Second: Robert Stacey**
- **Accepted with no objection**

CR Motion #17

- Move to accept resolutions to CIDs, 262,1083, 102, 612, 660, 830, 864, 1716, 2215, 2301, 2376, 372, 719, 864 in doc 11-16/0774r1

1737

- Move: Raja Banerjea
- Second: Simone Merlin
- Y/N/A
- Accepted with no objection

CR Motion # 18

- **Move to approve resolutions to CIDs, 101,103, 104,374,375, 377, 558, 561, 661, 662, 664, 688, 1296, 1299, 1301, 1717, 1718, 1882, 2113, 2114, 2174, 2217, 2302, 2421, 227, 720, 663,1303,1305,1306 in doc 11-16/0780r1**

- **Move: Raja Banerjea**
- **Second: Simone Merlin**
- **Accepted with no objection**
-

CR Motion #19

- **Move to approve resolutions to CIDs, 340, 341, 342, 343, 1023, 2734, and 2889 in doc 11-16/0775r2**

- **Move: Lochan Verma**
- **Second: Sameer Vermani**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #20

- **Move to approve resolutions of CIDs, 855, 1064, 1, 784, 90, 94, 654, 453, 1181, 2249, 2297, 2208, 2406, 2576, 2901, 2902, 2903, 2405, 2904, 1254, 1255, 1256, 1202, 1714, 1761, 1762, 1881, 1418 in doc 11-16/766r1**

- **Move: Alfred Asterjadhi**
- Second: Young Hoon kwon
- Y/N/A
- Accepted with no objection

CR Motion #21

- **Move to approve resolutions of CIDs, 1126, 1127, 1179, 58, 89, 361, 2248, 1877, 1878, 792, 686, 687, 793, 1133, 91, 92, 362, 363, 2296, 1712, 1713, 1250, 1253, 1711, 2204, 2205, 2206, 211, 364, 1231, 134, 1750, 1244 in doc 11-16/0798r0**

- **Move: Alfred Asterjadhi**
- Second: Simone Merlin
- Y/N/A
- No objection

1741

CR Motion #22

- **Move to approve resolutions to CIDs, 14, 127, 370, 371, 2602 in doc 11-16/0815r2**

- **Move: Young Hoon Kwon**
- **Second: Yongho Seok**
- **Accepted with no objection**

1742

CR Motion #23

- **Move to approve resolutions to CIDs, 961, 1137, 804, 212, 2212, 2412, 2413, 1136, 1493 in doc 11-16/0819r1**

- **Move: Alfred**
- **Second: Yasu**
- **Y/N/A**
- **Accepted with no objection**

1743

CR Motion #24

- **Move to approve resolutions to CIDs, 824, 93, 1067, 2388, 45, 178, 254, 438, 680, 769, 770, 771, 817, 818, 1062, 1065, 1066, 1550, 2189, 2190, 2191, 2272, 2711, 147 in doc 11-16/0806r0**

- **Move: Alfred Asterjadhi**
- Second: Matt Fischer
- Y/N/A
- Accepted with no objection

CR Motion #25

- **Move to approve the resolutions to CIDs, 963, 128, 214, 2171, 2428, 692, 124, 2906, 2840, 2603, 2599, 1209, 2264, 15, 13, 126, 1071, 693, 1768, 401, 1727, 403, 1644, 2281, 2282, 2279, 160 in doc11-16/0807r2**

1745

- **Move: Po-Kai Huang**
- **Second: Yongho Seok**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #26

- **Move to accept the resolutions of CIDs, 1311, 2223, 110, 2587, 8, 2222, 1068, 1310, 1312, 2588, 2601, 2894, 1204, 2907 in doc 11-16/0808r2**

1746

- **Move: Po-Kai Huang**
- **Second: Kiseon Ryu**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #27

- **Move to approve resolutions to CIDs, 2517, 1780, 1923, and 1610 in doc 11-16/0813r5.**

- **Move: Bo Sun**
- **Second: Hongyuan Zhang**
- **Y/N/A**
- **Accepted with no objection**

1747

CR motion #28

- **Move to approve resolutions to CIDs, 112, 380, 381, 456, 539, 689, 690, 1154, 1316, 1862 in doc 11-16/0836r1**

- **Move: Lochan Verma**
- **Second: Sriram**
- **Y/N/A**
- **No objection**

CR Motion #29

- **Move to approve resolution to CID 2183 in document 11-16/0816r1**

- **Move: Daewon Lee**
- **Second: Young Hoon Kown**
- **Y/N/A**
- **Accepted with no objection**

1749

CR Motion #30

- **Move to approve the resolutions to CIDs, 2007, 2005, 2123, 2747, 2746, 2244, 842, 846, 526, 910 in doc 11-16/0872r2**
-
- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

1750

CR Motion #31

- **Move to approve resolutions to CIDs, 302, 2040, 2132, 2680, 2039, 2038, 1001,479, 2150 in doc 11-16/0873r1**

- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #32

- **Move to approve resolutions to CIDs, 2032, 2549, 2133, 2548, and 1009 in doc 11-16/1021r2**

- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

1752

CR Motion #33

- **Move to approve the resolutions to CIDs, 1052, 2519 in doc 11-16/0900r1**

- **Move: Robert Stacey**
- **Second: Sriram**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #34

- **Move to approve the resolution to CID 854 in doc 11-16/0908r1**

- **Move: Joonsuk Kim**
- **Second: Yongho Seok**
- **Accepted with no objection**

1754

CR Motion #35

- **Move to approve the resolutions to CIDs, 1659, 493, 494 in doc 11-16/0920r3**

- **Move: Xiogang Chen**
- **Second: Bo Sun**
- **Y/N/A**
- **Accepted with no objection**

1755

CR Motion #36

- **Move to approve the resolutions to the CIDs, 1782, 2082, 2083 in doc 11-16/0922r2**

- **Move:** Sriram Venkaeswaran
- Second: Bo Sun
- Accepted with no objection

1756

CR Motion #37

- **Move to approve the resolutions to CIDs, 836 883 884 1930 2247 292 525 904 906 908 1984 1990 1995 1988 1994 1058 1992 1991 1985 1989 1684 523 1857 271 1412 1195 1996 2532 2120 2098 293 1987 1993 2748 2749 in doc 11-16/0937r7.**

1757

- **Move: Rui Cao**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #38

- Move to approve resolutions to CIDs, 482, 1867, 2084, 2085 in doc 11-16/0923r1

- Need presentation can skip
- Move: Sriram Venkateswaran
- Second:
- Y/N/A

1758

CR Motion #39

- **Move to approve resolutions to CIDs, 22, 23, 24, 136, 414, 415, 587, 694, 21, 1213, 2615, 1442, 1443, 1756, 1769, 2231 in doc 11-16/0829r3**

1759

- **Move: Reza Hedayat**
- **Second: Brian Hart**
- **Accepted with no objection**

CR Motion #40

- **Move to approve resolutions to CIDs, 1275, 1270, 1269, 1139, 97, 2213, 1809, 1808, 1807, 1806 in doc 11-16/0867r2**

1760

- **Move: George Cherian**
- **Second: Brian Hart**
- **Accepted with no objection**

CR Motion #41

- **Move to approve resolutions to CIDs, 76, 194, 258, 259, 1598, 1773, 2849 in doc 11-16/0844r2**

- **Move: Alfred Asterjadhi**
- Second: Brian Hart
- Y/N/A
- Accepted with no objection

1761

CR Motion #42

- **Move to approve resolutions to CIDs, 1482, 1481, 1480, 1479, 1478, 1476, 1475, 1474, 1473, 30, 1225, 1486, 967, 750, 697, 696, 1793, 424, 167, 2629, 2628, 2627, 2626, 2269, 1484, 1485, 1794, 1662, 1487, 2197, 2464, 2465, 1470, 165, 1217 in doc 11-16/0828r0**

- **Move: Alfred Asterjadhi**
- Second: Brian Hart
- Y/N/A
- Accepted with no objection

1762

CR Motion #43

- **Move to approve resolutions to CIDs, 2484, 2483, 2482, 2481, 2430, 2429, 2489 in doc 11-16/0860r1**

- **Move: Yongho Seok**
- **Second: Brian Hart**
- **Accepted with no objection**

1763

CR Motion #44

- **Move to approve the resolutions to CIDs, 73, 210, 192, 642, 1593, 1919, 643, 1595, 2259, 2260 in doc 11-16/0862r3**

1764

- **Move: Yongho Seok**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #45

- **Move to approve resolutions to CIDs, 2608, 2607, 2606, 2488, 2487, 1399, 2841 in doc 11-16/0861r2**

- **Move: Yongho Seok**
- **Second: Brian Hart**
- **Accepted with no objection**

1765

CR Motion #46

- **Move to approve the resolution to CID 2596 in doc 11-16/0953r2 and includes the text changes in the TG draft**

- **Move: Po-Kai Huang**
- **Second: Young Hoon Kown**
- **Accepted with no objection**

1766

CR Motion # 47

- **Move to approve resolutions to CIDs, 705, 2437, 2436, 2439, 2440 in doc 11-16/0879r2**

- **Move: Jeongki Kim**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

1767

CR Motion #48

- **Move to approve resolutions to CIDs, 62, 640, 2434, 2438, 703, 2435, 66, 257, 447, 186, 2661, 2662, 776, 2660, 1577, 2332, 2718 in doc 11-16/0889r1**

1768

- **Move: Young Hoon Kwon**
- **Second: Yongho Seok**
- **Accepted with no objection**

CR Motion #49

- **Move to approve resolutions of CIDs, 1070, 2226, 693, 125, 2650, 2651 in doc 11-16/0875r2**

- **Move: Kiseon Ryu**
- **Second: Po-Kai Huang**
- **Y/N/A**
- **accepted with no objection**

1769

CR Motion #50

- **Move to approve the resolutions of CIDs, 768, 829, 978, 1546, 1295, 2710, 2709, 2187, 2647, 2266 in doc 11-16/0876r2**

1770

- **Move: Kiseon Ryu**
- **Second: Po-Kai Huang**
- **Accepted with no objection**

CR Motion #51

- **Move to approve the resolutions of CIDs, 2890, 2896, 1634 in doc 11-16/0870r0**
- **Move: Zhou Lan**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

1771

CR Motion #52

- **Move to approve resolution to CID 783 in doc 11-16/0877 r5**
-
- **Move: Jeongki Kim**
- **Second: Kiseon Ryu**
- **Accpted with no objection**

1772

CR Motion #53

- **Move to approve resolutions of CIDs, 162, 2444, 2443, 2623 in doc 11-16/0835r1**

- **Move: Alfred**
- **Second: Po-Kai Huang**
- **Accepted with no objection**

1773

CR Motion #54

- **Move to approve resolutions to CIDs 507, 949, 1005, 1785, 1862 in doc 11-16/0866r4**

- **Move: Kome Oteri**
- **Second: Xiaofei**
- **Accepted with no objection**

1774

CR Motion #55

- **Move to approve resolutions to CIDs, 482, 1867, 2084, 2085 in doc 11-16/0923r1**
-
- **Move:** Sriram Venkateswaran
- Second: Ron Porat

- Accepted with no objection

CR Motion #56

- Move to approve resolutions of CIDs, 9, 228
- 2219, 2422, 2691, 2900 in doc 11-16/0725r3.

- Move: Alfred
- Second: Simone Merlin
- Second: Y/N/A
- Accepted with no objection

1776

CR Motion #57

- **Move to approve resolutions to CIDs, 55, 1000, 1221, 1915, 2234, 802,1695, 1222, 182, 971,2713, 702, 1916, 2233, 223 in doc 11-16/0773r2.**

- **Move: Alfred**
- **Second: Simone**
- **No objection**

CR Motion #58

- **Move to accept resolutions to CIDs, 262,1083, 102, 612, 660, 830, 864, 1716, 2215, 2301, 2376, 372, 719, 864 in doc 11-16/0774r1**

1778

- **Move: Alfred**
- **Second: Simone Merlin**
- **Y/N/A**

Accepted with no objection

CR Motion #59

- **Move to approve resolutions to CIDs, 101,103, 104,374,375, 377, 558, 561, 661, 662, 664, 688, 1296, 1299, 1301, 1717, 1718, 1882, 2113, 2114, 2174, 2217, 2302, 2421, 227, 720, 663,1303,1305,1306 in doc 11-16/0780r1**

- **Move: Alfred**
- **Second: Simone Merlin**

Accepted with no objection

1779

CR Motion #60

- **Move to accept resolutions to CIDs, 80, 1284, 1182, 1143, 1286, 962, 1287, 831, 508, 367, 100, 99, 98, 999, 1812, 2580, 2458, 2414, 2232, 2185, 2170, 1285, 1813, 2582, 1811, 1810, 1715, 1291, 1288, 1814 in doc 11-16/0868r1**

- **Move: George Cherian**
- **Second: Simone Merlin**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #61

- **Move to approve resolutions to CIDs, 306, 310, 311, 477, 1002, 1003, 1010, 1692, 2020, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2036, 2037, 2130, 2151, 2245, 2246, 2543, 2544, 2545, 2546, 2547, 2679, 2681 in doc 11-16/0928r2**

- **Move: Kaushik Josiam**
- **Second: Bo Sun**
- **Accepted with no objection**

1781

CR Motion #62

- **Move to approve resolutions to CIDs, 1589, 1590, 2668, and 2669 in doc 11-16/0938r0**

- **Move: Chitto Ghosh**
- **Second: Yasu**
- **Accepted with no objection**

1782

CR Motion #63

- **Move to approve resolutions to CIDs, 71 and 190 in doc 11-16/966r0**

- **Move: Jarkko Kneckt**
- **Second: Alfred**
- **Accepted with no objection**

1783

CR Motion #64

- **Move to approve resolution to CID 782 in doc 11-16/0878r1**

- **Move: Jeongki Kim**
- **Second: Kiseon Ryu**
- **Approved with no objection**

1784

Conference call times

- **August 4 20:00 – 22:00 ET is already approved**

- **August 11, 25, Sept 8 10:00 – 12:00 ET**
- **August 18, Sept 1 20:00 – 22:00 ET**

1785

APPENDIX BG

TGax September 2016 Meeting Agenda

Date: 2016-08-05

Authors:

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

1787

IEEE 802.11 TGax: High Efficiency WLAN Task Group

Warsaw, Poland

September 11-16, 2016

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

Meeting Protocol

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

1789

Attendance

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

1. Register

2. Indicate attendance

1790

Attendance, Voting & Document Status

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

1791

Patent Policy

- **Following 5 slides**

1792

Instructions for the WG Chair

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

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

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

1793

Participants, Patents, and Duty to Inform

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

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

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Slide #1

Patent Related Links

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

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

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

IEEE-SA Standards Board Operations Manual

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

Material about the patent policy is available at

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

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

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

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Slide #2

Call for Potentially Essential Patents

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

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Slide #3

Other Guidelines for IEEE WG Meetings

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

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

1797

Slide #4

Agenda Items for the Week

- **Approve TG and Telecons minutes since May meeting.**
- **Resolution of comments received on draft D0.1**
- **Ad Hoc group meetings**
- **Technical Presentations and related straw polls and/or motions**
- **Schedule Telecon times.**

General Flow of the Meeting

- **Monday September 12, 10:30 – 12:30**
  - Call Ad Hoc Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - AD hoc meeting Agenda setting
  - Approval of ad hoc meeting agenda
  - Call for submissions
  - Presentations
  - Recess
- **Monday September 12, 16:00 – 18:00**
  - Ad Hoc Group Meetings
- **Monday September 12, 19:30 – 21:30**
  - Ad Hoc Group Meetings
- **Tuesday September 13, 10:30 – 12:30**
  - Ad Hoc Group Meetings
- **Tuesday September 13, 16:00 – 18:00**
  - Ad Hoc Group Meetings
- **Wednesday September 14, 08:00 – 10:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Progress Review
  - Presentations
  - Recess
- **Wednesday September 14, 13:30 – 15:30**
  - Ad Hoc Group Meetings
- **Wednesday September 14, 16:00 – 18:00**
  - Ad Hoc Group Meetings
- **Thursday September 15, 10:30 – 12:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Recess
- **Thursday September 15, 13:30 – 15:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Recess
- **Thursday September 28, 16:00 – 18:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Goals for November 2016
  - Telecon Schedule
  - Adjourn

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TGax Schedule in a Glance

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

1800

*** Ad Hoc group is tbd**

Agenda for Monday September 12, 10:30 – 13:30

- **Call meeting to order**
- **Patent policy, etc.**
- **Call for submissions**
- **Set Ad Hoc Groups schedule and approve agenda**
- **Summary from July 2016 meeting**
- **TG motions**
  - Approve TG meeting and Telecon minutes since November meeting.
  - Approve resolutions of comments, if needed.
- **Comment Resolution Status – Robert Stacey**
- **Timeline**
- **Presentations and Comment Resolution**
- **Recess**

1801

MAC Leftover

DCN	Title	Author	
11-16/0828	HE Fragmentation - part 1	Alfred Asterjadhi	
11-16/0829	Comment Resolution for Section 10.24.10 Block Ack/GCR block ack	Reza Hedayat	
11-16/0844	CC0-Intra_PPDU_PS	Alfred Asterjadhi	
11-16/0856	Issue of Buffer Status reporting	Stephane Baron	
11-16/0860	comment resolution on A-MPDU format	Yongho Seok	
11-16/0861	comment resolution on mu acknowledgment procedure	Yongho Seok	
11-16/0862	comment resolution on subclause 25.11	Yongho Seok	
11-16/0864	d0.1 comment resolution on clause 6	Yasuhiko Inoue	
11-16/0867	CIDs for CIDs: Section 9.3.1.9.3 Compressed BA format	George Cherian	
11-16/0868	CIDs for Section 9.3.1.9.7 Multi STA BAs	George Cherian	
11-16/0869	Comment resolution section 9.3 TWT	Zhou Lan	
11-16/0871	Trigger Frame Per User Info Order	Zhou Lan	
11-16/0877	Comment resolution on CID 783 (TXOP Duration field format)	Jeongki Kim	
11-16/0878	Comment resolution on CID 782 (Intra-PPDU PS)	Jeongki Kim	
11-16/0881	Comment resolution on ROMI	Jayh Park	
11-16/0882	Comment resolution on TOMI	Alfred	
11-16/0883	Comment resolution for CID152	Jayh Park	
11-16/0884	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu	
11-16/0890	Comment Resolution on NAV Setting of Single and Multiple Protection and Control Response	Po-Kai Huang	

1802

MAC Leftover (Cotinued)

DCN	Title	Author	
11-16/0913	SU Multi-TID Rules	Jarkko Kneckt	
11-16/0916	TID value of ALL ACK signaling	Woojin Ahn	
11-16/0917	Text for TID value of ALL ACK signaling	Woojin Ahn	
11-16/0918	Discussions on Partial BSS Color	Geonjung Ko	
11-16/0924	NAV resetting with RTS/MU-RTS	Weimin Xing	
11-16/0925	Spex text on NAV resetting with RTS/MU-RTS	Weimin Xing	
11-16/0941	CR HE Fragmentation - part 2	Ming Gan	
11-16/0942	CR Field	Ming Gan	
11-16/0951	Setting for TXOP Duration Field	Po-Kai Huang	
11-16/0952	Spec text trigger frame per user info order	Zhou Lan	
11-16/0953	Comment Resoluaton and Spec Text for Setting for TXOP Duration field	Po-Kai Huang	
11-16/0960	AP access procedure for UL MU operation	Jinsoo Ahn	
11-16/0961	Consideration on Multi-STA BlockAck Optimization	Hanseul Hong	
11-16/0962	EDCA rules-follow up 1	Jing Ma	
11-16/0963	EDCA rules-follow up 2	Jing Ma	
11-16/0966	CID71 and CID190 Resolutions	Jarkko Kneckt	
11-16/0998	Rules for 2 EDCA parameters	laurent cariou	

1803

MU Leftover

DCN	Title	Author	ad hoc
11-16/0866	Comment Resolution of Section 26.3.13 MU-MIMO	Kome Oteri	MU
11-16/0875	CR for the section 10.3.2.8a CS Condition to Respond CTS	Kiseon Ryu	MU
11-16/0876	CR for the section 25.5.2.4 UL MU CS CCA and CS Required Bit	Kiseon Ryu	MU
11-16/0880	UL MU Transmission Rules - EDCA backoff	Jayh Park	MU
11-16/0885	Comment Resolution on UL MU CS NAV Considerstion	Po-Kai Huang	MU
11-16/0886	Comment Resolution for some UL MU CS TBD	Po-Kai Huang	MU
11-16/0887	Spec Text for MU-RTS restriction on HE MU PPDU	Po-Kai Huang	MU
11-16/0926	Soliciting UL_MU_ACK	Raja Banerjea	MU
11-16/0929	CR - UL MU Operation	Simone Merlin	MU
11-16/0930	CD - DL MU Operation	Simone Merlin	MU
11-16/0938	Comment Resolution for Sub-clause 25.10.4	Chittabrata Ghosh	MU
11-16/0958	UL OFDMA for Unassociated STAs	Leonardo Lanante	MU

1804

PHY Leftover

DCN	Title	Author	ad hoc
11-16/0898	BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0899	Spec Text for BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0903	Gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0904	proposed text for gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0937	11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13	Rui Cao	PHY
11-16/0906	RU restriction on 20MHz operating STAs	Joonsuk Kim	PHY
11-16/0908	CR - proposed text on RU restriction of 20MHz STAs	Joonsuk Kim	PHY
11-16/0910	Minimum Occupied Bandwidth	Ron Porat	PHY
11-16/1021r1	further-change-on-the-proposed-change-of-cid-2032-2549-2133-2548-1009	Ross	PHY
11-16/0914	Bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0915	Text for bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0920	PHY comment resolution for CID 1659,493,494	Xiaogang Chen	PHY
11-16/0922	PHY CR 1024 QAM	Sriram Venkateswaran	PHY
11-16/0923	PHY CR DCM Constellation Mapping	Sriram Venkateswaran	PHY
11-16/0928	CR on Section 26.3.9.8 - HE-SIG-B	Kaushik Josiam	PHY
11-16/0964	Considerations on MAC-PHY interactions during SR operations	Jing Ma	PHY

1805

SR Leftover

DCN	Title	Author	Order
11-16/0879r2	Comment resolution on SR for VHT PPDUs	Jeongki Kim	1
11-16/0889r1	comment-resolution-SR-Intra-BSS-detection	Young Hoon Kown	2
11-16/0901r2	Clarification of SR Fields in HE Trigger Based PPDU	Daewon Lee	3
11-16/0902r2	Proposed Text Changes for SR Fields in HE Trigger-Based PPDU	Daewon Lee	4
11-16/0905	SR Fields Clarification	Ron Porat	5
11-16/0919r0	Discussions on SR Fields in HE Trigger-based PPDU	Geonjung Ko	6
11-16/0971r2	DSC Proposal Text	Graham Smith	10
11-16/0945	Clarifications for OBSS_PD-based SR parameters	Laurent Cariou	7
11-16/0947	Proposed text changes for OBSS_PD-based SR parameters	Laurent Cariou	8
11-16/0957	Comment Resolutions on OBSS_PD Conditions in 25.9.3	James Wang	9

1806

Submissions

- **TBD**

1807

MAC Submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/0864	d0.1 comment resolution on clause 6	Yasuhiko Inoue	MAC	presented during a telecon.
11-16/0869	Comment resolution section 9.3 TWT	Zhou Lan	MAC	
11-16/0881	Comment resolution on ROMI	Jayh Park	MAC	
11-16/0882	Comment resolution on TOMI	Alfred	MAC	
11-16/0883	Comment resolution for CID152	Jayh Park	MAC	
11-16/0884	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu	MAC	
11-16/0913	SU Multi-TID Rules	Jarkko Kneckt	MAC	
11-16/0917	Text for TID value of ALL ACK signaling	Woojin Ahn	MAC	
11-16/0918	Discussions on Partial BSS Color	Geonjung Ko	MAC	
11-16/0924	NAV resetting with RTS/MU-RTS	Weimin Xing	MAC	
11-16/0925	Spex text on NAV resetting with RTS/MU-RTS	Weimin Xing	MAC	
11-16/0941	CR HE Fragmentation - part 2	Ming Gan	MAC	
11-16/0942	CR Service Field	Ming Gan	MAC	
11-16/0960	AP access procedure for UL MU operation	Jinsoo Ahn	MAC	presented during telecon. waiting SP
11-16/0961	Consideration on Multi-STA BlockAck Optimization	Hanseul Hong	MAC	
11-16/0962	EDCA rules-follow up 1	Jing Ma	MAC	presented during telecon. waiting SP
11-16/0963	EDCA rules-follow up 2	Jing Ma	MAC	presented during telecon. Waiting SP
11-16/0998	Rules for 2 EDCA parameters	laurent cariou	MAC	
11-16/1110	comment resolution on subclause 10.22.2 and 10.22.4	Yongho Seok	MAC	
11-16/1131	comment resolution on mu ack policy	Yongho Seok	MAC	
11-16/1154	MAC CR for CID 966	Weimin Xing	MAC	
11-16/1157	Comment resolution on SU_MU ACK procedures	Jeongki Kim	MAC	
11-16/1173	Comment Resolution on Two NAVs - Part II	Po-Kai Huang	MAC	
11-16/1180	Proposed text changes for MU EDCA parameters	laurent cariou	MAC	
11-16/1181	CW value after UL MU procedure	Woojin Ahn	MAC	
11-16/1182	HE Sounding Feedback Segmentation	Liwen Chu	MAC	
11-16/1183	MU RTS CTS data rate comment	Liwen Chu	MAC	
11-16/1184	A-MPDU 25.10 25.10.2 comment resolution	Liwen Chu	MAC	
11-16/1185	A-MPDU 25.10.3 comment resolution	Liwen Chu	MAC	
11-16/1186	A-MPDU Content Comment Resolution	Liwen Chu	MAC	
11-16/1188	MAC Capabilities in HE Capabilities IE	Alfred Asterjadhi	MAC	
11-16/1189	CC0-TWT operation	Alfred Asterjadhi	MAC	
11-16/1195	MAC Clarifications	Alfred Asterjadhi	MAC	
11-16/1204	Intra-PPDU Power Save for a Multiple BSSID Set Case	Geonjung Ko	MAC	
11-16/1205	Text for Intra-PPDU Power Save for a Multiple BSSID Set Case	Geonjung Ko	MAC	
11-16/1210	Comment Resolution on MU acknowledgement procedure	Junichi Iwatani	MAC	
11-16/1211	CR_CID_122_576_972_2598	Huizhao Wang	MAC	
11-16/1213	CR TWT and HE element related	Matthew Fischer	MAC	
11-16/1220	MU mode EDCA control	Jinsoo Ahn	MAC	
11-16/1234	Spec Text for TWT Protectioin field	Hanseul Hong	MAC	
11-16/1236	Text for Partial BSS Color and AID Assignment Rule	Geonjung Ko	MAC	
11-16/1237	setting-quiet-time-period	Chao-Chun Wang	MAC	
11-16/1238	Setting Quiet time period - text	Chao-Chun Wang	MAC	

1808

PHY Submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/1133	11ax sounding modes reduction	Yan Zhang	PHY	
11-16/1134	11ax spec text on sounding modes reduction	Yan Zhang	PHY	
11-16/1135	11ax comment resolutions for clause 26.3.5	Yan Zhang	PHY	
11-16/1136	11ax comment resolutions for clause 26.3.8	Yan Zhang	PHY	
11-16/1137	11ax comment resolutions for clause 26.3.9	Yan Zhang	PHY	
11-16/1138	11ax comment resolutions for clause 26.3.10	Yan Zhang	PHY	
11-16/1148	CR HE-SIG-A part III	Ross Jian Yu	PHY	
11-16/1149	CR HE-SIG-A part II	Ross Jian Yu	PHY	
11-16/1150	CR Packet Extension Part I	Ross Jian Yu	PHY	
11-16/1160	Comment Resolution for CID 355	Eunsung Park	PHY	
11-16/1167	UL MU Clarifications	Ron Porat	PHY	
11-16/1168	DCM TBDs	Sriram Venkateswaran	PHY	
11-16/1169	CR Duplicate MU MIMO	Sriram Venkateswaran	PHY	
11-16/1170	HE PHY Capabilities	Lochan Verma	PHY	
11-16/1171	PHY Miscellaneous Part-1	Lochan Verma	PHY	
11-16/1176	PHY CR Miscellaneous Part-2	Lochan Verma	PHY	
11-16/1179	PHY section editorial comments on D0.4	Sungeun Lee	PHY	maybe discuss with the Editor
11-16/1190	Tx Quality Requirements	Daewon Lee	PHY	
11-16/1191	Comment Resolution for CIDs on PHY Transmit Spec	Daewon Lee	PHY	
11-16/1192	Comment Resolution for CID 1450	Daewon Lee	PHY	
11-16/1193	HE variant HT Control - He Link Adaptation	Daewon Lee	PHY	
11-16/1194	Removal of Unnecessary PHY TBDs	Daewon Lee	PHY	
11-16/1202	CR HE-LTF	Ming Gan	PHY	
11-16/1227	cr-on-26-3-7	Shahrnaz Azizi	PHY	
11-16/1232	Text change proposal of TXTIME in 26.3.19 and 26.4.3	Daewon Lee	PHY	
11-16/1233	CR for DCM related CID 503, 504 and 2750	Daewon Lee	PHY	
11-16/1240	Packet Extension Factor calculation fix	Yan Zhang	PHY	
11-16/1242	spec text for packet extension factor calculation fix	Yan Zhang	PHY	

28 submissions

1809

MU Submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/773	Comment Resolution Section 25.6 HE Sounding	Raja Banerjea	MU	presented before July meeting. New revision
11-16/0929	CR - UL MU Operation	Simone Merlin	MU	presented during a telecon.
11-16/1152	DL OFDMA Ack rule for uplink trigger based PPDU	Ming Gan	MU	
11-16/1158	Comment resolution on OFDMA random access procedure	Jeongki Kim	MU	
11-16/1162	Comment Resolution on Retansmission of OFDMA Random Access	Yunbo Li	MU	
11-16/1163	Concluding OFDMA M-BA transmission	Zhou Lan	MU	
11-16/1177	comment-resolution-TXOP-truncation	Young-Hoon Kown	MU	
11-16/1239	Trigger Frame_MUBAR_part1	Raja Banerjea	MU	
11-16/1241	Trigger Frame_MUBAR_part2	Raja Banerjea	MU	
11-16/1199	Proposed text changes for DL OFDMA Acknowledge rule for trigger based PPDU	Ming Gan	MU	
11-16/1222	Comment Resolution on UL OFDMA Random Access	Chittabrata Ghosh	MU	
11-16/1224	Random Access Paramer Set (RAPS) element	Chittabrata Ghosh	MU	

1810

12 MU

SR Submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/0945	Clarification for OBSS_PD-based SR parameters	Matthew Fischer	SR	
11-16/0947	Proposed text changes for OBSS_PD-based SR parameters	Laurent Cariou	SR	
11-16/1064	Unified SR approach DSC, ATPC and Inter-BSS	Graham Smith	SR	
11-16/1155	SR Comment Resolution for CID994	Kaiying Lv	SR	
11-16/1161	Simulation-based evaluation of OBSS_PD-based SR default parameters	Tanguy Ropitault	SR	
11-16/1178	comment-resolution-SR-RSSI	Young-Hoon Kown	SR	
11-16/1216	SR Field SRP Table for HE-Trigger-Based PPDU	James Wang	SR	
11-16/1223	CR for Section 25.9.2 OBSS_PD Spatial reuse	laurent cariou	SR	
11-16/1225	Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA	Sean Coffey	SR	

1811

TG submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/1095	OFDMA performance in 11ax	Suhwook Kim	TG	
11-16/1143	11ax PAR Verification	TG	TG	
11-16/1159	Summary of Mandatory or Optional Features of 802.11ax	Joonsuk Kim	TG	
11-16/1166	Meeting PAR requirements with UL OFDMA	Sriram Venkateswaran	TG	
11-16/1198	Preliminary 11ax PAR Verification	Jiyong Pang	TG	
11-16/1219	Considerations on CR for 2665 and 2715	Jing Ma	TG	

1812

6 submissions

Summary from July 2016 Meeting

- **Approved the resolutions of about 230 comments discussed during telecons before July meeting.**
- **Approved resolutions of almost 350 CIDs during the July meeting**
- **Approved a number of submissions proposing new text to be added to the draft.**
- **Editor generated draft D0.3 and draft D0.4.**
- **Conducted weekly telecons since July F2F meeting.**
  - Covered 17 submissions
  - Discussed resolutions of almost 250 CIDs
  - Please refer to telecon minutes
    - https://mentor.ieee.org/802.11/dcn/16/11-16-1105-03-00ax-tgax-teleconference-minutes-from-august-to-september-2016.docx



Microsoft Word Document

1813

Approval of TG Minutes (July 2016 Meeting and Telecon Minutes)

- **Approve TGax minutes of meetings and teleconferences from July 2016 plenary meeting to today:**
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0967-00-00ax-tgax-july-2016-san-diego-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1105-03-00ax-tgax-teleconference-minutes-from-august-to-september-2016.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1040-00-00ax-tgax-july-2016-san-diego-phy-ad-hoc-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1000-02-00ax-july-2016-san-diego-tgax-mac-ad-hoc-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1027-00-00ax-mu-ad-hoc-meeting-minutes-july-2016.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1022-00-00ax-tgax-spatial-reuse-ad-hoc-group-meeting-minutes.docx

- **Move: Peter Loc** **Second: Yasu Inoue**
- **Approved with no objection**

1814

Comment Resolution Status (Editor Report)

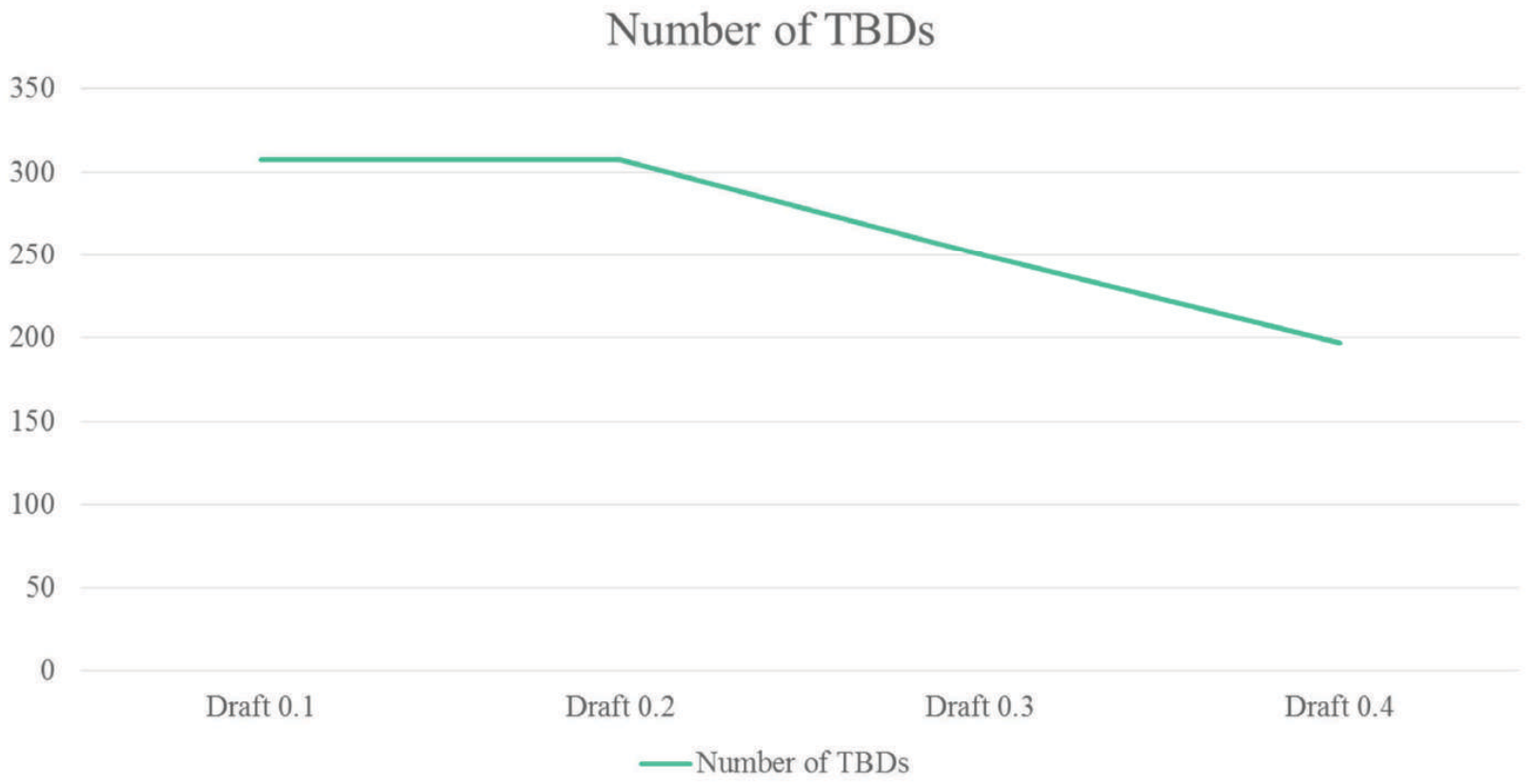
- **Robert Stacey**

1815

Timeline

- May 2014: start of the TG
- Nov. 2014: First draft of the TG SFD was approved
- Jan. 2016: proposed TG draft
- March 2016: Draft D0.1 was approved and CC started
- September 2016: Draft 1.0 and WG letter ballot
- March 2017: Draft 2.0 and recirculation
- July 2017: MDR (Mandatory Document Review)
- November 2017: Formation of SB pool
- March 2018: Sponsor Ballot
- December 2018: RevCom

Number of TBDs



1817

Agenda for Monday September 12, 16:00 – 18:00

- **Ad Hoc Meetings**
  - PHY: Ballroom C&D
  - MAC : Baltic I

1818

Agenda for Monday September 12, 19:30 – 21:30

- **Ad Hoc Meetings**
  - PHY: Ballroom C&D
  - SR: Baltic I

1819

Agenda for Tuesday September 13, 10:30 – 12:30

- **Ad Hoc Group Meetings**
  - MU: Ballroom C&D
  - MAC: Baltic I

1820

Agenda for Tuesday September 13, 16:00 – 18:00

- **Ad Hoc Group Meetings**
  - PHY: Ballroom C&D
  - MAC: Baltic I

1821

Agenda for Wednesday September 14, 08:00 – 10:00

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Progress from the ad hocs**
- **Presentations**
  - 11-16/1143, "11ax PAR Verification"
  - 11-16/1159, "Summary of Mandatory or Optional Features in 11ax"
  - 11-16/1223, "CR for Section 25.9.2 OBSS_PD Spatial reuse" - SP
  - 11-16/1219, "Consideration on CR for 2665 and 2715 – Jing Ma
  - 11-16/1225, "Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA" – move to Thursday AM2
- **Recess**

1822

11-16/1223 SP

- **Do you agree with the comment resolutions in document 1223r6 for CIDs 2386, 1232, 63, 463, 2663, 67, 641, 2913, 65, 462, 2742, 2743, 777, 255, 2665, 449, 68, 706, 1018, 2723, 1017, 1582, and 2667?**

1823

- **Accepted with no objection**

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

- **Ad Hoc Group Meetings**
  - PHY: Ballroom C/D
  - MAC: Baltic I

1824

Agenda for Wednesday September 14, 16:00 – 18:00

- **Ad Hoc Group Meeting**
  - MU : Ballroom C/D
  - MAC: Baltic I

1825

Agenda for Thursday September 15, 08:00 – 10:00

- **Ad Hoc Meetings**
  - PHY: Ballroom C/D
  - MAC: Baltic I

1826

Agenda for Thursday September 15, AM2, PM1, and PM2

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Presentations**
  - Continuation of PHY comments assignment
  - 11-16/1225, "Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA" – move to Thursday AM2
  - 11-16/1241 from the MAC ad hoc
- **TG Motions**
- **Timeline**
- **Goals for November 2016**
- **Telecon Schedule**
- **Adjourn**

1827

Motions

- **TG Motions start here**

1828

PHY Motion #166

Move to make the following changes to the spec.

Replace the following text in Subclause 26.3.5 P82 L65

The HE extended range SU PPDU is 20 MHz and can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>, <MCS 1, 1> and <MCS 2, 1>

by

The HE extended range SU PPDU only supports single 242-tone and 106-tone RU. The 242-tone RU can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>, <MCS 1, 1> and <MCS 2, 1>. The 106-tone RU can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>. The 106-tone RU location within the 20MHz tone plan is fixed as the right one.

Move: Bin Tian Second: VK Jones

Accepted with no objection

PHY Motion #167

- **Move to accept the spec text changes as shown in doc 11/16-1134r1 and add to the next revision of the TG draft**

1830

- **Move: Yan Zhang**
- **Second: Daewon Lee**
- **Accepted with no objection**

PHY Motion

- **Move to adopt the following SRP values for the corresponding entries in Spatial Reuse fields (in Spatial Reuse 1, Spatial Reuse 2, Spatial Reuse 3, and Spatial Reuse 4) for HE Trigger-based PPDU**

Spatial Reuse	SRP	Spatial Reuse	SRP
0001	-80 dBm	1000	-44 dBm
0010	-74 dBm	1001	-41 dBm
0011	-68 dBm	1010	-38dBm
0100	-62 dBm	1011	-35dBm
0101	-56 dBm	1100	-32 dBm
0110	-50 dBm	1101	-29 dBm
0111	-47 dBm	1110	-26 dBm

- SRP = $TX\ PWR_{AP}$ + Acceptable Receiver Interference $level_{AP}$
- Adjustment range for parameters (referenced to the antenna port)
  - TX_PWR_{AP}: -10 dBm to 26 dBm
  - Acceptable Receiver Interference $Level_{AP}$: -82dBm to -36 dBm
- If SRP is below <-80 dBm, set to Spatial Reuse to 0001, if SRP is above -26 dBm, set Spatial reuse to 1110
- Set Spatial Reuse to 0000 for SR disallowed flag, Value 1111 is reserved
- Same table is used for AP and STA.

Doc 11-16/1216r1

Move: James Wang Second:

Motion is not run since it is included in comment resolution doc 11-16/1148r6

PHY Motion # 168

- **Move to accept the proposed spec text in doc 11-16/1170r1 and include it in the next revision of the TG draft**

1832

- **Move: Sameer Vermani**
- **Second: Bin Tian**
- **Accepted with no objection**

PHY Motion #169

- **Move to accept the proposed spec text in doc 11-16/1171r0 and include it in the next revision of the TG draft**

1833

- **Move: Sameer Vermani**
- **Second: Bin Tian**
- **Accepted with no objection**

PHY Motion #170

- **Move to add to 11ax spec draft D0.4 page 227 line 7 the following statement:**
  - A STA that applies beamforming (BF) in the UL should take the BF gain into account when calculating the transmit power needed to meet the target RSSI.

1834

- **Move: Sriram**
- **Second: Zhou Lan**

- **Doc 11-16/1167r1**
- **Accepted with no objection**

PHY Motion

- **Move to add to the 11ax spec draft D0.4 on page 186 line 52 (after "It is mandatory to support transmission of 1x HE-LTF in an UL MU-MIMO PPDU over the full bandwidth, for a STA declaring support for UL MU-MIMO") the following sentence:**
  - When 1xLTF is used for full BW UL MU-MIMO, no pilots (in the LTF field) or frequency domain masking are applied.

1835

- **Move: Sriram** **Second:**
- **Doc: 11-16/1167r1**
- **Skipped because it is already in a CR document 11-16/1202r2**

PHY Motion #171

- **Move to add the proposed spec text changes in 11-16/1168r2 and include it in the next revision of the TG draft**

1836

- **Move: Sriram Venkateswaran**
- **Second: Bin Tian**
- **Accepted with no objection**

PHY Motion #172

- **Move to add the proposed spec text changes in 11-16/1179r4 and include in the next revision of the TG draft**

1837

- **Move: Daewon Lee**
- **Second: Sai**
- **Accepted with no objection**

PHY Motion #173

- **Move to add the proposed spec text changes in 11-16/1194r1 and include it in the next revision of the TG draft**

1838

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

PHY Motion #174

- **Move to add the proposed spec text changes in 11-16/1242r1 and include it in the next revision of the TG draft**

1839

- **Move: Yan Zhang**
- **Second: Daewon Lee**

- **Accepted with no objection**

SR Motion #12

- **Move to accept the modifications as proposed in submission 11-16/0947r12 and include it in the next TG draft**

1840

- **Move: Matthew Fischer**
- **Second: Alfred Asterjadhi**

- **Y:27 N: 10 A;21 Motion fails**

Motion to amend (SR #12 *)

- **Move to amend the motion (2016-09 SR #12) as follows:**
  - Alter to:
    - Move to accept the modifications as proposed in submission 11-16/0947r12, with the normative text

      "In the SR subfield of the HE-SIGA field:
      - One entry disallows SRP-based SR;
      - One entry disallows both SRP-based SR and OBSS_PD-based SR."

      added in Section 25.9.2,

      and include it in the next TG draft
- **Move: Sean Coffey**
- **Second: George Cherian**
- **Y 26 N 22 A 17**
- **Simple majority required. Motion passes**

1841

Motion (2016-09 SR #12A)

Move to accept the modifications as proposed in submission 11-16/0947r12, with the normative text

"In the SR subfield of the HE-SIGA field:

- One entry disallows SRP-based SR;
- One entry disallows both SRP-based SR and OBSS_PD-based SR."

added in Section 25.9.2,

and include it in the next TG draft

1842

Motion to amend (SR #12 **)

Amend to read as:

"Move to accept the modifications as proposed in submission 11-16/0947r12, with the normative text

"In the SR subfield of the HE-SIGA field:

- One entry disallows both SRP-based SR and OBSS_PD-based SR."

added in Section 25.9.2,

and include it in the next TG draft"

1843

Move: Matthew Fischer

Second: Bin Tian

Y 39 N 14 A 9

Simple majority required. Motion passes

Motion (2016-09 SR #12B)

"Move to accept the modifications as proposed in submission 11-16/0947r12, with the normative text

"In the SR subfield of the HE-SIGA field:

- One entry disallows both SRP-based SR and OBSS_PD-based SR."

added in Section 25.9.2,

and include it in the next TG draft"

Y 44 N 21 A 4

75% majority required. Motion fails

1844

Motin To reconsider SR Motion #12

- **Move to reconsider SR Motion #12**

- **Move: Robert Stacey**
- **Second Po-Kai Huang**

1845

- **Y: 34 No: 5 A: 25**
- **Motion Passes**
- **Back to the original SR #12 motion.**

Move to amend ST Motion #12

- **Move to amend the motion**
- **Delete the exploratory text**

1846

MU motion #58

- **Move to add the following text after the end of the first paragraph of section 10.3.2.11.3 of the draft spec:**

Specifically, when an AP transmits an immediate acknowledgement in HE MU PPDU in response to (A-)MPDU sent in HE trigger-based PPDU, the AP should send it within the 20 MHz channel(s) where the pre-HE modulated fields of the HE trigger-based PPDU sent by the STA are located. The immediate acknowledgement is either Block Ack frame (or Ack frame) or Multi-STA Block Ack frame.

1847

Move: Ming Gan

Second: David Yang

Accepted with no objection

MU Motion #59

- **Move to add the following paragraph after the first paragraph of section 25.4.1**

1848

A HE AP should only transmit group addressed M-BA in the DL MU PPDU to HE non AP STA *n* on the (broadcast RU) RU (26/52/106/242/484/996) that includes the RU used for receiving the immediate preceding HE Trigger Based PPDU from STA *n*. There shall be no more than one M-BA that is addressed to multiple recipients carried in a broadcast RU of the DL MU PPDU.

- **Move: Zhou Lan Second: Sriram**
- **Doc: 11-16/1163r0**
- **Approved with no objection**

MU Motion #60

- **Move to add the following text to the next revision of the TG draft**

1849

- ***TGax editor: Add the Paragraph on page 40 line 62 as the following:***
  - An MU-RTS frame shall not be carried in an HE MU PPDU.

- **Move: Po-Kai Huang**
- **Second: Robert Stacey**
- **Accepted with no objection**
- **Doc 11-16/0887r1**

MAC Motion #88

- **Move to accept the proposed text in document 16/0884r5 and include it in the next revision of the TG draft.**

- **Move: Tianyu Wu**
- **Second: David Yang**
- **Accepted with no objection**

MAC Motion #89

- **Move to accept the proposed text in document 16/0925r1 and include it in the next revision of the TG draft.**

1851

- **Move: Weimin Xing**
- **Second: Kaiying**
- **Accepted with no objection**

MAC Motion #90

- **Move to add the following sentence to the section 25.5.2.2.3 AP access procedures for UL MU operation on page 92 line 31, draft D0.4**
  - An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2 (HCF contention based channel access (EDCA)) for obtaining and sharing the TXOP

1852

- **Move: Jing Ma**
- **Second: Young Hoon Kwon**

Accepted with no objection

- **Doc:11-16/0962r5**

MAC Motion #91

- **Move to accept the spec changes proposed in document 16/1180r1 and include them in the next revision of the TG draft**

1853

- **Move: Po-Kai Huang**
- **Second: Young Hoon Kwon**

- **Accepted with no objection**

MAC Motion

- **Move to add the subfields below to the HE Capabilities IE and include it in the next revision of the TG draft**

1854

+HTC-HE Support	HE Link Adaptation	All Ack Support	32 bit BA Bitmap Support	MU Cascading Supported	Broadcast TWT Supported	Ack-enabled Multi-TID Aggregation Support	Group Addressed Multi-STA BlockAck In DL MU Support	OMI A-Control Support	OFDMA RA Support
Bits: 1	2	1	1	1	1	1	1	1	1

- **Move: Alfred Asterjadhi**
- **Second:**
- **Doc:11-16/1188r1**
- **Motion is not run. It is included in another CR document 11-16/1266r3**

MAC Motion

- **Do you support that:**
  - The reception of Action (ACK) frame aggregated with Data is optional.
  - The reception of acknowledgement frames (ACK, BA, M-BA) aggregated with Data is optional (indicated via MU Cascading Supported bit).
  - The reception of Basic variant Trigger frame aggregated with Data is mandatory.

- **What is the action?**

1855

MAC Motion

- **Move to accept the proposed text in document 16/0884r5 and add it to the next revision of the TG draft.**

1856

- **Move: Jianhan Liu**
- **Second:**
- **Motion is skipped. Duplication of MAC Motion #88**

MAC Motion #92

- **Move to instruct the TGax Editor to make the following changes:**
- *TGax Editor: Change the paragraph below of 9.3.1.23.1 of D0.4 as follows:*
- **The TID Aggregation Limit subfield indicates the maximum number of TIDs ~~minus 1~~ that can be aggregated by a STA in a multi-TID A-MPDU carried in the responding HE trigger-based PPDU.**
- **NOTE– A value of 7 in the TID Aggregation Limit subfield indicates to the STA that it can aggregate QoS Data frames from any number of different TID values in the multi-TID A-MPDU.**
-
- *TGax Editor: Change the paragraph below of 25.5.2.2.2 of D0.4 as follows:*
- **The AP shall set the value in the TID Aggregation Limit subfield in the Type dependent Per User Information field to 0 or 1 for an HE STA with STA that has indicated a zero value in the Multi-TID Aggregation Support field of the HE Capabilities element it transmits and is identified by the AID12 subfield of the User Info field of a Basic Trigger variant Trigger frame (see 9.3.1.23 (Trigger frame format)).(#2669) A value of zero indicates to the STA that it shall not solicit any immediate response for the MPDUs that the STA aggregates in the Trigger-based PPDU.**
- **Move: Alfred Asterjadhi Second: George Cherian**
- **Accepted with no objection**
- **Doc: 11-16/1195r1**

1857

MAC Motion

- **Move to accept the following NAV update rule:**
  - A STA shall update its NAV, irrespectively of whether it is the intended receiver of an MPDU contained in the received PPDU, except that it shall ignore the NAV if the PPDU solicits an immediate response from the STA

1858

- **Move: Alfred Asterjadhi**
- **Second:**
- **Skipped because it is included in CR document 11-16/1173r2**
- **Doc: 11-16/1195r1**

MAC Motion #93

- **Move to accept the proposed spec text change in document 16/1205r0 and include it in the next revision of the TG draft**

1859

- **Move: Geonjung Ko**
- **Second: John Son**
- **Accepted with no objection**

CR Motion #65

- **Move to accept resolutions to CIDs; 1467, 635, 2648, 2708, 1544, 1545, 2649, 437, 1542, 990, 2256, 1543, 599 in doc 11-16/0885r3**

1860

- **Move: Po-Kai Huang**
- **Second: Alfred**
- **Accepted with no objection**

CR Motion #66

- **Move to accept resolutions to CIDs; 177, 2188, 1220, 206, 700 in doc 11-16/0886r3**

- **Move: Po-Kai Huang**
- **Second: Alfred**
- **Accepted with no objection**

1861

CR Motion #67

- **Move to accept resolutions to CIDs; 2579, 1203, 795, 610, 2408, 2375, 2184, 1263, 1264, 2409, 2410, 2411 in doc 11-16/0890r2**

1862

- **Move: Po-Kai Huang**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

CR Motion #68

- **Move to accept resolutions to CIDs; 1218, 31, 168, 752, 1495, 1498, 1499, 1500, 1664, 1795, 1900, 2319, 813 doc 11-16/1028r3**

1863

- **Move: Bin Tian**
- **Second: Alfred**
- **Accepted with no objection**

CR Motion #69

- **Move to accept resolutions to CID; 32, 33, 169, 221, 250, 427, 429, 753, 754, 755, 756, 1502, 1503, 1504, 1505, 1506, 1508, 1801, 1901, 1902, 1903, 2632, 2633, 2634, 2635 in doc 11-16/930r3**

1864

- **Move: Alfred Asterjadhi**
- **Second: VK Jones**

- **Accepted with no objection**

CR Motion #70

- **Move to accept resolutions to CIDs; 34, 35, 36, 39, 40, 42, 43, 44, 170, 172, 173, 174, 175, 176, 432, 436, 460, 591, 593, 594, 676, 677, 678, 698, 699, 800, 815, 816, 859, 860, 862, 968, 977, 997, 1078, 1079, 1080, 1081, 1082, 1184, 1438, 1519, 1522, 1530, 1531, 1534, 1538, 1541, ~~1646~~, 1648, 1665, 1753, 1772, 1802, 1828, 1904, 1905, 1906, 1909, 1910, 1911, 1912, 2173, 2175, 2176, 2194, 2255, 2271, 2321, 2381, 2382, 2452, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2644, 2645, 2646, 2682, 2706, 2707 in doc 11-16/0929r3**

- **Move: Alfred Asterjadhi Second: Bin Tian**
- **Accepted with no objection**

1865

CR Motion #71

- **Move to accept resolutions to CIDs; 112, 380, 381, 456, 539, 689, 690, 1154, 1316, 1862 in doc 11-16/1097r1**

1866

- **Move: Sameer Vermani**
- **Second: Bin Tian**
- **Accepted with no objection**

CR Motion #72

- **Move to accept resolutions to CIDs; 1743, 1775, 1638, 785, 1742, 164, 1636, 28, 163, 2317, 1463, 2625, 2702, 2703, 2704, 2705, 422, 748, 1216, 1744, 1759, 866, 788, 2739, 220, 1014, 1011, 746, 1466, 709, 27, 1469, 2473, 747, 2491, 1215, 29 in doc 11-16/1106r2**

1867

- **Move: Po-Kai Huang**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

CR Motion #73

- **Move to accept resolutions to CIDs; 2207, 857, 2611, 2612, 1429, 1434, 1435, 1817 in doc 11-16/1127r0**

- **Move: Alfred Asterjadhi**
- **Second: Bin Tian**
- **Accepted with no objection**

1868

CR Motion #74

- **Move to accept resolutions to CIDs; 995, 2597, 2584 in doc 11-16/1122r0**

- **Move: Po-Kai Huang**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

1869

CR Motion #75

- **Move to accept resolutions to CIDs; 83, 1227, 1228, 1229, 1238, 1239, 1240, 2292, 2293, 2294, 2304, 2305, 2306, 1125, 1230, 1241, 1596, 1869, 2420, 1123 in doc 11-16/0864r6**

1870

- **Move: Yasu Inoue**
- **Second: Alfred**

- **Accepted with no objection**

CR Motion #76

- **Move to accept resolutions to CIDs; 2386, 1232, 63, 463, 2663, 67, 641, 2913, 65, 462, 2742, 2743, 777, 255, 2665, 449, 68, 706, 1018, 2723, 1017, 1582, and 2667 in doc 1223r6**

- **Move: Po-Kai Huang**
- **Second: Chittabrata Ghosh**
- **Accepted with no objection**

CR Motion #77

- **Move to approve resolutions of CIDs; 2664 and 2744 in doc 11-16/1178r0**

- **Move: Youn Hoon Kwon**
- **Second: Daewon Lee**
- **Accepted with no objection**

1872

CR Motion #78

- **Move to accept resolution to CID 979 in doc 11-16/0876r2**

- **Move: Kiseon Ryu**
- **Second: Alfred Asterjadhi**

- **Accepted with no objection**

1873

CR Motion #79

- **Move to approve resolutions to CIDs; 1927, 2521, 2522, 2523, 2107, 2108 in doc 11-16/1135r2**

- **Move: Yan Zhang**
- **Second: Bo Sun**
- **Accepted with no objection**

1874

CR Motion #80

- **Move to approve resolutions to CIDs; 286, 290, 2137, 287, 288, 289, 528, 1676, 1980, 1982, 1983, 2417, 2418, 2419, 298, 299, 300, 1979, 2370, 901, 1847, 1967, 1968, 1970, 1971, 1973, 1974, 1976, 1977, 1978 in doc 11-16/1136r5.**

- **Move: Yan Zhang**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #81

- **Move to approve resolutions of CIDs; 294, 873, 1099, 1698, 1997, 1998, 1999, 2000, 2019, 2531, 2540, 2541 and 2542 in doc 11-16/1137r4**

1876

- **Move: Yan Zhang**
- **Second: Daewon Lee**
- **Accepted with no ojection**

CR Motion #82

- **Move to approve the resolutions of CIDs; 2097, 2099, 2563, 2564, 2726, 2881, 484 in doc 11-16/1138r4**

- **Move: Yan Zhang**
- **Second: Bo Sun**
- **Accepted ith no objection**

1877

CR Motion #83

- **Move to approve the resolutions of CIDs; 1022, 2864, 2678, 2016, 2011, 2010, 2001, and 226 in doc 11-16/1148r6**

1878

- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #84

- **Move to approve the resolutions of CIDs; 304, 2035, 2033, 527, 478, 2550, 2157, 2131 in doc 11-16/1149r1**

- **Move: Ross Jian Yu**
- **Second: Bo Sun**

- **Accepted with no objection**

1879

CR Motion #85

- **Move to accept resolutions to CIDs; 1459, 2100, 2101, 2102, 2104, 2135, 2568, 2569, 2570, 2571, 2573, 1414, 1626, 2015, and 336 in doc 11-16/1150r3**

1880

- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #86

- **Move to approve resolution of CID 355 in doc 11-16/1160r0**

- **Move: Eunsung Park**
- **Second: Jinsoo Choi**

- **Accepted with no objection**

1881

CR Motion #87

- **Move to approve resolutions to CIDs; 834, 1030, 1604, 1861, 2242, and 2919 in doc 11-16/1176r1**

1882

- **Move: Sameer Vermani**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #88

- **Move to accept resolutions to CIDs; 506, 851, 1024, 1628, 1693, 1694, 1696, 2159, 2162, 2163, 2165, 2166 in doc 11-16/1169**r1

1883

- **Move:** Sriram Venkateswaran
- **Second: Bo Sun**

- **Accepted with no objection**

CR Motion #89

- **Move to approve resolutions to CIDs; 1778, 1784, 2063, 2064, 2065, 2069, 2071, 2073, 2074, 925, 2561, 2560, 2562, 2076, 2070, 332, 2075, 328, 329, 331, 2160, 2161, 2164, 2067 in doc 11-16/1259r2**

1884

- **Move: Sriram Venkateswaran**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #90

- **Move to approve resolutions to CIDs; 538, 496, 497, 498, 499, 344, 501, 1026, 1115, 2351, 500 in doc 11-16/1191r2**

1885

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #91

- **Move to approve the resolution of CID 1450 in doc 11-16/1192r0**

1886

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**

- **Accepted with no objecton**

CR Motion #92

- **Move to accept resolutions to CIDs 4 and 2740 in doc 11-16/1193r1**

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

1887

CR Motion #93

- **Move to accept resolutions to CIDs; 503, 504 and 2750 in doc 11-16/1233r1**

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

1888

CR Motion #94

- Move to accept resolutions to CIDs; 327, 2442 in doc 11-16/0942r3

- Move: Min Gan
- Second:Peter Loc
- Accepted with no objection

CR Motion

- **Move to accept resolutions to CID 286 and CID 2137 to as in 11-16/1136r5**
- **Move: Yan Zhang**
- **Skipped. Covered by motion #80**

1890

CR Motion #95

- **Move to approve resolution of CIDs 55, 1000, 1221, 1915, 2234, 802, 1695, 1222, 182, 971, 2713, 702, 1916, 2233, 223 as proposed in doc 11-16/0773r4**

1891

- **Move: Sameer Vermani**
- **Second: Bin Tian**

- **Accepted with no objection**

CR Motion #96

- **Move to approve resolution of CIDs 787 and 2471 as proposed in doc 11-16/1158r3**

- **Move: Jeongki Kim**
- **Second: Kiseon Ryu**

- **Accepted with no objection**

1892

CR Motion #97

- **Move to approve resolution of CIDs 49, 601, 442, 2385, 51, 602, 1198, 2684, 181, 440 and 2291 as proposed in doc 11-16/1162r4**

1893

- **Move: Yunbo Li**
- **Second: Ross Jian Yu**
- **Accepted with no objection**

CR Motion #98

- **Move to approve resolutions of CIDs 18, 204, 626, 673, 737, 738, 810, 1440, 1660, 2193, 2283, 2447, 2613, 2614 and 992 as proposed in doc 11-16/1177r2**

1894

- **Move: Young Hoon Kwon**
- **Second: Peter Loc**
- **Accepted with no objection**

CR Motion #99

- **Move to approve resolution of CIDs 5, 108, 512, 566, 567, 615, 665, 973, 1308, 1815, 2220, 2252, 2423, 2585 and 2586 as proposed in doc 11-16/1239r1**

1895

- **Move: George Cherian**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

CR Motion #100

- **Move to approve resolution of CIDs 863, 219, 411, 2380, 2609, 671, 2115, 986 and 734 as proposed in doc 11-16/1183r3**

1896

- **Move: Liwen Chu**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

CR Motion #101

- **Move to approve resolution of CIDs 47, 48, 179, 180, 450, 600, 701, 801, 820, 988, 1084, 1199, 1201, 1913, 1914 and 2384 as proposed in doc 11-16/1222r1**

1897

- **Move: Chittabrata Ghosh**
- **Second: Po-Kai Huang**
- **Accepted with no objection**

CR Motion #102

- **Move to approve resolution of CIDs 2316, 631, 811, 2905, 2257, 632, 205 and 966 as proposed in doc 11-16/1173r2**

1898

- **Move: Po-Kai Huang**
- **Second: Chittabrata Ghosh**
- **Accepted with no objection**

CR Motion #103

- **Move to accept resolutions to CIDs: 1315, 2424, 2589, 2590, 2591 in doc 11-16/0869r2**

- **Move: Zhou Lan**
- **Second: Alfred Asterjadhi**
- **Accepted with no objection**

1899

CR Motion #104

- **Move to accept resolutions to CIDs: 2, 60, 61, 184, 185, 207, 445, 446, 655, 685, 775, 856, 1223, 1224, 1562, 1565, 1568, 1569, 1572, 1573, 1574, 2200, 2236, 2238, 2239, 2328, 2330, 2657 in doc 11-16/0881r2**

1900

- **Move: Jayh Park**
- **Second: Brian Hart**
- **Accepted with no objection**

CR Motion #105

- **Move to accept resolution for CIDs: 152 in doc 11-16/0883r1**

- **Move: Jayh Park**
- **Second: Alfred Asterjadhi**

- **Accepted with no objection**

1901

CR Motion #106

- **Move to accept resolutions to CIDs: 1477, 675, 423, 166, 1823, 2270, 2268, 2254, 2198, 1824, 1818, 1800, 1796, 1663, 1491, 1489, 1488, 2630 in doc 11-16/0941r0**

1902

- **Move: Ming Gan**
- **Second: Peter Loc**

- **Accepted with no objection**

CR Motion #107

- **Move to accept resolutions to CIDs: 2468, 2470, 2448, 2450, 2451, 809 in doc 11-16/1110r0**

- **Move: Yongho Seok**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

1903

CR Motion #108

- **Move to accept resolutions to CIDs; 2445, 2457, 2494, 2395 in doc 11-16/1131r2**

- **Move: Yongho Seok**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

1904

CR Motion #108

- **Move to accept resolutions to CIDs: 129, 130, 131, 132, 405, 406, 407, 408, 672 in doc 11-16/1157r0**

- **Move: Jeongki Kim**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

1905

CR Motion #110

- **Move to accept resolutions to CIDs: 2258, 2446, 1588, 1645 in doc 11-16/1184r1**

- **Move: Liwen Chu**
- **Second: Lei Wang**
- **Accepted with no objection**

1906

CR Motion #111

- **Move to accept resolutions for CIDs: 984, 70, 229, 191, 2670, 1379, 1380 in doc 11-16/1185r2**

- **Move: Liwen Chu**
- **Second: Lei Wang**
- **Accepted with no objection**

1907

CR Motion #112

- **Move to accept resolutions for CIDs: 95, 365, 656, 794, 1134, 1135, 1260, 2298, 2407, 2463, 2469, 2658, 2659 in doc 11-16/0882r3**

1908

- **Move:Jayh Park**
- **Second: Alfred Asterjadhi**

- **Accepted with no objection**

CR Motion #113

- **Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1189r2 for CIDs: 1214, 1779, 1658, 2899, 959, 416, 1735, 740, 1445, 1639, 137, 139, 2398, 2399, 1640, 1738, 2616, 1651, 1652, 1736, 1737, 742, 25, 138, 2617, 1653, 744, 957, 26, 141, 420, 142, 2618, 1741, 1874, 2400, 2845, 1649, 1650, 1740, 1739, 695, 1641, 976, 144, 1077, 145, 146, 452, 1642, 2619, 2621, 1643, 1647, 958, 745, 586, 143, 2622, 2820, 1656, 1654, 1657, 1646, 1318, 544, 155, 153, 151 in doc 11-16/1189r2.**

- **Move: Alfred Asterjadhi**
- **Second: Reza Hedayat**
- **Accepted with no objection**

CR Motion #114

- **Move to accept resolutions for CIDs: 2313, 1410, 1454, 1728, 1897, 1411, 1729, 1898, 1899, 1730, 1731, 1403, 1427, 1409, 20, 1732, 1733, 17, 133 in doc 11-16/1210r1**

1910

- **Move: Junichi Iwatani**
- **Second: Yasu Inoue**
- **Accepted with no objection**

CR Motion #115

- **Move to accept resolutions for CIDs:122, 576, 972, 2598 in doc 11-16/1211r2**

- **Move: Huizhao Wang**
- **Second: Zhou Lan**
- **Accepted with no objection**

1911

CR Motion #116

- **Move to accept resolutions to CIDs; 1865 323 481 517 537 920 319 1059 2559 2551 2552 2553 2554 2555 2556 2557 2558 923 in doc 11-16/1202r5**

1912

- **Move: Ming Gan**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #117

- **Move to accept resolutions to CIDs; 841,1787,1945, 1946,1949,1950,1965,2365,2366,2524,2525,2526,2918 in doc 11-16/1227r2**

1913

- **Move: Po-Kai Huang**
- **Second: Chitto Ghosh**
- **Accepted with no objection**

CR Motion #118

- **Move to accept resolutions for CIDs: 805, 1354, 1356, 1357, 1358, 1360, 1359, 668, 1792, 2475, 2477, 2478, 2479, 2480, 1527, 2263, 120, 1366, 10, 1368, 1369, 1371, 1372, 1374, 1375, 394, 11,12, 669, 1378, 1376, 2455, 2592, 1381, 1384, 2456, 1377, 1635, 1804, 2309, 1367, 670, 2593, 2594, 2595, 1386 in doc 11-16/1186r1**

- **Move: Liwen Chu**
- **Second: Lei Wang**

- **Accepted with no objection**

CR Motion #119

- "Moved to add to the 11ax draft comment resolutions in document 16/1266r3 for CIDs:

113	114	115	116	117	156	196	197
	198	199	200	201	202	213	263
	264	267	387	388	389	390	391
	392	393	457	571	572	573	620
	621	666	667	682	723	724	
	1027	1152	1156	1157	1158	1159	1160
	1161	1162	1163	1164	1183	1205	1206
	1207	1314	1319	1320	1321	1322	1323
	1324	1325	1327	1332	1333	1335	1343
	1344	1346	1347	1348	1352	1415	1452
	1453	1655	1679	1680	1721	1723	1724
	1725	1764	1797	1798	1799	1803	1883
	1884	1885	1886	1887	1888	1889	1890
	1891	1892	1893	1894	1896	2253	2276
	2277	2278	2307	2308	2377	2390	2391
	2392	2393	2394	2425	2426	2427	2466
	2830	2831	2832	2836	2837	2838	2839

1915

- **Move: Brian Hart**
- **Second: Yasu Inoue**

- **Accepted with no objection**

1916

CR Motion #120

- **Move to accept resolutions to CIDs; 567,665, 2220,2586 in doc 11-16/1241r1**

- **Move: George Cherian**
- **Second: Reza Hedayat**

- **Accepted with no objection**

CR Motion #121

- **The comment resolution to the following CIDs is "Revised" since they have been resolved in D0.4 or by approved resolutions to other CIDs?**
  - CID 2745, 1981, 1025, 502, 1666, 284, 1670, 1788, 1672, 1675, 2139, 1622, 1681, 295, 297, 2182, 309

1918

- **Move to accept the resolution of the above CIDs as "Revised"**
- **Move: Bo Sun Second: Bin Tian**
- **Accepted with no objection**

CR Motion #122

- **The comment resolution to CID 261 is "Rejected" with the reason "HE modulated field consists HE-STF, HE-LTF and HE-DATA only as defined in 26.3.2"**

- **Move to accept "Rejected" as the resolution to CID 261.**

- **Move Bo Sun Second: Bin Tian**
- **Accepted with no objection**

1919

CR Motion #123

- **The comment resolution to CID 1458 is "Rejected" with the reason "The commenter failed to provide an applicable changes to the spec."**

- **Move to accept "Rejected" as the resolution to CID 1458**

- **Move: Bo Sun Second: Bin Tian**
- **Accepted with no objection**

CR Motion #124

- **Move to accept resolutions to CIDs, 1034, 1035, 1036, and 2138 in doc 11-16/1277r1**

- **Move: Yan Zhang**
- **Second: Bo Sun**
- **Accepted with no objectiom**

1921

Timeline

Current Timeline

- May 2014: start of the TG
- Nov. 2014: First draft of the TG SFD was approved
- Jan. 2016: proposed TG draft
- March 2016: Draft D0.1 was approved and CC started
- September 2016: Draft 1.0 and WG letter ballot
- March 2017: Draft 2.0 and recirculation
- July 2017: MDR (Mandatory Document Review)
- November 2017: Formation of SB pool
- March 2018: Sponsor Ballot
- December 2018: RevCom

Modified Timeline

- May 2014: start of the TG
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- Novemebr 2017: MDR (Mandatory Document Review)
- January 2018: Formation of SB pool
- March 2018: Sponsor Ballot
- December 2018: RevCom

1922

November 2016 Plan

- **Continue with the comment resolution**
- **Resolve as many comments as we can**
- **Prepare draft D1.0 and start a WG LB**

1923

Conference call times

- **Thursday Sept 29, Oct 20 10:00 – 12:00 ET**
- **Thursday Oct 13 20:00 -22:00 ET**
- **Thursday Oct 27 10:00 – 12:00 ET**
- **Thursday Nov 17 10:00 -12:00 ET**

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APPENDIX BH

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax

November 2016 San Antonio Meeting Minutes

Date: 2016-11-29

Author(s):

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Abstract

TGax meeting minutes from the IEEE 802.11 November 2016 San Antonio meeting, November 7th – 11th, 2016.

Minutes/motions from the ad hoc groups are contained in the following documents:

- PHY Ad Hoc
  - Agenda: 11-16-1475, TGax PHY Ad Hoc Nov 2016 Meeting Agenda
  - Minutes: 11-16-1530, November 2016 San Antonio PHY Ad Hoc Meeting Minutes

- MAC Ad Hoc
  - Agenda: 11-16-1478, TGax MAC Ad Hoc November 2016 Meeting Agenda
  - Minutes: 11-16-1480, November 2016 San Antonio TGax MAC Ad hoc Meeting Minutes

- MU Ad Hoc
  - Agenda: 11-16-1487, TGax MU Ad-hoc Agenda November 2016
  - Minutes: 11-16-1520, IEEE 802.11 TGax, MU Ad hoc November 2016 Meeting Minutes

- SR Ad Hoc
  - Agenda: 11-16-1481, TGax Spatial Reuse Ad-hoc Agenda November 2016 Meeting
  - Minutes: 11-16-1569, TGax Spatial Reuse ad hoc group meeting minutes – San Antonio, November 2016

IEEE 802.11 Task Group AX (TGax)
November 2016 San Antonio Meeting
Grand Hyatt San Antonio, TX, U.S.A.
November 7th – 11th, 2016

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

Monday, November 7th, 2016, AM1 TGax Ad Hoc Session (8:00 - 10:00 AM)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @08:03 AM
   1.1. Introduction of TGax chair, secretary, vice chair.

2. Announcement
   2.1. Agenda Doc.11-16/1310r0 on the server. Rev. 1 is the working document.
   2.2. Meeting Protocol:
      2.2.1. Chair asked to set the mobile devices mute.
      2.2.2. Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/
   2.4. Since this is an ad hoc meeting, no motion will be conducted.

3. Agenda Setting.
   3.1. Proposed Agenda for Monday AM1:
      3.1.1. Call meeting to order
      3.1.2. Ad Hoc Meeting (no Motions)
      3.1.3. Patent policy, etc.
      3.1.4. Agenda Items for the week.
      3.1.5. Call for submissions.
      3.1.6. Set Ad hoc Group schedule and approve agenda.
      3.1.7. Comment Resolution Status – Robert Stacy (TGax editor).
      3.1.8. Timeline
      3.1.9. Presentations and Comment Resolution
         3.1.9.1. 11-16/1348 Coexistence assurance document
         3.1.9.2. 11-16/1363 11ax PAR Verification through OFDMA
         3.1.9.3. 11-16/1414 Verifying 11ax¡¯s PAR by UL MU-MIMO
         3.1.9.4. 11-16/1435 PAR Verification Simulation Followup
         3.1.9.5. More presentations if time allows
      3.1.10. Recess.
   3.2. Chair asked if there are any other items – No items proposed. Meeting will be conducted based on this order.

4. The chair reviewed the mandatory 5 slides of P&P.
   4.1. Instructions for the WG Chair.
   4.2. Participants, Patents, and Duty to Inform.

4.3. Patent Related Links.
4.4. Call for potentially essential patents.
4.4.1. Chair asked if anyone is aware of potentially essential patents.
4.4.2. No potentially essential patents reported.
4.5. Other Guidelines for IEEE WG Meetings.

5. Agenda items for the week

- Approve TG and Teleconferences minutes since September meeting.
- Complete the resolution of comments received on draft D0.1
- Approve a motion to prepare draft D1.0 and start WG LB
- Ad Hoc group meetings
- Technical Presentations and related straw polls and/or motions
- Schedule Teleconference times.

6. General Flow of the meeting

6.1. Slides 13 and 14 of the 16/1310r1 contain general flow of the meeting.
6.2. There are eight meeting slots planed for TGax.

	Monday		Tuesday		Wednesday		Thursday	
AM1	TGax (full ad hoc)				TGax (full)		TGax (ad hoc)	TGax (ad hoc)
AM2			TGax (Ad Hoc)	TGax (Ad Hoc)				
PM1	TGax (full)				TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (full)	
PM2	TGax (ad hoc)	TGax (ad hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (ad hoc)	TGax (ad hoc)	TGax (full)	
PM3	TGax (ad hoc)	TGax (ad hoc)						

7. Call for submissions – there are about 90 submissions

7.1. PHY – 29 submissions
7.1.1. 16/1295, “CC23 PHY CR Miscellaneous Part-1,” Yongho Seok (Newracom)
7.1.2. 16/1340, “CR HE-PHY Miscellaneous Part-3,” Lochan Verma (Qualcomm)
7.1.3. 16/1341, “CR HE-PHY-Introduction-Part-2,” Lochan Verma (Qualcomm)
7.1.4. 16/1356, “Spec text for HE NDP,” Yongho Seok (Newracom)
7.1.5. 16/1370, “Proposed Spec Text for CCA Section,” Laurent Cariou (Intel)
7.1.6. 16/1371, “CR HE-SIG-B part III,” Ross Jian Yu (Huawei)
7.1.7. 16/1372, “Some proposed changes to D0.5,” Ross Jian Yu (Huawei)
7.1.8. 16/1374, “Resolution on CID495 and Removal of Unnecessary PHY TBDs,” Yujin Noh (Newracom)
7.1.9. 16/1375, “Comment Resolution for CID2867 and Text Change Proposal of 26.3.10.8 HE-SIG-B,” Yujin Noh (Newracom)
7.1.10. 16/1377, “Comment resolution on Clauses 26.3.9 and 26.3.10,” Yusuke Asai (NTT)
7.1.11. 16/1387, “Comment resolution on CID2506 and proposed changes,” Jinsoo Chio (LG Electronics)
7.1.12. 16/1393, “EVM Definition for UL OFDMA,” Ron Porat (Broadcom)
7.1.13. 16/1398, “CR for CID 2077,” Sriram Venkateswaran (Broadcom)
7.1.14. 16/1399, “Changes to D0.5,” Sriram Venkateswaran (Broadcom)
7.1.15. 16/1402, “11ax Receiver Specification,” Bin Tian (Qualcomm)
7.1.16. 16/1406, “Spec Text for 11ax Receiver Requirements,” Bin Tian (Qualcomm)

7.1.17. 16/1407, “Changes to D0.5,” Xiaogang Chen (Intel)
7.1.18. 16/1408, “PHY CRs 26.3.3,26.3.18,26.3.19,” Xiaogang Chen (Intel)
7.1.19. 16/1410, “Clause 26 Fixes,” Hongyuan Zhang (Marvell)
7.1.20. 16/1411, “TXTIME and RXTIME Fixes,” Hongyuan Zhang (Marvell)
7.1.21. 16/1421, “Smoothness Recommendation for 4x HE-LTF,” Feng Jiang (Intel)
7.1.22. 16/1427, “Remove TBDs in PHY Transmit Spec.,” Yujin Noh (Newracom)
7.1.23. 16/1434,” Miscellaneous HE PHY corrections,” Lochan Verma (Qualcomm)
7.1.24. 16/1437, “Updated Text for DCM,” Jianhan Liu (MediaTek)
7.1.25. 16/1438, “0.8us GI with 4x HE LTF,” Jianhan Liu (MediaTek)
7.1.26. 16/1439, “Error correction to D0.5_on Beam-change text,” Jianhan Liu (MediaTek)
7.1.27. 16/1443, “Spec text: Smoothness Recommendation for HE-LTF,” Feng Jiang (Intel)
7.1.28. 16/1448, “Remaining CR on secition-26-2-2 TXRXVECTOR Parameters,” Ke Yao (ZTE)
7.1.29. 16/1449, “Proposed Text Changes to TXRXVECTOR in Clause 26.2.2,” Ke Yao (ZTE)

7.2. MAC – 36 submissions
7.2.1. 16/1238, “Setting Quiet time period – text,” Chao-Chun Wang (MediaTek)
7.2.2. 16/1352, “CC23 MAC CR Miscellaneous Part-1,” Yongho Seok (Newracom)
7.2.3. 16/1354, “CC23 CR Annex C,” Yongho Seok (Newracom)
7.2.4. 16/1355, “Spec text for 10.22.2.5 and 3.2,” Yongho Seok (Newracom)
7.2.5. 16/1358, “CC0-Remaining CIDs on BA,” Alfred Asterjadhi (Qualcomm)
7.2.6. 16/1359, “CC0-Some remaining CIDs related to TWT,” Alfred Asterjadhi (Qualcomm)
7.2.7. 16/1360, “CC0-HE variant HT control - Some Remaining CIDs,” Alfred Asterjadhi (Qualcomm)
7.2.8. 16/1362, “CC0-Complete RTS Enablement,” Alfred Asterjadhi (Qualcomm)
7.2.9. 16/1367, “NDP feedback report,” Laurent Cariou (Intel)
7.2.10. 16/1368, “Follow-up on MU EDCA parameters,” Laurent Cariou (Intel)
7.2.11. 16/1380, “Proposed text changes for TWT in congested environment,” Laurent Cariou (Intel)
7.2.12. 16/1381, “Proposed text changes for fragmentation operation,” Laurent Cariou (Intel)
7.2.13. 16/1404, “Early TWT SP Termination in TWT Operation,” Jayh Hyunhee Park (LG Electronics)
7.2.14. 16/1409, “A-MSDU Fragmentation,” Matthew Fischer (Broadcom)
7.2.15. 16/1413, “CID193 BSS Color Disabled Indication,” Abhishek Patil (Qualcomm)
7.2.16. 16/1415, “CID72 BSS Color change mechanism,” Abhishek Patil (Qualcomm)
7.2.17. 16/1416, “CC0-HE BSS operation11-16-xxxx-00-00ax-CC0-HE BSS operation,” Alfred Asterjadhi (Qualcomm)
7.2.18. 16/1417, “CC0-HE BSS operation,” Alfred Asterjadhi (Qualcomm)
7.2.19. 16/1418, “CC0-HE Multirate Support and 2G4 40MHz HE STA,” Alfred Asterjadhi (Qualcomm)
7.2.20. 16/1419, “MCS_NSS_BW_PPDU_Selection_for_11ax,” Alfred Asterjadhi (Qualcomm)
7.2.21. 16/1420, “TWT Information frames in 11ax,” Alfred Asterjadhi (Qualcomm)
7.2.22. 16/1423, “NAV Update Rule Considering UL MU Operation,” Geonjung Ko (WILUS)
7.2.23. 16/1424, “Issue on the CWmax value in MU EDCA,” Woojin Ahn (WILUS)
7.2.24. 16/1425, “Clarification on applying MU EDCA parameter set,” Woojin Ahn (WILUS)
7.2.25. 16/1431, “IEEE 802.11ax Annex G,” Osama Aboul-Magd (Huawei Technologies)
7.2.26. 16/1442, “Spec texts for section 25.4 BA,” Jeongki Kim (LG Electronics)
7.2.27. 16/1452, “Multiple BSSID and MU,” Liwen Chu (Marvell)
7.2.28. 16/1453, “A-MPDU content,” Liwen Chu (Marvell)
7.2.29. 16/1454, “Multiple BSSID and MU Discussion,” Liwen Chu (Marvell)
7.2.30. 16/1456, “A-MPDU content discussion,” Liwen Chu (Marvell)
7.2.31. 16/1458, “Comment Resolution for Sub-clause 25.13.2,” Chittabrata Ghosh (Intel)
7.2.32. 16/1459, “Considerations on Quiet Time Period,” Jinsoo Ahn (Yonsei Univ.)
7.2.33. 16/1461, “MU BAR comment resolutions,” Reza Hedayat (Newracom)
7.2.34. 16/1464, “RD Protocol,” Jarkko Kneckt (Apple)
7.2.35. 16/1468, “A-MPDU Content Capabilities,” Raja Banerjea (Qualcomm)
7.2.36. 16/1477, “CC23 Proposed Resolution (Update for) TWT Element,” Matthew Fischer (Broadcom)

7.3. SR – 9 submissions
- 7.3.1. 16/0947, "Proposed text changes for OBSS_PD-based SR parameters," Matthew Fischer (Broadcom)
- 7.3.2. 16/1063, "Unified SR text DSC, ATPC, inter-BSS," Graham Smith (SR Technologies)
- 7.3.3. 16/1064, "Unified SR approach DSC, ATPC and Inter-BSS," Graham Smith (SR Technologies)
- 7.3.4. 16/1121, "Spec Texts: Spatial Reuse Indication for Trigger," Po-Kai Huang (Intel)
- 7.3.5. 16/1337, "CR on SR CCA rules clause 25.9," Bo Sum (ZTE)
- 7.3.6. 16/1403, "SR Backoff Procedure," Jayh Hyunhee Park (LG Electronics)
- 7.3.7. 16/1430, "Comment Resolution for SR on BSS Color," Junichi Iwatani (NTT)
- 7.3.8. 16/1440, "Proposed Resolutions to CID 2719," Jing Ma (NICT)
- 7.3.9. 16/1450, "CR for CID 2492 section 25.9 spatial reuse operation," Kaiying Lv (ZTE)

7.4. MU – 12 submissions
- 7.4.1. 16/1353, "CC23 MAC CR Miscellaneous Part-2," Yongho Seok (Newracom)
- 7.4.2. 16/1357, "CC0 Remaining CIDs on sounding," Alfred Asterjadhi (Qualcomm)
- 7.4.3. 16/1361, "CC0- Remaining CIDs on MU Operation," Alfred Asterjadhi (Qualcomm)
- 7.4.4. 16/1382, "MAC support of preamble puncture," Zhou Lan (Broadcom)
- 7.4.5. 16/1383, "Spec Text: MAC support of preamble puncture," Zhou Lan (Broadcom)
- 7.4.6. 16/1389, "Comment Resolution for CID 807," Po-Kai Huang (Intel)
- 7.4.7. 16/1390, "Spec Text: Revision for NAV Setting Rule under Immediate Response," Po-Kai Huang (Intel)
- 7.4.8. 16/1391, "Comment Resolution Random Access miscellaneous," Young Hoon Kwon (Newracom)
- 7.4.9. 16/1392, "Comment Resolution CID 2624 and 2738," Young Hoon Kwon (Newracom)
- 7.4.10. 16/1426, "DL/UL indication in MU-RTS," Woojin Ahn (WILUS)
- 7.4.11. 16/1441, "Consideration on Internal Contention Between Data and Trigger Frame," Jing Ma (NICT)
- 7.4.12. 16/1457, "11ax D0.1 Comment Resolution for Clause 25.5.3," David Xun Yang (Huawei)

7.5. TG – 4 submissions
- 7.5.1. 16/0995, "Editor's report," Robert Stacy (Intel)
- 7.5.2. 16/1363, "11ax PAR Verification through OFDMA," Suhwook Kim (LG Electronics)
- 7.5.3. 16/1414, "Verifying 11ax's PAR by UL MU-MIMO," Jason Yuchen Guo (Huawei)
- 7.5.4. 16/1435, "PAR Verification Simulation Followup, " James Yee (MediaTek)

8. Ad Hoc meeting scheduling

8.1. Ad Hoc slot assignment
- 8.1.1. PHY … 5, MAC … 5, SR … 2, MU … 2.

	Monday		Tuesday		Wednesday		Thursday	
AM1	TGax (full ad hoc)				TGax (full)		TGax (PHY)	TGax (MAC)
AM2			TGax (PHY)	TGax (MAC)				
PM1	TGax (full)				TGax (PHY)	TGax (MAC)	TGax (full)	
PM2	TGax (PHY)	TGax (MAC)	TGax (SR)	TGax (MU)	TGax (PHY)	TGax (MAC)	TGax (full)	
PM3	TGax (SR)	TGax (MU)						

8.2. Chair asked if there are any objections to approve the TGax schedule as follow.
- 8.2.1. There are no objections. The TGax schedule is approved.

9. Presentations

9.1. Osama Aboul-Magd (Huawei Technologies), Chair of TGax, presented "Coexistence assurance document," based on the submission 11-16/1348r1, on behalf of Eldad Perahia (HP Enterprise).

9.1.1.Summary

9.1.1.1. Eldad Perahia (HP Enterprise) created the coexistence assurance document and the initial version was presented during the TGax teleconference.

9.1.1.2. The TGax chair presented the updated document.

9.1.2.Discussion

9.1.2.1. During the teleconference, some issues have been raised such as the definition of "legacy 802.11 system," and content of the section 5 New Features.

9.1.2.2. Osama asked for suggestions for the above issues.

9.1.3.Next Step

9.1.3.1. Osama will make some modification before the motion to approve the document as the official TGax CA document.

9.2. Suhwook Kim (LG Electronics) presented "11ax PAR Verification through OFDMA," based on the submission 11-16/1363r0.

9.2.1.Summary

9.2.1.1. It was verified that OFDMA can provide four times throughput enhancement in outdoor environment and DL/UL mixed traffic.

9.2.1.2. More gain in OFDMA can be obtained e.g., by adopting a better scheduler than a random scheduler.

9.2.2.Discussion

9.2.2.1. A member asked for the details of simulation conditions such as frame aggregation and MCS selection. Another member also asked for the simulation set up.

9.2.2.2. Chair asked for the importance of the simulation scenario that 37 STAs are on the same location. The answer is that it is to obtain the highest performance gain.

9.2.3.Next Step

9.2.3.1. The presenter plans to provide more simulation results.

9.3. Jason Yuchen Guo presented "Verifying 11ax's PAR by UL MU-MIMO," based on the submission 11-16/1414r2.

9.3.1.Summary

9.3.1.1. This presentation is to verify the four times throughput gain by UL MU-MIMO.

9.3.1.2. Higher throughput gain can be expected as the STA density goes higher.

9.3.1.3. Use of efficient scheduling algorithm also important for the higher throughput gain.

9.3.2.Discussion

9.3.2.1. There was a discussion on the fairness of the scheduling algorithm.

9.3.2.2. A member asked for the reason of fixed throughput performance in slide 4. → It is due to the assumed scheduling algorithm.

9.3.2.3. There was a discussion on the MCS selection/link adaptation.

9.3.2.4. There was a question on the use of buffer status report. → It is not considered in the simulations.

9.4. James Yee (MediaTek) presented "PAR Verification Simulation Follow-up ," based on the submission 11-16/1435r0.

9.4.1.Summary

9.4.1.1. In the residential scenario, increasing STA size improves DL gain and using higher UL MCS (5->8, 9) improves UL gain.

9.4.1.2. Indoor BSS scenario with more STAs and no frequency reuse does not show additional performance gain.
9.4.1.3. 4x gain with certain single BSS scenarios, but they are not the ‘dense’ STA and BSS scenarios we target in the EVM.
9.4.2. Discussion
9.4.2.1. A member commented on the throughput of MU with and without OBSS_PD that overhead introduced by the trigger frame is not so significant.
9.4.2.2. There was a discussion on the adjustment of OBSS_PD in a multiple BSS scenario.
9.4.2.3. A member asked if there are simulation results changing the packet size. The answer is yes. Additional gain can be expected in some cases.
9.4.2.4. There was a discussion on the impact of legacy STAs.
9.4.3. Straw poll
9.4.3.1. The straw poll was deferred until PM1 (due to lack of time).

10. Adjournment
10.1. TGax ad hoc session adjourned @ 10:00 AM.

Monday, November 7th, 2016, PM1 TGax Ad Hoc Session (13:30 - 15:30)

1. **The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @13:33 AM**
   1.1. Introduction of TGax chair, secretary, vice chair.

2. **Announcement**
   2.1. Agenda Doc.11-16/1310r1 on the server. Rev. 2 is the working document.
   2.2. Meeting Protocol: Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **Agenda for Monday, November 7th, PM1 (13:30 – 15:30).**
   3.1. Proposed Agenda for Monday PM1:
      3.1.1. Call meeting to order
      3.1.2. Patent policy, etc.
      3.1.3. Call for submissions.
      3.1.4. Set Ad hoc Group schedule and approve agenda.
      3.1.5. Summary from September 2016 meeting.
      3.1.6. TG motions
         3.1.6.1. Approve TG meeting and Telecon minutes since November meeting.
         3.1.6.2. Approve resolutions of comments, if needed
      3.1.7. Comment Resolution Status – Robert Stacy (TGax editor).
      3.1.8. Timeline
      3.1.9. Presentations and Comment Resolution
      3.1.10. Recess.
   3.2. Chair asked if there are any other items – No items proposed. Meeting will be conducted based on this order.

4. **The chair reviewed the mandatory 5 slides of P&P.**
   4.1. Instructions for the WG Chair.
   4.2. Participants, Patents, and Duty to Inform.
   4.3. Patent Related Links.
   4.4. Call for potentially essential patents.
      4.4.1. Chair asked if anyone is aware of potentially essential patents.
      4.4.2. No potentially essential patents reported.
   4.5. Other Guidelines for IEEE WG Meetings.

5. **Agenda items for the week**
   5.1. Approve TG and Telecons minutes since July meeting.
   5.2. Resolution of comments received on draft D0.1
   5.3. Ad Hoc group meetings
   5.4. Technical Presentations and related straw polls and/or motions
   5.5. Schedule Telecon times.

6. **Summary from the September 2016 Meeting – slide 23 of the agenda document.**
   - Continue with the resolution of comments received on CC-23
   - Good progress on the comment resolution
   - Adjusted the TG timeline with draft D1.0 available after November meeting.
   - Draft D0.5 was prepared by the TG Editor.

- Conducted "almost" weekly telecons since September F2F meeting.
  - **Covered 13 submissions**
  - **Discussed resolutions of almost 55 CIDs**
  - **Please refer to telecon minutes**
    - **https://mentor.ieee.org/802.11/dcn/16/11-16-1308-02-00ax-tgax-teleconference-minutes-from-september-to-october.docx**

7. TG Motions

7.1. Approve TGax minutes of meetings and teleconferences from September 2016 meeting to today:

- **https://mentor.ieee.org/802.11/dcn/16/11-16-1231-00-00ax-tgax-september-2016-warsaw-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1308-02-00ax-tgax-teleconference-minutes-from-september-to-october.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1300-00-00ax-september-2016-tgax-spatial-reuse-ad-hoc-group-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1276-00-00ax-september-2016-warsaw-tgax-phy-ad-hoc-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1252-01-00ax-september-2016-warsaw-tgax-mac-ad-hoc-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1275-00-00ax-mu-ad-hoc-meeting-minutes-september-2016.docx**

7.2. Moved by Simone Merlin, Seconded by Robert Stacy

7.3. Result: Motion was accepted with no objection.

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8. Editor's Report

8.1. Robert Stacy (Intel), TGax Editor, presented "," based on the submission 11-16-0995-02.

8.2. CR Status Summary

8.3. Discussion – No discussion.

9. Timeline

- **Current Timeline**
  - **May 2014: start of the TG**
  - **Nov. 2014: First draft of the TG SFD was approved**
  - **Jan. 2016: proposed TG draft**
  - **March 2016: Draft D0.1 was approved and CC started**
  - **November 2016: Draft 1.0 and WG letter ballot**
  - **May 2017: Draft 2.0 and recirculation**
  - **November 2017: MDR (Mandatory Document Review)**
  - **January 2018: Formation of SB pool**
  - **March 2018: Sponsor Ballot**
  - **December 2018: RevCom**

9.1. The good news is that the number of TBDs in the draft is reduced as shown in slide 27.

10. Presentation and Comment Resolution

10.1. PAR Verification Discussion

10.1.1. Discussion on continuing the work on PAR verification

10.1.1.1. 4 time improvement is already shown for outdoor scenarios in 11-16/1363

10.1.1.2. 4 times for indoor scenario is observed in 11-16/1414

10.1.2. Discussion

10.1.2.1. A member commented that it is hard to show x4 improvement for indoor cases. Outdoor scenario is more appropriate.

10.1.2.2. There was a comment that some simulation results are not based on realistic scenarios. More time is needed to evaluate realistic scenario.

10.1.2.3. There was a comment that indoor scenario is very important.

10.1.2.4. A member suggested mixed environment of HE and legacy STAs.

10.1.2.5. There was a comment that single BSS is not a dense environment.

10.1.3. Straw poll by James Yee (MediaTek) re: submission 11-16-1435-00.

10.1.3.1. Straw Poll: While we continue to look for additional gain under new modes - combination of 11ax features, do we:

Option 1

Continue to use current EVM scenarios.

Option 2

Modify scenarios in the EVM. E.g.

- Adding single BSS scenarios

- New OBSS scenarios

10.1.3.2. Discussion

10.1.3.2.1. Chair commented that we need more time if we choose option 2.

10.1.3.2.2. A member asked if EVM is the right reference to discuss the simulation scenario.

10.1.3.2.3. Chair asked if there is any objection to go with option 2. → No objection. The simulation scenario will be discussed in the TGax conferences.

10.2. James Wang (MediaTek) presented "Spatial Reuse Subfield Encoding Rule Clarification," based on the submission 11-16-1473-00.

10.2.1. Summary

10.2.1.1. This is the proposed changes to the Spatial Reuse subfield encoding rule based on TGax Draft 0.5

10.2.1.2. Transmit power of AP in table 26-19 Spatial Reuse subfield encoding is changed from "TX PWRAP: -10 dBm to 26 dBm" to "TX PWRAP: ≥ -10 dBm."

10.2.2. Discussion

10.2.2.1. A member commented it could mean infinite transmit power is allowed. → The upper limit of the transmit power is obviously the regulatory limit.

10.2.3. Next Step

10.2.3.1. Chair asked if there is objection to this change. → No objection heard.

10.3. Sameer Vermani (Qualcomm) presented "Comment Resolutions of Miscellaneous HE PHY comments," based on the submission 11-16-1340-03.

10.3.1. Summary

10.3.1.1. A previous version of this document was presented by Lochan Verma during the TGax conference call on October 27th and got some minor comment.
10.3.1.2. This is the update considering those comments.
10.3.2. Discussion
10.3.2.1. A member suggested further change to the document. → Sameer agreed.
10.3.3. Next Step
10.3.3.1. Chair asked if there is any objection to accept the resolution. → No objection heard.

10.4. Sameer Vermani (Qualcomm) presented "Comment Resolutions on Clause 26.1.1 Part 2," based on the submission 11-16-1341-06.

10.4.1. Summary
10.4.1.1. Previous version of this document was presented by Lochan Verma during the TGax teleconference on October 27th.
10.4.1.2. Proposed changes to the text in 26.1.1 Introduction to the HE PHY.
10.4.2. Discussion
10.4.2.1. No discussion.
10.4.3. Next Step
10.4.3.1. Chair asked if there is any objection to the resolution. → No objection heard.

10.5. Sameer Vermani (Qualcomm) presented "Miscellaneous HE PHY Corrections," based on the submission 11-16-1434-01.

10.5.1. Summary
10.5.1.1. Various fixes relevant to the HE PHY propsoed.
10.5.2. Discussion
10.5.2.1. A member suggested minor correction to the document. Sameer agreed and updated the document.
10.5.3. Next Step
10.5.3.1. Chair asked if there is any objection to this resolution. → No objection heard.

10.6. Jarkko Kneckt (Apple) presented "Resolution to CIDs 52, 2459 and 2632," based on the submission 11-16-1464-00.

10.6.1. Summary
10.6.1.1. This document contains proposed resolutions for CIDs 52, 2459 and 2632 regarding the reverse direction protocol.
10.6.1.2. Text for the RD protocol signaling and the use of Multi-TID transmissions in RD protocol were proposed.
10.6.2. Discussion
10.6.2.1. A member commented that there is duplicate on the definition of the Multi-TID Aggregation. → Jarkko to update the document.
10.6.2.2. There was a discussion on the tradeoff between the AC constraint and QoS.
10.6.3. Next Step
10.6.3.1. Chair asked if there is any objection to incorporate these changes to the draft. → No objection heard.

10.7. Ross Jian Yu (Huawei Technologies) presented "Proposed resolutions to comments on clause 26.3.10.8 in D0.5," based on the submission 11-16-1371-00.

10.7.1. Summary
10.7.1.1. The document contains the proposed resolutions for CIDs 308, 1619 and 2847.
10.7.1.2. The document contains the proposed changes to the text in clause 26.3.10.8.4 as well which clarifies the mapping of user-fields to the RU allocation signaling for 80 and 160 MHz.
10.7.2. Discussion
10.7.2.1. No discussion.

10.7.3. Next Step
10.7.3.1. Chair asked if there is any objection to the proposed resolutions. → No objection.

10.8. Ross Jian Yu (Huawei Technologies) presented "Proposed change," based on the submission 11-16-1372-01.
10.8.1. Summary
10.8.1.1. This submission contains the proposed changes to clause 26.3.10.5 L-SIG and 26.3.10.8 HE-SIG-B.
10.8.2. Discussion
10.8.2.1. Chair confirmed that this is not comment resolution.
10.8.3. Next Step
10.8.3.1. Chair asked if there is any objection to accept the proposed changes in 16/1372r1. → No objection.

11. AoB
11.1. Chair asked if we have any business that can be conducted.
11.2. Room assignment for PM2 & PM3:
11.2.1. PM2: PHY – Texas D, MAC - Texas E.
11.2.2. PM3: MU – Texas D, SR – Texas E.

12. Adjournment
12.1. TGax recessed @ 15:29 PM.

Monday, November 7th, 2016, PM2 TGax ad hoc sessions (16:00-18:00)

Ad Hoc room assignment:
- PHY ad hoc: Texas D
- MAC ad hoc: Texas E

Monday, November 7th, 2016, PM3 TGax ad hoc sessions (19:30-21:30)

Ad Hoc room assignment:
- SR ad hoc: Texas D
- MU ad hoc: Texas E

Tuesday, November 8th, 2016, AM2 TGax ad hoc sessions (10:30-12:30)

Ad Hoc room assignment:

- PHY ad hoc: Texas D
- MAC ad hoc: Texas E

Tuesday, November 8th, 2016, PM2 TGax ad hoc sessions (16:00-18:00)

Ad Hoc room assignment:

- SR ad hoc: Texas D
- MU ad hoc: Texas E

Wednesday, November 9th 2016, AM1 TGax Full Sessions (8:00-10:00)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @8:04 AM.
   1.1. Introduction of the TG leadership.
   1.2. Agenda 11-16-1310-02 is on the server.

2. Announcements/Reminder
   2.1. Chair asked participants to state name and affiliation when speaking for the first time during the session.
   2.2. Chair reminded that the meeting is conducted under IEEE 802 and 802.11 P&P.
   2.3. Chair reminded attendance.

3. Agenda Setting
   3.1. Proposed agenda for this session
      3.1.1. Call Meeting to order
      3.1.2. IEEE 802 and 802.11 IPR Policy and procedure.
      3.1.3. Progress Review
      3.1.4. Presentations
         3.1.4.1. 11-16/1472 New Amendment Style – Robert Stacey
         3.1.4.2. 11-16/1431 IEEE 802.11ax Annex G - Osama
         3.1.4.3. Presentations from ad hocs
      3.1.5. Recess
   3.2. Chair asked if there is any objection to proceed with this agenda. → No objection.
   3.3. The agenda for Wednesday AM1 was approved.

4. Progress from Ad Hoc groups
   4.1. MU and SR ad hocs – completed.
   4.2. PHY: 7 – 8 presentations left.
   4.3. MAC: 16 presentations to go.

5. Presentations
   5.1. Robert Stacy (Intel) presented "New Amendment Style," based on the submission 11-16-1472r01.
      5.1.1. Summary
         5.1.1.1. The new amendment style is not a radical departure from how we amend the 802.11 specification.
         5.1.1.2. It concentrates MAC changes into one clause which helps with a number issues.
         5.1.1.3. The requirement inheritance is clear from the structure of the document.
      5.1.2.Discussion
         5.1.2.1. A member asked if there is a plan to apply this new style to the previous amendment. → Currently there is no plan to do so.
         5.1.2.2. Chair mentioned that the issue raised during the conference call was cross reference. Not sure what is the real issue.

   5.2. Osama Aboul-Magd (Huawei Technologies) presented "IEEE 802.11ax Annex G," based on the submission 11-16-1431r01.
      5.2.1. Summary
         5.2.1.1. This document contains resolutions for CIDs 1430, 1703 and 2503.

5.2.1.2. The initial text for the G.5 HE Sequences is proposed. The plan is to put one example here and add more, or reject current text and start from the scratch after the WG LB.

5.2.2. Discussion

5.2.2.1. A member commented that people should pay more attention to this clause since Annex. G is normative. The only trigger sequence looks quiet incomplete.

5.2.2.2. Another member suggested the trigger sequence to be the placeholder.

5.3. Jeongki Kim (LG Electronics) presented "Spec text for section 25.4 Block Acknowledgment," based on the submission 11-16-1442r00.

5.3.1. Summary

5.3.1.1. This is basically a clarification to the texts in subclause 25.4 Block Acknowledgment in D0.5.

5.3.1.2. In 9.3.1.9.7 Multi-STA BlockAck variant (D0.5), ACK of all MPDUs in an A-MPDU is indicated by Ack Type = 1 and TID subfield = 14 of Multi-STA Block ACK frame. The same concept should also be used in other subclauses (25.4 Block Acknowledgement).

5.3.2. Discussion

5.3.2.1. No discussion.

5.3.3.Next Step

5.3.3.1. Chair asked if there is any objection to accept this spec text. → No objection.

5.4. Abhishek Patil (Qualcomm) presented "Proposed Resolution for CID 193 (BSS Color Disable Indication)," based on the submission 11-16-1413r06.

5.4.1. Summary

5.4.1.1. The submission contains a resolution for CID 193.

5.4.1.2. The proposed resolution is to disable BSS Color when AP determines that there is a color collision.

5.4.2. Discussion

5.4.2.1. The document is not on the server. A member asked for more time to review.

5.5. Alfred Asterjadhi (Qualcomm) presented "HE BSS Operation," based on the submission 11-16-1417r00.

5.5.1. Summary

5.5.1.1. This document contains a resolution for the CID 154.

5.5.1.2. Proposed resolution includes expansion of the Basic HE MCS and NSS Set field from 2 to 3 bits to include the new MCSs added in 11ax (1024 QAM) and the addition of the VHT Operation Information field to the HE Operation element to remove dependency from the VHT Operation element.

5.5.2. Discussion

5.5.2.1. No discussion.

5.5.3.Next Step

5.5.3.1. Chair asked if there is any objection to accept this resolution and the changes to the draft. → No objection.

5.6. Alfred Asterjadhi (Qualcomm) presented "MCS, NSS, BW and PPDU selection for 11ax," based on the submission 11-16-1419r00.

5.6.1. Summary

5.6.1.1. This submission contains a proposed clarification on the selection rules for PPDU type, BW, and <MCS, NSS> for 11ax.

5.6.1.2. Proposed to finalize all the normative behavior for the selection of these parameters for control response frames.

5.6.1.3. Related submission (11-16-1418) which contains the spec text was presented as well.
5.6.2. Discussion
5.6.2.1. There was a discussion on the applicability of each rule.
5.6.3.Next Step
5.6.3.1. Chair asked if there is any objection to this resolution for CID #203. → No objection.

6. Preview of WG Motion
6.1. Chair showed the motion text for WG Letter Ballot:
6.1.1.Discussion
6.1.1.1. A member mentioned that TGax, at this point, does not need detailed description as in the motion for WG recirculation ballot. Just need to say:
6.1.1.1.1. Instruct the editor to prepare for TGax draft 1.0, and
6.1.1.1.2. Approve a 30-day Working Group Letter Ballot.
6.1.2. Chair will update the motion text as suggested.
6.2. Chair showed the motion text for approval of coexistence assurance document.

7. AOB
7.1. Only 5 minutes left.
7.2. No other business to conduct.

8. Recess
8.1. TGax full session is in recess @9:55 AM, until Thursday AM2.

Wednesday, November 9th 2016, PM1 TGax Ad Hoc Sessions (13:30-15:30)

- PHY ad hoc → Texas D.
- MAC ad hoc → Texas E

Wednesday, November 9th 2016, PM2 TGax ad hoc Sessions (16:00-18:00)

- PHY ad hoc → Texas D
- MAC ad hoc → Texas E

Thursday, November 10th, 2016, AM1 TGax full Session (8:00-10:00)

1 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @8:04 AM

1.1 Agenda 16/1310r3 is on the server. Rev. 4 is the working document.
1.2 Introduction of people at the front table.

2 Announcement/Reminder

2.1 Chair reminded IEEE 802 and 802.11 IPR P&P.
2.2 Chair asked people to state name and affiliation when addressing for the first time in the session.
2.3 Chair reminded people to do attendance.

3 Agenda for this session

3.1 Thursday AM1, PM1 and PM2
- 3.1.1 Call Meeting to order
- 3.1.2 Announcement/Reminder
  - 3.1.2.1 IEEE 802 and 802.11 IPR Policy and procedure.
  - 3.1.2.2 Attendance
- 3.1.3 Agenda Setting
- 3.1.4 Presentations
- 3.1.5 TG Motions
- 3.1.6 New Business:
  - 3.1.6.1 11-16-1238-04 Setting Quiet Time Period, by Chao-Chun Wang
- 3.1.7 WG LB, CA Doc Motions
- 3.1.8 11-16-1537-00, by Guido R. Hiertz.
- 3.1.9 Goals for January 2017
- 3.1.10 Teleconference schedule
- 3.1.11 AOB
- 3.1.12 Adjourn

3.2 Chair asked if there are any modifications to the agenda.
3.3 Agenda approved with no objection.

4 TG Motions

Chair asked the people to check the agenda file to make sure that the motion text is correct.

4.1 PHY Motion

4.1.1 PHY Motion #175: Move to accept the proposed changes to 11ax D0.5 spec text as in 11-16/1356r0.

4.1.1.1 Moved by Young Hoon Kwon, Seconded by Alfred Asterjadhi
4.1.1.2 Discussion – No discussion.
4.1.1.3 Result: The motion was accepted with no objection.

4.1.2 PHY Motion #176: Move to accept the proposed spec changes in doc 11-16/1387r3.

4.1.2.1 Moved by Jinsoo Choi, Seconded by Kiseon Ryu.
4.1.2.2 Discussion – No discussion.
4.1.2.3 Result: The motion was accepted with no objection

4.1.3 PHY Motion #177: Move to accept the proposed spec text changes in doc 11-16/1427r2.

4.1.3.1 Moved by Yujin Noh, Seconded by Young Hoon Kwon.
4.1.3.2 Discussion – No discussion.
4.1.3.3 Result: The motion was accepted with no objection.

4.1.4 PHY Motion #178: Do you agree the proposed spec text changes as in doc 11-16/1370r4.

4.1.4.1 Moved by Laurent Cariou, Seconded by Chittabrata Ghosh.
4.1.4.2 Discussion – No discussion.
4.1.4.3 Result: The motion was accepted with no objection.

4.1.5 PHY Motion #179: Move to accept the proposed spec text changes in doc 11-16/1399r2.

4.1.5.1 Moved by Sriram Venkateswaran, Seconded by Ron Porat.
4.1.5.2 Discussion – No discussion.
4.1.5.3 Result: The motion was accepted with no objection.

4.1.6 PHY Motion #180: Move to adopt the spec text in doc 11/16-1406r1 on 11ax Receiver Requirements.

4.1.6.1 Moved by Bin Tian, Seconded by Abhishek Patil.
4.1.6.2 Result: The motion was accepted with no objection.

4.1.7 PHY Motion #181: Move to adopt the changes to the 11ax spec text in doc 11/16-1407r4.

4.1.7.1 Moved by Xiaogang Chen, Seconded by Chittabrata Ghosh.
4.1.7.2 Discussion - No discussion.
4.1.7.3 Result: The motion was accepted with no objection.

4.1.8 PHY Motion #182: Move to adopt the spec text in doc 11/16-1443r0 into 11ax draft.

4.1.8.1 Moved by Feng Jiang, Seconded by Chittabrata Ghosh.
4.1.8.2 Discussion – No discussion.
4.1.8.3 Result: The motion was accepted with no objection.

4.1.9 PHY Motion #183: Move to adopt the spec text in doc 11/16-1410r2 into 11ax draft.

4.1.9.1 Moved by Hongyuan Zhang, Seconded by Saishankar Nandagopalan.
4.1.9.2 Discussion – No discussion.
4.1.9.3 Result: The motion was accepted with no objection.

4.1.10 PHY Motion #184: Move to adopt the spec text in doc 11/16-1411r1 into 11ax draft.

4.1.10.1 Moved by Hongyuan Zhang, Seconded by Saishankar Nandagopalan.

4.1.10.2 Discussion – No discussion.
4.1.10.3 Result: The motion was accepted with no objection.

4.1.11 PHY Motion #185: Move to adopt the spec text in doc 11/16-1437r0 into 11ax draft.

4.1.11.1 Moved by Tianyu Wu, Seconded by Hongyuan Zhang.
4.1.11.2 Discussion – No discussion.
4.1.11.3 Result: The motion was accepted with no objection.

4.1.12 PHY Motion #186: Move to adopt the spec text in doc 11/16-1438r4 into 11ax draft.

4.1.12.1 Moved by Tianyu Wu, Seconded by Hongyuan Zhang.
4.1.12.2 Discussion – No discussion.
4.1.12.3 Result: The motion was accepted with no objection.

4.1.13 PHY Motion #187: Move to adopt the spec text in doc 11/16-1439r1 into 11ax draft.

4.1.13.1 Moved by Tianyu Wu, Seconded by Hongyuan Zhang.
4.1.13.2 Discussion – No discussion.
4.1.13.3 Result: The motion was accepted with no objection.

4.1.14 PHY Motion #188: Move to adopt the spec text in doc 11/16-1449r3 into 11ax draft.

4.1.14.1 Moved by Bin Tian, Seconded by Alfred Asterjadhi.
4.1.14.2 Discussion – No discussion.
4.1.14.3 Result: The motion was accepted with no objection.

4.1.15 PHY Motion #189: Move to adopt the spec text in doc 11/16-1434r2 into 11ax draft.

4.1.15.1 Moved by Sameer Vermani, Seconded by Abhishek Patil.
4.1.15.2 Discussion – No discussion.
4.1.15.3 Result: The motion was accepted with no objection.

4.1.16 PHY Motion #190: Move to adopt the spec text in doc 11-16/1372r1 into 11ax draft.

4.1.16.1 Moved by Ross Jian Yu, Seconded by Ron Porat.
4.1.16.2 Discussion – No discussion.
4.1.16.3 Result: The motion was accepted with no objection.

4.2 MAC Motions

4.2.1 MAC Motion #94: Move to update the 11ax specification D0.5 according to the instructions in document 16/1355r0.

4.2.1.1 Moved by Young Hoon Kwon, Seconded by Eric Wong.
4.2.1.2 Discussion - No discussion.
4.2.1.3 Result: The motion was accepted with no objection.

4.2.2 MAC Motion #95: Move to update the 11ax specification D0.5 according to the instructions in document 16/1362r1.

4.2.2.1 Moved by Alfred Asterjadhi, Seconded by George Cherian.
4.2.2.2 Discussion – No discussion.
4.2.2.3 Result: The motion was accepted with no objection.

4.2.3 MAC Motion #96: Move to update the 11ax specification D0.5 according to the instructions in slide 16 of document 16/1367r0.
And append the following sentence at the end of slide 16
- This mechanism is optional for non-AP STA

4.2.3.1 Moved by Laurent Cariou, Seconded by Alfred Asterjadhi.
4.2.3.2 Discussion – No discussion.
4.2.3.3 Result: The motion was accepted with no objection.

4.2.4 MAC Motion #97: Move to update the 11ax specification D0.5 according to the instructions in document 16/1368r2.

4.2.4.1 Moved by Laurent Cariou, Seconded by Eric Wong.
4.2.4.2 Discussion – No discussion.
4.2.4.3 Result: The motion was accepted with no objection.

4.2.5 MAC Motion #98: Move to update the 11ax specification D0.5 according to the instructions in slide 16 of document 16/1404r1.

4.2.5.1 Moved by Kiseon Ryu, Seconded by Alfred Asterjadhi.
4.2.5.2 Discussion – No discussion.
4.2.5.3 Result: The motion was accepted with no objection.

4.2.6 MAC Motion #99: Move to update the 11ax specification D0.5 according to the instructions in document 16/1409r3.

4.2.6.1 Moved by Zhou Lan, Seconded by Eric Wong.
4.2.6.2 Discussion – No discussion.
4.2.6.3 Result: The motion was accepted with no objection.

4.2.7 MAC Motion #100: Move to update the 11ax specification D0.5 according to the instructions in slides 8, 9 and 10 in document 16/1420r0.

4.2.7.1 Moved by Alfred Asterjadhi, Seconded by Abhishek Patil.
4.2.7.2 Discussion – No discussion.
4.2.7.3 Result: The motion was accepted with no objection.

4.2.8 MAC Motion #101: Move to update the 11ax specification D0.5 according to the instructions in document 16/1380r3.

4.2.8.1 Moved by Laurent Cariou, Seconded by Abhishek Patil.
4.2.8.2 Discussion – No discussion.
4.2.8.3 Result: The motion was accepted with no objection.

4.2.9 MAC Motion #102: Move to update the 11ax specification D0.5 according to the instructions in slide 6 of document 16/1425r2.

4.2.9.1 Moved by Woojin Ahn, Seconded by John Son.
4.2.9.2 Discussion – No discussion.
4.2.9.3 Result: The motion was accepted with no objection.

4.2.10 MAC Motion #103: Move to update the 11ax specification D0.5 according to the instructions in document 16/1452r2.

4.2.10.1 Moved by Liwen Chu, Seconded by Abhishek Patil.
4.2.10.2 Discussion – No discussion.
4.2.10.3 Result: The motion was accepted with no objection.

4.2.11 MAC Motion #104: Move to update the 11ax specification D0.5 according to the instructions in document 16/1453r1.

4.2.11.1 Moved by Liwen Chu, Seconded by Eric Wong.
4.2.11.2 Discussion – No discussion.
4.2.11.3 Result: The motion was accepted with no objection.

4.2.12 MAC Motion #105: Move to update the 11ax specification D0.5 according to the instructions in document 16/1381r2.

4.2.12.1 Moved by Laurent Cariou, Seconded by Chittabrata Ghosh.
4.2.12.2 Discussion – No discussion.
4.2.12.3 Result: The motion was accepted with no objection.

4.2.13 MAC Motion #106: Move to instruct the TGax editor to remove the sentence below from IEEE802.11ax D0.5 in clause 9.3.1.23.
"The exact location of each 20 MHz for 80 MHz BW is TBD"

4.2.13.1 Moved by Alfred Asterjadhi, Seconded by Ron Porat.
4.2.13.2 Discussion – No discussion.
4.2.13.3 Result: The motion was accepted with no objection.

4.2.14 MAC Motion #107: Move to instruct the TGax Editor to make the following changes (related to HE Link adaptation A-Control format):

- Replace "TBD" with "16" in P17L21 of TGax D0.5
- Replace "TBD" with "Reserved" in P19L8 of TGax D0.5
- Replace "B6+X" with "B15" in P19L6 of TGax D0.5
- Replace "X" with "9" in P19L6 of TGax D0.5

4.2.14.1 Moved by Abhishek Patil, Seconded by Alfred Asterjadhi.

4.2.14.2 Discussion – No discussion.
4.2.14.3 Result: The motion was accepted with no objection.

4.2.15 MAC Motion #108: Move to instruct the TGax Editor to make the changes as shown in 16/1529r0.

4.2.15.1 Moved by Zhou Lan, Seconded by Eric Wong.
4.2.15.2 Discussion – No discussion.
4.2.15.3 Result: The motion was accepted with no objection.

4.2.16 MAC Motion #109: Move to instruct the TGax Editor to make the changes as shown in slide 6 of document 16/1424r2.

4.2.16.1 Moved by Woojin Ahn, Seconded by John Son.
4.2.16.2 Discussion – No discussion.
4.2.16.3 Result: The motion was accepted with no objection.

4.2.17 MAC Motion #110: Move to instruct the TGax Editor to make the changes as shown in 16/1442r0.

4.2.17.1 Moved by Jeongki Kim, Seconded by Kiseon Ryu.
4.2.17.2 Discussion – No discussion.
4.2.17.3 Result: The motion was accepted with no objection.

4.2.18 MAC Motion #111: Move to instruct the TGax Editor to make the changes as shown in 16/1238r4.

4.2.18.1 Moved by Chao-Chun Wang, Seconded by Dengyu Qiao.
4.2.18.2 Discussion – No discussion.
4.2.18.3 Result: The motion was accepted with no objection.

4.3 MU Motions

4.3.1 MU Motion #61: Move to update the 11ax draft specification D0.5 according to editor instruction in document 802.11-16/1383r2

- A HE AP transmits a new trigger variant (Bandwidth Query Report Poll) to solicit bandwidth Query Report from one or multiple HE non AP STAs
- A HE non AP STA after receiving Bandwidth Query Report Poll from a HE AP responds with channel availability information in a new A-control field (Bandwidth Query Report)
- It is optional for a non AP STA to support the Bandwidth Query mechanism

4.3.1.1 Moved by Zhou Lan, Seconded by Ron Porat.
4.3.1.2 Discussion – No discussion.
4.3.1.3 Result: The motion was accepted with no objection.

4.3.2 MU Motion #62: Move to accept the proposed changes to D0.5 in 802.11-16/1390r0.

4.3.2.1 Moved by Po-Kai Huang, Seconded by Kiseon Ryu.
4.3.2.2 Discussion – No discussion.

4.3.2.3 Result: The motion was accepted with no objection.

4.4 SR Motions

4.4.1 SR Motion #13: Move to incorporate 11-16/947r18 into the TGax draft.

4.4.1.1 Moved by Zhou Lan, Seconded by Ron Porat.
4.4.1.2 Discussion:
- A member commented that this motion should be withdrawn and whole SR related text should be reviewed.
- Another member agreed with the previous commenter and proposed a motion to table this motion.

4.4.1.3 Motion to table SR Motion #13: Move to table the SR Motion #13 till January 2017 F2F meeting.
4.4.1.3.1. Moved by Sean Coffey, Seconded by Graham Smith.
4.4.1.3.2. Result: Y/N/A = 16/42/43, motion to table the SR motion #13 fails.

- **Go back to the main motion.**
- **A member asked for a recorded vote.**

4.4.1.4 Result: Y/N/A = 45/19/51, motion fails (< 75%).
- **The vote record can be found in the Annex of this document.**

4.4.2 SR Motion #14: Move to incorporate 11-16/1121r2 into the TGax draft.

4.4.2.1 Moved by Po-Kai Huang, Seconded by Laurent Cariou.
4.4.2.2 Discussion – No discussion.
4.4.2.3 Result: The motion was accepted with no objection.

4.4.3 SR Motion #15: Move to add the following text in the 11ax spec draft (11-16/1403r1).

25.9.2.1 General

- **SR Backoff procedure for SR delayed case**

The STA may resume its backoff procedure after the end of the PPDU carrying the SR delay entry by following the procedure defined in 10.22.2 HCF contention based channel access (EDCA)

NOTE - The countdown of an existing backoff procedure is suspended until the end of the PPDU carrying the SR delay entry since the medium is busy during the duration of the PPDU carrying the SR delay entry..

4.4.3.1 Moved by Kiseon Ryu, Seconded by Po-Kai Huang.
4.4.3.2 Discussion – No discussion.
4.4.3.3 Result: The motion was accepted with no objection.

4.4.4 SR Motion #16: Move to accept the changes to the TG draft in doc 11-16/1473r0.

4.4.4.1 Moved by James Wang, Seconded by Bahar Sadeghi.
4.4.4.2 Discussion – No discussion.
4.4.4.3 Result: The motion was accepted with no objection.

Chair asked if there is any business that can be done in 6 minutes. → No response.

5 Recess

TGax Recess @9:54 until PM1 (13:30) this afternoon.

Thursday, November 10th, 2016, PM1 TGax full Session (13:30-15:30)

6 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax @ 13:35.

6.1 The agenda file: 11-16-1310-04.

7 Announcement

7.1 Chair reminded IEEE 802 and 802.11 IPR P&P.
7.2 Chair asked people to state name and affiliation when addressing for the first time in the session.
7.3 Chair reminded people to do attendance.

8 Agenda for this sessions – as approved during AM1 session.

8.1.1 Call Meeting to order
8.1.2 Announcement/Reminder
8.1.2.1 IEEE 802 and 802.11 IPR Policy and procedure.
8.1.2.2 Attendance
8.1.3 Agenda Setting
8.1.4 Presentations
8.1.5 TG Motions
8.1.6 New Business:
8.1.6.1 11-16-1238-04 Setting Quiet Time Period, by Chao-Chun Wang
8.1.7 WG LB, CA Doc Motions
8.1.8 11-16-1537-00, by Guido R. Hiertz.
8.1.9 Goals for January 2017
8.1.10 Teleconference schedule
8.1.11 AOB
8.1.12 Adjourn

9 TG Motions (continued from AM1)

9.1 CR Motions

9.1.1 CR Motion #125 (PHY): Move to accept resolutions to CIDs

- **CID 495 as in 11-16/1374r1**
- **CID 2867 in 11-16/1375r1**
- **CID 2043, 2044, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2058, 2059, 2062 in doc 11-16/1377r6**
- **CID 2431 in 11-16/1295r0**
- **CID 2077 in doc 11-16/1398r1**
- **CID 1031, 1827, 2472, 2753 in doc 11-16/1448r0**
- **CID 1116, 2350, 2460, 2461, 1038, 2147, 275 in doc 11-16/1408r0**
- **CID 1864 and 1849 in doc 11-16/1341r6**
- **CID 2506 in doc 11-16/1387r3**
- **CID 2147 in doc 11-16/1522r2**
- **1932, 2106, 2572, 2796 in doc 11-16/1340r4**
- **CID 308, 1619, 2874 in doc 11-16/1371r0**

9.1.1.1 Moved by Bin Tian, Seconded by Jianhan Liu.
9.1.1.2 Discussion – No discussion.
9.1.1.3 Result: The motion was accepted with no objection.

9.1.2 CR Motion #126 (PHY): Move to accept the following resolution to CID 85
- **Resolution: Rejected**
- **Reason: The comment doesn't provide an applicable change suggestion to the spec draft**

9.1.2.1 Moved by Jianhan Liu, Seconded by Hongyuan Zhang.
9.1.2.2 Discussion – No discussion.
9.1.2.3 Result: The motion was accepted with no objection.

9.1.3 CR Motion #127 (MAC): Move to accept resolutions to CIDs
- **CIDs: 150, 1020, 2201 in doc 11-16/1354r0**
- **CIDs: 135, 658, 2389 in doc 11-16/1358r0**
- **CIDs: 385, 419, 458, 459, 514, 630, 741, 743, 2844, 2846 in doc 11-16/1359r0**
- **CIDs: 93, 824, 819, 989, 1067, 2388, 147, 161 in doc 11-16/1360r1**
- **CID 72 in doc 11-16/1415r2**
- **CID 193 in doc 11-16/1413r8**
- **CIDs: 195, 723, 779, 780, 1087, 1088, 2179, 2387, 2672, 2673, and 2674 in doc 11-16/1458r0**
- **CID 6 and 7 in doc 11-16/1461r1**
- **CIDs: 969, 1517, 1558, 1560, 1917, 2180 in doc 11-16/1357r0**

9.1.3.1 Moved by Reza Hedayat, Seconded by George Cherian.
9.1.3.2 Discussion – No discussion.
9.1.3.3 Result: The motion was accepted with no objection.

9.1.4 CR Motion #128 (MAC): Move to accept resolutions to CIDs
- **CID 682 in doc 11-16/1477r2**
- **CID 991 in doc 11-16/1503r2**
- **CID 1012 in doc 11-16/1350r0**
- **CID: 861, 1073, 16, 1398, 1212, 1211, 1176, 964, 823, 798, 797, 781, 733, 1400, 1072, 735 in doc 11-16/1332r3**
- **CID: 81, 82, 710, 1226, 1235, 1236, 1351, 1707, 1776 in doc 11-16/1336r1**
- **CID 2186 in doc 11-16/1342 (Editor)**
- **CID 154 in doc 11-16/1417r0**
- **CID 203 in doc 11-16/1418r0**
- **CID 1430, 1703, and 2503 in doc 11-16/1431r1**
- **CID 1700 and 2504 in doc 11-16/1335r3**

9.1.4.1 Moved by Yonggang Fang, Seconded by Reza Hedayat.
9.1.4.2 Note: The motion is referring to the latest revision of 1342 which is r0.
9.1.4.3 Discussion – No discussion.
9.1.4.4 Result: The motion was accepted with no objection.

9.1.5 CR Motion #129 (MAC): Move to accept resolutions to CIDs
- **CID 52, 2459, and 2632 in doc 11-16/1464r1**
- **CID 2113 in doc 11-16/1346r1**

- CIDs: 1920, 2441, 2671, 2262, 2396, 2454, 2604, 2605, 1734, 118, 691, 822, 1353 in doc 11-16/1352r1

9.1.5.1 Moved by Reza Hedayat, Seconded by George Cherian.
9.1.5.2 Discussion – No discussion.
9.1.5.3 Result: The motion was accepted with no objection.

9.1.6 CR Motion #130 (MU): Move to accept resolutions to CIDs
- CIDs 2490 and 2505 as proposed in 11-16/1353r1
- CIDs 37, 38, 171, 759, 761, 763, 764, 815, 950, 1219, 1540, 2273, 2320, 2449, 2467, 2636, 2656 and 2910 as proposed in 11-16/1361r1
- CIDs 59, 2652 and 2653 as proposed in 802.11-16/1391r0
- CIDs 2624 and 2738 as proposed in 802.11-16/1392r0
- CID 807 as proposed in 802.11-16/1389r0
- CIDs 53, 54, 56, 57, 604, 1553, 1554, 1555, 1557 and 2655 as proposed in 802.11-16/1457r3
- CID: 729, 1069, 806, 2261, 2909, 1468, 1637, 998, 730, 245, 246, 247, 248, 399, 421, 1464, 588, 256, 812, 1661 in doc 11-16/1339r1

9.1.6.1 Moved by Kiseon Ryu, Seconded by Yonggang Fang.
9.1.6.2 Discussion – No discussion.
9.1.6.3 Result: The motion was accepted with no objection.

9.1.7 CR Motion #131 (SR): Move to accept resolutions to CIDs
- CIDs 187, 224, 803, 1233, 1578, 1579, 2284, 2433, 2666, 2912, 2915, 2916, 2917 in doc 11-16/1337r0.
- CIDs 448, 833, and 1232 in doc 11-16/1430r0
- CID 2492 as provided in submission 11-16/1450r0 and to modify the 802.11ax draft amendment as shown in the submission
- CID 2719 and to modify (adding text to the end of section 25.9.2.1 on page 153 line 15) the 802.11ax draft amendment as proposed in submission 11-16/1440r4

9.1.7.1 Moved by Sameer Alfred Asterjadhi, Seconded by Po-Kai Huang.
9.1.7.2 Discussion – No discussion.
9.1.7.3 Result: The motion was accepted with no objection.

9.1.8 CR Motion #132 (SR): Move to accept resolutions to CIDs
- CID 944, 64, and 2911 in doc 11-16/1476r6 with the exeption that 11-16/1476r6 replaces 11-16/: 461476r4 in the resolution

9.1.8.2 Moved by VK Jones, Seconded by Ron Porat.
9.1.8.3 Discussion
- A member asked to table this motion since there are so many additions to the current draft.
- The presenter replied that this document contains resolutions for the CIDs 944, 64 and 2911, and proposed text discussed in SR ad hoc in the simplest way.
- The previous commenter withdraws the motion to table, but recommends to vote No on this motion.
- This motion is determined to be a recorded vote.

9.1.8.4 Result: Y/N/A = 46/29/38, motion fails.
- The vote record is available in the Annex B of this document.

9.2 Motion to reconsider

9.2.1 Move to reconsider motion SR-13 on OBSS_PD SR.

9.2.1.1 Moved by Sriram Venkateswaran, Seconded Saishankar Nandagopalan.

9.2.1.1.1. Discussion

- **A member mentioned that this is out of order. The mover mentioned that he voted "No" for the SR motion #13, however it is worth to reconsider.**

9.2.1.2. Result: Motion to reconsider passed with no objection.

9.2.1.3. Go back to the main motion

9.2.1.4. Discussion – No discussion.

9.2.1.5. Result: Y/N/A = 46/18/38, motion fails (<75%)

- The vote record is available in the Annex C of this document.

9.3 WG Motions

9.3.1 WG LB Motion:

- **Instruct the editor to prepare TGax Draft D1.0**
- **Approve a 30 day Working Group Technical Letter Ballot asking the question "Should TGax Draft 1.0 be forwarded to Sponsor Ballot?"**

9.3.1.1 Moved by Robert Stacy, Seconded by Vinko Erceg.

9.3.1.2 Discussion – No discussion.

9.3.1.3 Result: Y/N/A = 89/0/6, motion passes.

9.3.2 Coexistence Assurance Document: Move to adopt 11-16/1348r2 as coexistence assurance document for 802.11ax amendment.

9.3.2.1 Moved by Robert Stacy, Seconded by Yasuhiko Inoue.

9.3.2.2 Discussion – No discussion.

9.3.2.3 Result: Y/N/A = 82/0/7, motion passes.

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10 Presentation

10.1 Guido R. Hiertz (Ericsson) presented "TGax ad hoc meeting," based on the submission 11-16-1537-00.

10.1.1 Summary

10.1.1.1 Guido proposes an ad hoc meeting in Stockholm, Sweden, just before the IEEE 802 Wireless Session January 2017.

10.1.1.2 Ericsson will host the meeting

10.1.2 Discussion

10.1.2.1 The editor will create draft 1.0 in two or three week after the November session and a 30-day WG letter ballot starts after that. The ballot will be closed early January. We can assign comments during the teleconferences in January.

10.1.2.2 A member mentioned that it is difficult to prepare the resolution before the January 2017 meeting considering the sequence of events we will have.

10.1.3 Motion: Authorize TGax to hold an ad-hoc meeting on January 11-13/2017 in Stockholm, Sweden, for the purpose of comment resolution.

10.1.3.1 Moved by Guido R. Hiertz, Seconded by Hakan Persson

10.1.3.2 Discussion

11.1.3.2.1. A member mentioned that it is generally good to have an ad hoc meeting to accelerate the comment resolution process, however January is not the right timing.

11.1.3.2.2. There were similar comments.

10.1.3.3 Result: Y/N/A = 9/52/32, motion fails.

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11 Teleconferences

11.1 Weekly conference calls are planned after September session.

- Thursday Dec. 1st, 8th and 15th, 2016 21:00 - 23:00 (ET) – For PAR Verification
- Thursday Jan. 5th, 2017 11:00 - 13:00 (ET)
- Thursday Jan. 12th, 2017 20:00 - 22:00 (ET)

12 AOB

12.1 No other business to conduct.

13 Adjournment

13.1 TGax adjourned for the week @ 15:35.

Thursday, November 10th, 2016, PM2 TGax full Session (16:00-18:00)

Upon completion of its business, TGax Thursday PM2 session was cancelled.

Annex A. Vote record of the SR Motion #13 - Thursday, November 10th, 2016, AM1 session.

Annex B. Vote record of the CR Motion #132 (SR) - Thursday, November 10th, 2016, PM1 session.

Annex C. Vote record of the SR Motion #13 (reconsider) - Thursday, November 10th, 2016, PM1 session.

The results are contained in separate tabs the excel file below..



802.11 TGax roll call vote November

APPENDIX BI

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax

March 2017 Vancouver Meeting Minutes

Date: 2017-04-05

Author(s):

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Abstract

TGax meeting minutes from the IEEE 802.11 Vancouver session, March 13th – 17nd, 2017.

Minutes/motions from the ad hoc groups are contained in the following documents:

- PHY Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/17/11-17-0494-00-00ax-march-2017-vancouver-phy-ad-hoc-meeting-minutes.docx
- MAC Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/17/11-17-0155-01-00ax-11ax-mac-ad-hoc-minutes.docx
- MU Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/17/11-17-0495-00-00ax-tgax-mu-ad-hoc-minutes-march-2017.docx
- SR Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/17/11-17-0504-00-00ax-spatial-reuse-ad-hoc-group-march-2017-minutes.docx

IEEE 802.11 Task Group ax
March 2017 Vancouver Meeting
Hyatt Regency Vancouver, BC, Canada
March 13th – 17th, 2017

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

Monday, March 13th, 2017, PM1 TGax Session (13:30-15:30)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @13:35
   1.1. Introduction of front table.

2. Announcement
   2.1. Agenda Doc.11-17/0199r1 on the server. Rev. 2 is the working document.
   2.2. Meeting Protocol: Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. The chair reviewed the mandatory 6 slides of P&P.
   3.1. Instructions for the WG Chair.
   3.2. Participants, Patents, and Duty to Inform.
   3.3. Patent Related Links.
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents.
      3.4.2. No potentially essential patents reported.
   3.5. Other Guidelines for IEEE WG Meetings.
   3.6. Participation in IEEE 802 Meetings

4. Agenda items for the week
   4.1. Approve meeting and teleconferences minutes since January 2017
   4.2. Continue with comment resolution on draft D1.0
   4.3. Schedule TG ad hoc meeting (possibly in Korea)
   4.4. Schedule TG teleconferences.

5. General Flow of the meeting
   5.1. Slides 14 and 15 of the 17/0199r6 contain general flow of the meeting.

5.2. There are ten meeting slots planed for TGax.

	Monday		Tuesday		Wednesday		Thursday
AM1					TGax (full session)		
AM2			TGax (Ad Hoc)	TGax (Ad Hoc)			
PM1	TGax (full session)				TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (full session)
PM2	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (full session)
PM3			SR ad Hoc				

6. Call for submissions – 62 submissions

6.1. PHY – 13 submissions

6.1.1. 11-17-0044, "NDP Short Feedback Design," Ron Porat (Broadcom)
6.1.2. 11-17-0078, "RBW of 11ax," Xiaogang Chen (Intel)
6.1.3. 11-17-0231, "CR_clause 28.3.5," Xiaogang Chen (Intel)
6.1.4. 11-17-0234, "CR_clause 28.3.19_28.3.20," Xiaogang Chen (Intel)
6.1.5. 11-17-0247, "CR HE PHY Introduction Part 4," Lochan Verma (Qualcomm)
6.1.6. 11-17-0261, "CR HE PHY Transmit Requirements HE_TRIG_PPDU Part 1," Lochan Verma (Qualcomm)
6.1.7. 11-17-0290, "CRs on TX specification," Yujin Noh (Newracom)
6.1.8. 11-17-0345, "LB225 CR on TXOP_DURATION (28.2.2)," Jeongki Kim (LG Electronics)
6.1.9. 11-17-0398, "11ax Comment Resolutions for HE Preamble," Yan Zhang (Marvell)
6.1.10. 11-17-0400, "CRs for 20MHz-only STA - Part 1," Sungeun Lee (Cypress)
6.1.11. 11-17-0404, "CR on Pre-HE preamble transmission for trigger based PPDU," Ross Jian Yu (Huawei)
6.1.12. 11-17-0414, "CR on clause 28-3-11 HE PHY data field," Tianyu Wu (MediaTek)
6.1.13. 11-17-0436, "LB225 Comment Resolution of CID 7517," Jianhan Liu (MediaTek)

6.2. MAC – 25 submissions

6.2.1. 11-17-0074, "Explanations for CR on 27.5.2.7," Laurent Cariou (Intel)
6.2.2. 11-17-0088, "Discussion for CR on 10.22.2.8 TXOP limits," Woojin Ahn (Wilus)
6.2.3. 11-17-0239, "LB225-MAC-CR-HT Control subclause 9.2.4.6.X and 10.1 - Block 2," Alfred Asterjadhi (Qualcomm)
6.2.4. 11-17-0240, "LB225-MAC-CR-HT Control subclause 9.2.4.6.X and 10.1 - Block 3," Alfred Asterjadhi (Qualcomm)
6.2.5. 11-17-0283, "lb225-mac-cr-9-3-1-23," Raja Banerjea (Qualcomm)
6.2.6. 11-17-0285, "LB225-MAC-CR-HE MCS_NSS resolutions," Alfred Asterjadhi (Qualcomm)
6.2.7. 11-17-0308, "CR for section 9.4.2 BSS load PPT," Frank Hsu (MediaTek)
6.2.8. 11-17-0319, " CRs for Section 27.4," George Cherian (Qualcomm)
6.2.9. 11-17-0341, "LB225 11ax D1.0 Comment Resolution 10.13," Liwen Chu (Marvell)
6.2.10. 11-17-0344, "LB225 CR on EIFS and TXOP_DURATION (10.3.2.3.7 and 27.11.5)," Jeongki Kim (LG Electronics)
6.2.11. 11-17-0346, "LB225 CR on TXOP Truncation (10.22.2.9)," Jeongki Kim (LG Electronics)
6.2.12. 11-17-0347, "LB225 CR on Intra-PPDU PS (27.14.1)," Jeongki Kim (LG Electronics)
6.2.13. 11-17-0353, "LB225-CRs-on-OFDMA-based-random-access-Response," Suhwook Kim (LG Electronics)
6.2.14. 11-17-0359, "mac-cr-CS Required-9-3-1-23," Raja Banerjea (Qualcomm)
6.2.15. 11-17-0360, "LB225 CR for CID5917 and CID8165," Ming Gan (Huawei)

6.2.16. 11-17-0361, “BSS Load Information in 802.11ax,” Ming Gan (Huawei)
6.2.17. 11-17-0362, “LB225 CR for Subclause 9.4.2.218.2,” Ming Gan (Huawei)
6.2.18. 11-17-0384, “LB225, Comment resolution for 10.24.10,” Reza Hedayat (Newracom)
6.2.19. 11-17-0389, “CIDs-for-27-2-1-part1,” Kaiying Lv (ZTE)
6.2.20. 11-17-0395, “LB225-CR-on-Pre-association,” Ming Gan (Huawei)
6.2.21. 11-17-0396, “Association Exchange using Contention based UL OFDMA,” Ming Gan (Huawei)
6.2.22. 11-17-0421, “cr-for-11.49-HE BSS operation,” Chao-Chun Wang (MediaTek)
6.2.23. 11-17-0443, “LB225-CRs-on-OFDMA-based-random-access-Figure,” Suhwook Kim (LG Electronics)
6.2.24. 11-17-0445, “CR on Per-TID All Ack in Multi-STA BlockAck Frame,” Geonjung Ko (Wilus)
6.2.25. 11-17-0448, “Proposed resolution for comments related to CIDs in 27.5.2,” Jing Ma (NICT)

6.3. MU – 9 submissions
6.3.1. 11-17-0271, “CR for 17.2.2.1 and 17.3.9.10,” Po-kai Huang (Intel)
6.3.2. 11-17-0282, “11-17-xxxx-0x-00ax-lb225-mac-cr-number-of-ss-9-3-1-23,” Raja Banerjea (Qualcomm)
6.3.3. 11-17-0302, “D1.0 MAC Resolution CR for 27.5.2.4,” Po-Kai Huang (Intel)
6.3.4. 11-17-0325, “CR for 27.14.3 OPS,” Laurent Cariou (Intel)
6.3.5. 11-17-0335, “CR for CID 8142 - Random Access acronym,” Rojan Chitrakar (Panasonic)
6.3.6. 11-17-0338, “CR for 27.5.2.4 - Physical CS CIDs,” Rojan Chitrakar (Panasonic)
6.3.7. 11-17-0349, “LB225 CR for 25.5.2.4 Setting of CS Required Bit,” Kiseon Ryu (LG Electronics)
6.3.8. 11-17-0403, “CR-Subclause-27-5-3-MU-Cascading,” David Xun Yang (Huawei)
6.3.9. 11-17-0442, “LB225, CR CIDs 3215, 3216,” Reza Hedayat (Newracom)

6.4. SR – 10 submissions
6.4.1. 11-16-1063, “Unified SR text DSC, ATPC, inter-BSS,” Graham Smith (SR Technologies)
6.4.2. 11-16-1476, “CR-for section-25-9-spatial-reuse-operation-for-HE-PPDU,” Matthew Fischer (Broadcom)
6.4.3. 11-17-0075, “SRP-based SR Summary and Update,” Matthew Fischer (Broadcom)
6.4.4. 11-17-0163, “DSC as OBSS_PD,” Graham Smith (SR Technologies)
6.4.5. 11-17-0267, “CR for 25.9.2.2 OBSS_PD Spatial reuse,” Laurent Cariou (Intel)
6.4.6. 11-17-0383, “Spatial Reuse Group Challenges,” Reza Hedayat (Newracom)
6.4.7. 11-17-0452, “LB225, CR for CID3222,” Reza Hedayat (Newracom)
6.4.8. 11-17-0455, “Some clarifications on current SR spec text,” Laurent Cariou (Intel)
6.4.9. 11-17-0458, “OBSS_PD: Threshold problems,” Sean Coffey (RealTek)
6.4.10. 11-17-0459, “,” Kaiying Lv (ZTE)

6.5. TG – 5 submissions
6.5.1. 11-17-0112, “Link Transmit Power,” Matthew Fischer (Broadcom)
6.5.2. 11-17-0328, “Link Adaptation Feedback for Combating Interference,” Feng Jiang ()
6.5.3. 11-17-0334, “Proposed Text for Simulation Scenarios,” Frank Hsu (MediaTek)
6.5.4. 11-17-0369, “Some CIDs related to 20MHz operation,” Guoqing Li (Apple)
6.5.5. 11-17-0370, “Some CIDs related to 20MHz operation -- text,” Guoqing Li (Apple)

6.6. Ad Hoc meeting scheduling
6.6.1. Ad Hoc slot assignment
6.6.1.1. MAC … 5, PHY … 3.5, SR … 1, MU … 1.5.
6.6.2. Chair asked if there are any objections to approve the TGax schedule as follow.
6.6.2.1. There are no objections. The TGax schedule is approved.

	Monday		Tuesday		Wednesday		Thursday
AM1					TGax (full session)		
AM2			TGax (PHY)	TGax (MAC)			TGax (full session)
PM1	TGax (full session)				TGax (MAC)	TGax (MU)	
PM2	TGax (PHY)	TGax (MAC)	TGax (PHY)	TGax (MAC)	TGax (MAC)	TGax (PHY/MU)	TGax (full session)
PM3			TGax (SR)				

7. Agenda for Monday, March 14th, PM1 (13:30 – 15:30).

7.1. Proposed Agenda for Monday PM1:

- 7.1.1. Call meeting to order
- 7.1.2. Patent policy, etc.
- 7.1.3. Call for submissions
- 7.1.4. Set Ad Hoc Groups schedule and approve agenda
- 7.1.5. Summary from January 2017 meeting
- 7.1.6. TG motions
  - 7.1.6.1. Approve TG meeting and Telecon minutes since November meeting.
  - 7.1.6.2. Approve resolutions of comments, if needed.
- 7.1.7. Editor Report – Robert Stacey
- 7.1.8. Timeline
- 7.1.9. On Comment Resolution
- 7.1.10. Next ad Hoc Meeting (May)
- 7.1.11. Presentations and Comment Resolution
- 7.1.12. Recess

7.2. Chair asked if there are any other items – No items proposed. Meeting will be conducted based on this order.

8. Summary from January 2017 Meeting

8.1. Continued with the resolution of comments received on draft D1.0
8.2. Discussed issues related to spatial Reuse.
8.3. Held a weekly teleconferences to advance comment resolution
8.4. Held a TG 3-day ad hoc meeting in San Diego

9. TG Motions

9.1. Motion: Approve TGax minutes of meetings and teleconferences from January 2017 interim meeting to today:

- **https://mentor.ieee.org/802.11/dcn/17/11-17-0126-00-00ax-tgax-january-2017-atlanta-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/17/11-17-0224-03-00ax-tgax-teleconference-minutes-from-jan-to-mar-2017.docx**
- **https://mentor.ieee.org/802.11/dcn/17/11-17-0155-00-00ax-11ax-mac-ad-hoc-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/17/11-17-0358-00-00ax-tgax-march-2017-ad-hoc-meeting-minutes-non-phy-ad-hoc.docx**

- https://mentor.ieee.org/802.11/dcn/17/11-17-0456-00-00ax-mar-2017-tgax-sd-phy-ad-hoc-premeeting-minutes.docx

9.1.1. Discussion:

9.1.1.1. A member requested to check the CIDs discussed during the TGax ad hoc meeting.

9.1.2. Result: The motion was postponed until Wednesday AM1.

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10. Editor's Report

10.1. Draft 1.1 is on the members' only area of the 802.11 web site.

11. Timeline

11.1. Slide 24 of the agenda document contains the current timeline.

11.1.1. May 2014: start of the TG
11.1.2. Nov. 2014: First draft of the TG SFD was approved
11.1.3. Jan. 2016: proposed TG draft
11.1.4. March 2016: Draft D0.1 was approved and CC started
11.1.5. November 2016: Draft 1.0 and WG letter ballot
11.1.6. May 2017: Draft 2.0 and recirculation
11.1.7. November 2017: MDR (Mandatory Document Review)
11.1.8. January 2018: Formation of SB pool
11.1.9. March 2018: Sponsor Ballot
11.1.10. December 2018: RevCom

11.2. Draft 2.0 is very unlikely to be available in May 2017.

11.2.1. Chair asked for comments and suggestions.

11.2.2. Timeline will be discussed during the TGax full session on Thursday session.

12. On Comment Resolutions

12.1. Number of comments were rejected with no proper reasons

12.2. Some of the reasons cited, "it is in the SFD", "the group adopted it"

12.3. Please refer to the comment resolution tutorial;
https://mentor.ieee.org/802.11/dcn/16/11-16-0230-03-000m-sb1-stephens-resolutions-part-1.doc

13. Presentations

13.1. Guoqing Li (Apple) presented "CIDs Related to 20MHz-only STAs operating on non-primary 20 MHz channels," based on the submission 11-17-0369-03.

13.1.1. Summary

13.1.1.1. The 802.11ax draft is introducing 20 MHz-only STAs which operate at 20MHz BW only, however, it is not clear on whether and how these STAs can operate on non-primary 20MHz channel, see text below.

13.1.1.2. What's defined in 11ax draft 1.0 is ready to enable the non-primary channel operation mode which enables intelligent load balancing and interference management, maximizes BSS BW utilization and reduces STA power consumption.

13.1.2. Discussion

13.1.2.1. A member mentioned that he/she likes this idea. However, he/she is concerned about the consistency with the protection mechanism, i.e. MU-RTS/CTS procedure.

13.1.2.2. Another member is concerned about the range disadvantage that a 20 MHz-only STA may have, and also the additional complexity since such a device is very likely to be a low cost device.
13.1.2.3. There is a comment that efficiency can be achieved by putting 20 MHz-only STA on the primary channel while placing other HE STAs secondary channels.
13.1.2.4. There is a comment that this proposal introduces an OBSS coexistence issue. The commenter would like to see all the mechanism for this procedure and results of evaluation.
13.1.2.5. A member mentioned that he/she generally agrees with the idea of giving a kind of flexibility. He/she would like to understand relationship between MU-RTS/CTS procedure and power efficiency.
13.1.3. Next Step
13.1.3.1. It is good to give people to review the document 17/370r2 that contains the text of this proposal.

14. AoB
14.1. PM2 session on Monday March 13th is ad hoc sessions
14.1.1. Ad Hoc #1 – PHY – Regency C.
14.1.2. Ad Hoc #2 – MAC – Regency D.

15. TGax meeting recessed @ 15:30.
The next TGax full session is AM1 on Wednesday, March 15th.

Monday, March 13th, 2017, PM2 TGax Ad Hoc Sessions (16:00-18:00)

- Ad Hoc #1: PHY – Regency C
  - Agenda: 11-17-0464
- Ad hoc #2: MAC – Regency D
  - Agenda: 11-17-0453

Tuesday, March 14th, 2017, AM2 TGax Ad Hoc Sessions (10:30-12:30)

- Ad hoc #1: PHY – Regency C
  - Agenda: 11-17-0464

- Ad hoc #2: MAC – Regency D
  - Agenda: 11-17-0453

Tuesday, March 14th, 2017, PM2 TGax Ad Hoc Sessions (16:00-18:00)

- Ad hoc #1: PHY – Regency C.
  - Agenda: 11-17-0464

- Ad hoc #2: MAC – Regency D
  - Agenda: 11-17-0453

Tuesday, March 14th 2016, PM3 TGax ad hoc Session (19:30-21:30)

- Ad hoc #1: SR – Regency C.
  - Agenda: 11-17-0482

Wednesday, March 15th 2017, AM1 TGax full Sessions (13:30-15:30)

1 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @8:00 AM

1.1 Agenda 17/0199r3 is on the server.
1.2 Rev. 4 is the working document.

2 Agenda Setting

2.1 Proposed agenda for this session
- 2.1.1 Call Meeting to order
- 2.1.2 IEEE 802 and 802.11 IPR Policy and procedure.
- 2.1.3 Approval of TG Minutes
- 2.1.4 May ad hoc Meeting and motion
- 2.1.5 Timeline
- 2.1.6 Progress Review from ad hocs
- 2.1.7 Presentations
  - 2.1.7.1 SP remaining from yesterday
  - 2.1.7.2 11-17/0075 and 11-16/1476
  - 2.1.7.3 11-17/0383 and 11-17/0452
  - 2.1.7.4 11-17/0459
  - 2.1.7.5 11-17/0267 – SP
- 2.1.8 Recess

2.2 Chair asked if there any comments or suggestions on the proposed agenda. No response.
- 2.2.1 The agenda for Wednesday AM1 is approved.

3 Reminder

3.1 Chair reminded that we are still operating under IEEE 802 and 802.11 Policies and Procedures.
3.2 Chair asked to state name and affiliation when addressing for the first time in the session.
3.3 Chair asked to put cellphone mute.

4 Approval of TG minutes (January 2017 meeting and teleconferences)

4.1 Motion: Approve TGax minutes of meetings and teleconferences from January 2017 plenary meeting to today:
- **4.1.1 https://mentor.ieee.org/802.11/dcn/17/11-17-0126-00-00ax-tgax-january-2017-atlanta-meeting-minutes.docx**
- **4.1.2 https://mentor.ieee.org/802.11/dcn/17/11-17-0224-03-00ax-tgax-teleconference-minutes-from-jan-to-mar-2017.docx**
- **4.1.3 https://mentor.ieee.org/802.11/dcn/17/11-17-0155-00-00ax-11ax-mac-ad-hoc-minutes.docx**
- **4.1.4 https://mentor.ieee.org/802.11/dcn/17/11-17-0358-02-00ax-tgax-march-2017-ad-hoc-meeting-minutes-non-phy-ad-hoc.docx**
- **4.1.5 https://mentor.ieee.org/802.11/dcn/17/11-17-0456-00-00ax-mar-2017-tgax-sd-phy-ad-hoc-premeeting-minutes.docx**

4.2 Moved by Bo Sun, Seconded by Bin Tian.
4.3 Discussion: No discussion.
4.4 Result: Motion was approved with no objection.

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5 Ad Hoc Meeting in May 2017

5.1 Jinsoo Ahn (LG Electronics) volunteers to host the TGax ad hoc meeting in May 2017 before the week of the IEEE 802 Wireless Interim session.

5.2 Discussion

5.2.1 Some members prefer to have the ad hoc meeting on Saturday and Sunday.

5.2.2 PHY ad hoc does not need ad hoc meeting.

5.3 Motion

5.3.1 Authorize TGax to hold an ad-hoc meeting on May 3-5 in Seoul, Korea, for the purpose of working on comment resolution excluding PHY CIDs.

5.3.2 Moved by Robert Stacey, Seconded by Qinghua Li

5.3.3 Discussion: No discussion.

5.3.4 Result: Y/N/A = 55/0/2, motion passes.

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6 Timeline discussion

6.1 Chair showed the proposed modification to the timeline contained in the agenda file and requested for comments and suggestions.

6.1.1 There will be a motion to approve the modified timeline on Thursday.

7 Progress from ad hoc groups

7.1 Report from the ad hoc groups:

7.1.1 PHY (Bo): 4 presentations left. Need one more session.

7.1.2 MU (Sigurd): 8 submissions left. Need one more session. It can be a joint session with PHY ad hoc.

7.1.3 SR (Guido): 5 left. Want Thursday AM1 session.

7.1.4 MAC (Eric): 14 left. Need more sessions.

7.2 Chair will request additional meeting slot during the WG mid-week plenary session.

7.3 Chair also asked the members to review the motion text contained in the agenda file.

8 Presentations

8.1 Matt. Fischer (Broadcom) presented "SRP-Based SR Operation," based on the submission 11-17-0075-07.

8.1.1 Summary

8.1.1.1 This is an update of a presentation that was given in January 2017 session.

8.1.2 Discussion

8.1.2.1 Q: A member asked about the retransmission procedure when the acknowledgment is not returned. → It is not likely that the retransmission occurs within the same SRP PPDU. We may need to think about the use of Delayed Block ACK procedure.

8.1.2.2 C: Some members disagree with the concept of SRP. Although some cases are explained in the document, there seems to be many hidden assumptions. More details of this procedure have to be discussed.

8.1.2.3 C: A member commented that AP will have an advantage for SR transmissions.

8.1.2.4 Q: A member asked if we have a mechanism to completely ON/OFF this procedure. → SR_Disallow bit.

8.1.2.5 C: Another member pointed out that there are some issues such as number of STAs participating SR transmissions, collision probability in a dense wireless LAN environment, UL/DL balancing.

8.1.3 Straw Polls

8.1.3.1 Straw Poll #1: Do you support the use of SRP in the DSRP_PPDU case, i.e. Trigger followed by UL Trigger-based PPDU?

8.1.3.1.1 Y/N/A = 31/12/35

8.1.3.2 Straw Poll #2: Do you support the use of SRP in the TSRP_PPDU case, i.e. HE Trigger-based PPDU preceded by IDLE or by PPDU with color match of Trigger-based PPDU?

8.1.3.2.1 Y/N/A = 24/26/29

8.1.3.3 Straw Poll #3: Do you support the use of SRP in the ULSRP_PPDU case 1, i.e. HE UL SU PPDU or HE UL MU PPDU preceded by IDLE?

8.1.3.3.1 Y/N/A = 13/25/31

8.2 Reza Hedayat (Newracom) presented "LB225, CR for CID3222," based on the submission 11-17-0452-02.

8.2.1 Summary

8.2.1.1 As a resolution for CID #3222, OBSS_PD Rule is modified.

8.2.1.2 The proposal is to use a more relaxed OBSS-PD for response frames to protect intended recipients of data frames from potential interference/collision.

8.2.1.3 Proposed text is contained in slide 10 of 11-17-0452-02.

8.2.2 Discussion

8.2.2.1 A member commented that we should have protection for response frame.

8.2.3 Straw Poll

8.2.3.1 Do you accept the Revised resolution for CID 3222 with the proposed text in slide 10 of 17-0452r1?

8.2.3.1.1 Accepted with no objection.

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9 AoB

9.1 Guoqing Li (Apple) has straw polls from submission 11-17-0369

9.1.1 Straw Polls:

9.1.1.1 Straw Poll #1: Do you agree to accept the text described in 0370r2 for comment resolution for CID 8810 and 8811?

9.1.1.1.1 Discussion:

9.1.1.1.1.1 A member commented that this adds lots of complexity.

9.1.1.1.2 Result: Y/N/A = 39/26/17, straw poll will not be converted to a motion.

9.1.1.2 Straw Poll #2: Do you agree to allow 20 MHz-only STAs to operate on any 20 MHz channel within the BSS bandwidth as an optional mode?

9.1.1.2.1 Discussion:

9.1.1.2.2 Result: This straw poll was not conducted.

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10 Recess

10.1 There will be TGax ad hoc meetings this afternoon.

10.2 Chair will send out an email.

Wednesday, March 15th 2017, PM1 TGax Ad Hoc Sessions (13:30-15:30)

- Ad Hoc #1: MAC – Regency C
  - Agenda: 11-17-0453
- Ad Hoc #2: MU – Regency D
  - Agenda: 11-17-0485

Wednesday, March 15th 2017, PM2 TGax Ad Hoc Sessions (16:00-18:00)

- Ad Hoc #1: MU/PHY – Regency C
  - Agenda: 11-17-0485/11-17-0464
- Ad Hoc #2: MAC – Regency D
  - Agenda: 11-17-0453

Thursday, March 16th, 2017, PM1 TGax full Session (13:30-15:30)

1 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @13:30.

1.1 Agenda 17/0199r5 is on the server. Rev. 6 is the working document.

2 Agenda for this session

2.1 Thursday PM1 and PM2
- 2.1.1 Call Meeting to order
- 2.1.2 Agenda Setting
- 2.1.3 Announcement/Reminder
  - 2.1.3.1 IEEE 802 and 802.11 IPR Policy and procedure.
  - 2.1.3.2 Attendance
- 2.1.4 TG Motions
- 2.1.5 Timeline update
- 2.1.6 Goals for May 2016
- 2.1.7 Teleconferences
- 2.1.8 Presentations
  - 2.1.8.1 11-17/0328
  - 2.1.8.2 11-17/0112
- 2.1.9 Adjourn

2.2 Chair asked if there are any modifications to the agenda.

2.3 Agenda approved without objections.

3 Announcement/Reminder

3.1 Chair reminded IEEE 802 and 802.11 IPR P&P.

3.2 Chair asked people to state name and affiliation when addressing for the first time in the session.

3.3 Chair reminded people to do attendance.

4 Motions – TG documents

4.1 CR Motions

4.1.1 CR Motion #152 (MAC): Move to accept resolutions to CIDs; 5164, 6974, 6975,6978, 6979, 6980, 6981, 7532, 7533, 8293, 8486, 9865, and 9866 in doc 11-17/0191r5

4.1.1.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.1.2 Discussion: No discussion.
4.1.1.3 Result: Motion was accepted with no objection.

4.1.2 CR Motion #153 (MAC): Move to accept resolutions to CIDs; 3193, 3194, 4747, 4748, 5032, 5172, 5684, 5854, 5906, 5908, 6159, 6160, 7138, 7178, 7185, 7186, 7795, 8212, 8213, 8214, 8264, 8295, 8296, 8297, 9403, 9491, 9521, 9586, 9702, 10248, 10249, 10327, 3244, 3389, 3499, 3830, 3919, 4270, 4454, 4483, 4742, 4744, 5843, 5911, 5912, 6462, 6463, 6464, 7562, 8201, 8262, 8263, 8265, 8290, 8291, 8519, 4745, 7660 in doc 11-17/0204r5.

4.1.2.1 Moved by Laurent Cariou, Seconded by Yasu Inoue.
4.1.2.2 Discussion: No discussion.
4.1.2.3 Result: Motion was accepted with no objection.

4.1.3 CR Motion #154 (MAC): Move to accept resolutions to CIDs; 6935, 3102, 7707, 8494, 4715, 6936, 4716, 6937, 5432, 4717 in doc 11-17/0223r2.

4.1.3.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.3.2 Discussion: No discussion.
4.1.3.3 Result: Motion was accepted with no objection.

4.1.4 CR Motion #155 (MAC): Move to accept resolutions to CIDs; 5931, 7528, 9748 in doc 11-17/0227r0.

4.1.4.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.4.2 Discussion: No discussion.
4.1.4.3 Result: Motion was accepted with no objection.

4.1.5 CR Motion #156 (MAC): Move to accept resolutions to CIDs; 4266, 4479, 5211, 10290 in doc 11-17/0248r3.

4.1.5.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.5.2 Discussion: No discussion.
4.1.5.3 Result: Motion was accepted with no objection.

4.1.6 CR Motion #157 (MAC): Move to accept resolutions to CIDs; 9756, 7788 in doc 11-17/0255r0.

4.1.6.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.6.2 Discussion: A member asked for a count.
4.1.6.3 Result: Y/N/A = 28/3/9, motion passes.

4.1.7 CR Motion #158 (MAC): Move to accept resolutions to CIDs; 3166, 6086, 6328, 7267, 7272, 7275, 7753, 8396, 9834, 9836, 5682, 7271, 3019, 6329, 9835, 9646, 9647, 8252, 7273, 7274, 7490, 8117, 10342 in doc 11-17/0207r6.

4.1.7.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.7.2 Discussion: No discussion.
4.1.7.3 Result: Motion was accepted with no objection.

4.1.8 CR Motion #159 (MAC): Move to accept resolutions to CIDs; 9612, 4832 in doc 11-17/0208r2.

4.1.8.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.8.2 Discussion:
4.1.8.2.1 A member asked for deferral of CID #9612.
4.1.8.2.2 Another member objects to it.
4.1.8.3 Result: Y/N/A = 28/3/9, motion passes.

4.1.9 CR Motion #160 (MAC): Move to accept resolutions to CIDs; 7667, 9693, 6529 in doc 11-17/0209r2.

4.1.9.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.

4.1.9.2 Discussion: No discussion.
4.1.9.3 Result: Motion was accepted with no objection.

4.1.10 CR Motion #161 (MU): Move to accept resolutions to CIDs; 7840, 7959, 8502, 9771, 8715, 10071 in doc 11-17/0309r1.

4.1.10.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.10.2 Discussion: No discussion.
4.1.10.3 Result: Motion was accepted with no objection.

4.1.11 CR Motion #162 (MAC): Move to accept resolutions to CIDs; 7668, 7669, 7906, 9694, 4833, 5775, 9600, 5969, 9861, 5968, 7670, 7881, 9346, 3188 in doc 11-17/0210r2.

4.1.11.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.11.2 Discussion: No discussion.
4.1.11.3 Result: Motion was accepted with no objection.

4.1.12 CR Motion #163 (MAC): Move to accept resolutions to CIDs; 6935, 3102, 7707, 8494, 4715, 6936, 4716, 6937, 5432, 4717 in doc. 11-17/0223r2.

4.1.12.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.12.2 Discussion: This is a duplicate of a previous motion (CR Motion #154).

4.1.13 CR Motion #164 (MAC): Move to accept resolutions to CIDs; 4754, 6094, 7564, 8404, 8689, 9677, 6480, 7565, 5848, 6481, 8406, 6484, 9611 in doc 11-17/0226r3.

4.1.13.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.13.2 Discussion: No discussion.
4.1.13.3 Result: Motion was accepted with no objection.

4.1.14 CR Motion #165 (MAC): Move to accept resolutions to CIDs; 8394, 5215, 7142, 10292 in doc 11-17/0263r3.

4.1.14.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.14.2 Discussion: No discussion.
4.1.14.3 Result: Motion was accepted with no objection.

4.1.15 CR Motion #166 (MAC): Move to accept resolutions to CIDs; 5075, 5076, 5561, 9481, 5562, 5563, 9274, 7140, 9423, 5044, 9425, 8095, 8096, 5045, 9427, 7975, 5932, 7976, 9424, 9426, 9557, 9681, 9850, 5933, 8411, 9515, 7569, 8410, 5795, 7137, 5761, 9682, 8256, 8257, 9428, 4835, 5934, 9851, 7663 in doc 11-17/0264r3.

4.1.15.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.15.2 Discussion: No discussion.
4.1.15.3 Result: Motion was accepted with no objection.

4.1.16 CR Motion #167 (MAC): Move to accept resolutions to CIDs; 10250, 10320, 10321, 10322, 10323, 10247, 10005, 10006, 10246, 9584, 9386, 9285, 8592, 8354, 8211, 7233, 6068, 6056, 5930, 5559, 5468, 5466, 5463, 5358, 5169, 3057, 8268, 8269, 7844, 9442 in doc 11-17/0324r1.

4.1.16.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.16.2 Discussion: No discussion.
4.1.16.3 Result: Motion was accepted with no objection.

4.1.17 CR Motion #168 (MAC): Move to accept resolutions to CIDs; 3006, 3010, 3112, 3162, 5047, 5058, 5067, 5926, 6075, 6076, 6272, 6273, 7134, 7311, 7312, 7314, 7475, 7733, 7734, 7735, 7736, 7737, 7934, 8113, 8186, 8187, 8474, 8475, 8477, 8478, 9362, 9363, 9364, 9625, 9626, 9642, 9814, 9815, 9816, 9817, 9818 in doc 11-17/306r4.

4.1.17.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.17.2 Discussion: No discussion.
4.1.17.3 Result: Motion was accepted with no objection.

4.1.18 CR Motion #169 (MAC): Move to accept resolutions to CIDs; 3060, 3063, 3064, 3065, 3201, 3202, 3203, 3204, 3205, 3206, 3213, 5174, 5178, 5650, 5651, 5652, 5653, 5654, 5655, 5668, 5685, 5803, 5804, 5805, 5806, 6060, 6135, 6608, 6611, 6621, 6623, 6637, 6639, 6640, 6641, 7082, 7393, 7534, 7653, 7654, 7655, 7656, 7802, 7967, 8122, 8391, 8392, 8459, 8490, 8491, 9214, 9286, 9718, 9736, 9737, 9882, 10009, 10329, 10330, 10333, 8395 in doc 11-17/0319r1.

4.1.18.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.18.2 Discussion: No discussion.
4.1.18.3 Result: Motion was accepted with no objection.

4.1.19 CR Motion #170 (MAC): Move to accept resolutions to CIDs; 3019, 9648, 9837, 10162 in doc 11-17/0359r2.

4.1.19.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.19.2 Discussion: No discussion.
4.1.19.3 Result: Motion was accepted with no objection.

4.1.20 CR Motion #171 (MAC): Move to accept resolutions to CIDs; 3018, 8190, 3167, 3216, 5130, 8166, 8335, 8336, 8380, 8415, 8539, 8540, 9494, 9645, 6082, 7484, 9831 in doc 11-17/0283r3.

4.1.20.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.20.2 Discussion: No discussion.
4.1.20.3 Result: Motion was accepted with no objection.

4.1.21 CR Motion #172 (MAC): Move to accept resolutions to CIDs; 6484, 9611 in document 17/0226r3.

1.1.1.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
1.1.1.2 Discussion: No discussion.
1.1.1.3 Result: Motion was accepted with no objection.

4.1.22 CR Motion #173 (MAC): Move to accept resolutions to CIDs; 9428 in document 17/0264r3.

4.1.22.1 Moved by Po-Kai Huang.

4.1.22.2 Discussion: This CID is included in a previous motion (CR Motion #166).

4.1.23 CR Motion #174 (MAC): Move to accept resolutions to CIDs; 3060, 3061, 9444, 5175, 3062, 3071, 5708, 5709, 5710, 9709, 5711, 7177, 3072, 4817, 3136, 9821, 3075, 7552, 7972, 8533, 5455, 7163, 7164, 9378, 7165, 7841, 7169, 9379, 7146, 8280, 8292 in document 17/0230r1.

4.1.23.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.

4.1.23.2 Discussion: No discussion.

4.1.23.3 Result: Motion was accepted with no objection.

4.1.24 CR Motion #175 (MU): Move to accept resolutions to CIDs; 7968, 8271, 4809, 4810, 4811, 5702, 5183, 5184, 9451, 5185, 5703, 7574, 9894, 4812, 5186, 5704, 9452, 8272, 9707, 5706, 5187, 6168, 5983, 8273, 8338, 9588, 6166, 10167, 4815, 4816, 7644, 7812, 9896, 6065, 7175, 9759, 9456, 9589, 7176, 10260, 9898, 8552, 3228, 9710, 4818, 8151, 8701, 8702, 4821, 9529, 4820, 8703, 4822, 4823, 4824, 4825, 6685, 7649, 5717, 3232, 7816, 5988, 9713, 4828, 6196, 3325*, 6695, 8705, 6696, 7817, 6697, 9917, 5997, 5998, 6701 in document 17/0250r2.

4.1.24.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.

4.1.24.2 Discussion: No discussion.

4.1.24.3 Result: Motion was accepted with no objection.

4.1.25 CR Motion #176 (MAC): Move to accept resolutions to CIDs; 6787, 7131, 10300, 10301, 4910, 4911, 6789, 8356, 4909, 9703, 4908 in document 17/138r1.

4.1.25.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.

4.1.25.2 Discussion: No discussion.

4.1.25.3 Result: Motion was accepted with no objection.

4.1.26 CR Motion #177 (MAC): Move to agree to the resolution of CID 5189 in document 17/0359r2.

4.1.26.1 Moved by George Cherian, Seconded by Yasu Inoue.

4.1.26.2 Discussion: No discussion.

4.1.26.3 Result: Motion was accepted with no objection.

4.1.27 CR Motion #178 (MAC): Move to accept the resolutions to CIDs 3015, 3016, 3165, 7487, 8660, 8661, 9262, 9263, 9633 from document 17/0282r4.

4.1.27.1 Moved by George Cherian, Seconded by Yasu Inoue.

4.1.27.2 Discussion: No discussion.

4.1.27.3 Result: Motion was accepted with no objection.

4.1.28 CR Motion #179 (MAC): Move to accept the resolutions to CIDs 4564, 4571, 4614, 7369, 8083, 8511, 8512, 9666, 9667 in document 11-17/0235r0.

4.1.28.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.28.2 Discussion: No discussion.
4.1.28.3 Result: Motion was accepted with no objection.

4.1.29 CR Motion #180 (MAC): Move to accept the resolutions to CIDs 3132, 3175, 4720, 6919, 7228, 8308 in document 11-17/0236r2.

4.1.29.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.29.2 Discussion: No discussion.
4.1.29.3 Result: Motion was accepted with no objection.

4.1.30 CR Motion #181 (MAC): Move to accept the resolutions to CIDs 4789, 4808, 5217, 5218, 5219, 5220, 5221, 5511, 5518, 7034, 7035, 7154, 7581, 7582, 8525, 8526, 8616, 8617, 8729, 8730, 9732, 9961, 9962, 9963, 9964 in document 11-17/0237r3.

4.1.30.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.30.2 Discussion: No discussion.
4.1.30.3 Result: Motion was accepted with no objection.

4.1.31 CR Motion #182 (MAC): Move to accept the resolutions to CIDs 3084, 3085, 3086, 5387, 7166, 6786, 6779, 6777, 6781, 3088, 9458, 10299, 3087, 5476 in document 11-17/0134r10.

4.1.31.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.
4.1.31.2 Discussion: No discussion.
4.1.31.3 Result: Motion was accepted with no objection.

4.1.32 CR Motion #183 (MAC): Move to accept the resolution to CID 5050 in document 11-17/0363r5.

4.1.32.1 Moved by Matt Fischer, Seconded by Yasu Inoue.
4.1.32.2 Discussion: No discussion.
4.1.32.3 Result: Motion was accepted with no objection.

4.1.33 CR Motion #184 (MAC): Move to accept the resolutions to CIDs 7809, 3074, 5999, 9121, 9122, 9123, 5018, 5019, 5020, 5021, 5022, 5023, 5066, 5714, 5986, 6167, 7648, 8156, 8279, 8554, 9100, 9591, 9904, 9975, 9708, 10168, 5364, 7814, 3097, 3229, 3230, 3301, 4819, 5035, 5094, 5190, 5370, 5713, 6195, 6677, 6999, 7097, 7845, 8276, 8299, 9528, 9711, 10169, 10010, 5810, 10012, 5365, 9916, 9258, 7745, 9827, 9630, 7329, 9997, 9998, 9826, 7041, 7141, 9897 in document 11-17/0229r2.

4.1.33.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.
4.1.33.2 Discussion: No discussion.
4.1.33.3 Result: Motion was accepted with no objection.

4.1.34 CR Motion #185 (MAC): Move to accept the resolutions to CIDs 5222, 5223, 5224, 5225, 5226, 7584, 7585, 7586, 9751, 9965, 9966, 3256, 3354, 3461, 3775, 3858, 4301, 4925, 5227, 5228, 7587, 7588, 7589, 7590, 7591, 7592 in doc 11-17/0237r3.

4.1.34.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.34.2 Discussion: No discussion.
4.1.34.3 Result: Motion was accepted with no objection.

4.1.35 CR Motion #186 (MAC): Move to accept the resolutions to CIDs; 3004, 4725, 5436, 7715, 8175 (5 CIDs),
3378, 3483, 3812, 3896, 4358, 4425, 4727, 5025, 5438, 7471, 7713, 7714, 8176, 8643, 8644, 9801, 9984 (17 CIDs),
3153, 3381, 3487, 3817, 3902, 4365, 4433, 4734, 5051, 5122, 5123, 5439, 8177, 8645, 8646, 10334, 10335, 10336, 10337 (19 CIDs)
in document 11-17/0238r2.

4.1.35.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.35.2 Discussion: No discussion.
4.1.35.3 Result: Motion was accepted with no objection.

4.1.36 CR Motion #187 (MAC): Move to accept the resolutions to CIDs;
- 4732, 4733, 5052, 5053, 5124, 5125, 5440, 7379, 7716, 7717, 8178, 8248, 9804,
- 5335, 5441, 7888,
- 5054, 5055, 5056, 5126, 5442, 7302, 7303, 7305, 7719, 7865, 7867, 8133, 8179, 8180, 8181, 8249, 9620, 9621, 9806
in document 11-17/0239r2.

4.1.36.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.36.2 Discussion: No discussion.
4.1.36.3 Result: Motion was accepted with no objection.

4.1.37 CR Motion #188 (MAC): Move to accept the resolutions to CIDs; 3155, 3382, 3489, 3819, 3905, 4368, 4436, 5443, 7887, 8162, 8647,
3005, 3147, 3157, 3158, 3159, 4738, 5013, 5014, 5127, 5444, 6191, 7015, 7016, 7017, 7018, 7019, 7380, 7472, 7570, 7720, 8182, 8183, 8184, 8250, 8334, 8374, 9397, 9807, 9808, 10339
in document 11-17/0240r2.

4.1.37.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.37.2 Discussion: No discussion.
4.1.37.3 Result: Motion was accepted with no objection.

4.1.38 CR Motion #189 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0243r2.
CIDs: 3795, 4854, 4855, 4856, 4902, 4930, 4931, 5232, 5234, 5242, 5746, 5747, 5750, 5754, 5755, 5791, 10355, 10356

4.1.38.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.38.2 Discussion: No discussion.
4.1.38.3 Result: Motion was accepted with no objection.

4.1.39 CR Motion #190 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0245r2.
CIDs: 4903, 4934, 4935, 5236, 5237, 5238, 5239, 5240, 5745, 6110, 6818, 6819, 7218, 8331, 8332, 8357, 8361

4.1.39.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.39.2 Discussion: No discussion.
4.1.39.3 Result: Motion was accepted with no objection.

4.1.40 CR Motion #191 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0242r5.
CIDs: 3554, 5157, 5786, 5789, 6429, 7558, 8258, 9083, 9114, 8676, 8381, 6074

4.1.40.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.40.2 Discussion: No discussion.
4.1.40.3 Result: Motion was accepted with no objection.

4.1.41 CR Motion #192 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0244r2.
CIDs: 5147, 5148, 5149, 5150, 5151, 5152, 5153, 5154, 5841, 5842, 7557, 7559, 7573, 8346, 8347

4.1.41.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.41.2 Discussion: No discussion.
4.1.41.3 Result: Motion was accepted with no objection.

4.1.42 CR Motion #193 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0246r1.
CIDs: 8623, 8624, 8635, 8637, 8638, 8639, 8640, 8733, 8734, 8736, 8738, 8740, 8741, 8742, 8743, 10404, 10355

4.1.42.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.42.2 Discussion: No discussion.
4.1.42.3 Result: Motion was accepted with no objection.

4.1.43 CR Motion #194 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0247r2.
CIDs: 7036, 7217, 7218, 7428, 7429, 7824, 8359, 8626, 8627, 8629, 8630, 8631, 8632, 8633, 8634, 8732, 8735, 8737, 8739, 9113, 9134, 9777, 7778, 9779, 9780, 10081 10082, 10196

4.1.43.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.43.2 Discussion: No discussion.
4.1.43.3 Result: Motion was accepted with no objection.

4.1.44 CR Motion #195 (MU): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0303r2.
CIDs: 6341, 6339, 7355, 7354, 7349, 3425, 3539, 3440, 3439, 3436, 3434, 3431, 3430, 3428, 3427, 9265 9266, 9840, 7756, 8665, 8666, 8667, 8669, 8670

4.1.44.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.44.2 Discussion: No discussion.
4.1.44.3 Result: Motion was accepted with no objection.

4.1.45 CR Motion #196 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0330r2.
CIDs: 3293, 3343, 3579, 3660, 4009, 4096, 5112, 5113, 5114, 5115, 5306, 5539, 6921, 7694, 7695, 8306, 8307, 8498, 9217, 9220, 9222, 9227, 9228, 9229, 9230, 9231, 9498, and 9499

4.1.45.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.45.2 Discussion: No discussion.
4.1.45.3 Result: Motion was accepted with no objection.

4.1.46 CR Motion #197 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0333r2.
CIDs: 9025 and 9658.

4.1.46.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.46.2 Discussion: No discussion.
4.1.46.3 Result: Motion was accepted with no objection.

4.1.47 CR Motion #198 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0332r2.
CIDs: 4995, 7234, 8894 and 8895.

4.1.47.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.47.2 Discussion: No discussion.
4.1.47.3 Result: Motion was accepted with no objection.

4.1.48 CR Motion #199 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0299r2.
CIDs: 4918, 5264, 6117, 8935, 8936, 10062.

4.1.48.1 Moved by Dongguk Lim, Seconded by Ron Porat.
4.1.48.2 Discussion: No discussion.
4.1.48.3 Result: Motion was accepted with no objection.

4.1.49 CR Motion #200 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0300r2.
CIDs: 5104, 8891, 8892, 8893, 9469.

4.1.49.1 Moved by Dongguk Lim, Seconded by Ron Porat.
4.1.49.2 Discussion: No discussion.
4.1.49.3 Result: Motion was accepted with no objection.

4.1.50 CR Motion #201 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0331r2.
CIDs: 4884, 5279, 7687, 9012, 9071, 10056, 10057 and 10075.

4.1.50.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.50.2 Discussion: No discussion.
4.1.50.3 Result: Motion was accepted with no objection.

4.1.51 CR Motion #202 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0320r2.
CIDs: 5300, 6837, 6838, 7221, 7514, 8859, 8862.

4.1.51.1 Moved by Eunsung Park, Seconded by Ron Porat.
4.1.51.2 Discussion: No discussion.
4.1.51.3 Result: Motion was accepted with no objection.

4.1.52 CR Motion #203 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0321r3.
CIDs: 7048, 8969, 8970, 8971, 8974, 9749, 9750.

4.1.52.1 Moved by Eunsung Park, Seconded by Ron Porat.
4.1.52.2 Discussion: No discussion.
4.1.52.3 Result: Motion was accepted with no objection.

4.1.53 CR Motion #204 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as proposed in 11-17/0317r1.
CIDs: 5284, 10315, 8329, 8330, 9032, 7833, 9033, 8330, 4873, 5878, 7834, 10307, 5875, 5876, 5877, 9035, 9036, 10308, 10309, 10310, 5875, 5876, 5877, 9035, 9036, 10309, 10310.

4.1.53.1 Moved by Bin Tian, Seconded by Ron Porat.
4.1.53.2 Discussion: No discussion.
4.1.53.3 Result: Motion was accepted with no objection.

4.1.54 CR Motion #205 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0305r2.
CIDs: 8880, 8881,5255, 8883, 8884, 7515, 8885, 8887, 4866,8888, 4867, 8889, 4868, 4994, 9484, 4990, 4993.

4.1.54.1 Moved by Yan Zhang, Seconded by Ron Porat.
4.1.54.2 Discussion: No discussion.
4.1.54.3 Result: Motion was accepted with no objection.

4.1.55 CR Motion #206 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0261r2.
CIDs: 5784, 5785, 5953, 5954, 7442,6869, 6870, 6871, 3606, 3609,3359, 5282, 5281, 9028, 9027, 9090, 9078, 10125, 10314, 7678, 8575, 8581, 8582, 8583, 8578.

4.1.55.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.55.2 Discussion: No discussion.
4.1.55.3 Result: Motion was accepted with no objection.

4.1.56 CR Motion #207 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0329r4.
CIDs: 3251, 3252, 3393, 3395, 3502, 3504, 3834, 3836, 3924, 3926, 4461, 4464, 5041, 5042, 5275, 5276, 5277, 5278, 6197, 7430, 7431, 7432, 7434, 7435, 7437, 7438, 7439, 7440, 7441, 7516, 8565, 8997, 8998, 8999, 9000, 9001, 9002, 9004, 9005 and 9069.

4.1.56.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.56.2 Discussion: No discussion.
4.1.56.3 Result: Motion was accepted with no objection.

4.1.57 CR Motion #208 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0301r4.
CIDs: 5287, 5288, 8842, 5289, 3317, 3397, 3666, 3756, 4016, 4140, 4242, 4253, 5095, 5290, 8843, 8844, 10205, 3318, 3399, 3669, 3758, 4145, 4246, 5096, 5291, 8845, 5097, 5293, 5294, 8846, 9162, 5098, 5099, 5100, 5295, 5296, 8847, 9163, and 6114.

4.1.57.1 Moved by Dongguk Lim, Seconded by Ron Porat.
4.1.57.2 Discussion: No discussion.
4.1.57.3 Result: Motion was accepted with no objection.

4.1.58 CR Motion #209 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0231r2.
CIDs: 4000, 4236, 4897, 5254, 8161, 8838, 8841, 10202, and 10203.

4.1.58.1 Moved by Po-Kai Huang, Seconded by Ron Porat.
4.1.58.2 Discussion: No discussion.
4.1.58.3 Result: Motion was accepted with no objection.

4.1.59 CR Motion #210 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0232r2.
CIDs: 5101, 5102, 5103, 5297, 5298, 5299, 7513, 8848, 8849, 8850, 8851, 8852, 8853, 8854, 8855, 8856, 8857, 8858, 8985, 9158, 9159, 9160, 9166, 9167, and 10114.

4.1.59.1 Moved by Xiaogang Chen, Seconded by Ron Porat.
4.1.59.2 Discussion: No discussion.
4.1.59.3 Result: Motion was accepted with no objection.

4.1.60 CR Motion #211 (MAC): Move to accept the resolutions to the CIDs as in 11-17/0283r6.
CIDs: 8114, 3018, 8190, and 9494.

4.1.60.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.60.2 Discussion: No discussion.
4.1.60.3 Result: Motion was accepted with no objection.

4.1.61 CR Motion #212 (SR): Move to accept "Revised" as the resolution for CID 3222 with the proposed text in slide 10 of 11-17/0452r2.

4.1.61.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.61.2 Discussion: No discussion.
4.1.61.3 Result: Motion was accepted with no objection.

4.1.62 CR Motion #213 (MAC): Move to accept resolutions to CIDs; 5054, 5055, 5056, 5126, 5442, 7302, 7303, 7305, 7719, 7865, 7867, 8133, 8179, 8180, 8181, 8249, 9620, 9621, 9806 in doc 11-17/0239r2.

4.1.62.1 Moved by Alfred Asterjadhi, Seconded by .
4.1.62.2 Discussion: This is a duplicate of the previous motion.

4.1.63 CR Motion #214 (MAC): Move to accept resolutions to CIDs; 3384, 3491, 3822, 3907, 4371, 4439, 4740, 5445, 7020, 7473, 8185, 8375, 9809, 9810, 9811, 6965 in doc 11-17/0240r2.

4.1.63.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.63.2 Discussion: No discussion.
4.1.63.3 Result: Motion was accepted with no objection.

4.1.64 CR Motion #215 (MAC): Move to accept resolutions to CIDs; 6537, 9282 (2 CIDs) in doc 11-17/0346r1.

4.1.64.1 Moved by Jeongki Kim, Seconded by Yasu Inoue.
4.1.64.2 Discussion: No discussion.
4.1.64.3 Result: Motion was accepted with no objection.

4.1.65 CR Motion #216 (MAC): Move to accept resolutions to CIDs; 3089, 6057, 7527, 9599, 9385 in doc 11-17/0344r1.

4.1.65.1 Moved by Jeongki Kim, Seconded by Yasu Inoue.
4.1.65.2 Discussion: No discussion.
4.1.65.3 Result: Motion was accepted with no objection.

4.1.66 CR Motion #217 (MAC): Move to accept resolutions to CIDs; 3091, 5216, 5506, 5938, 6055, 6782, 6783, 6784, 6785, 7602, 8241, 8242, 9602 in doc 11-17/0347r2.

4.1.66.1 Moved by Jeongki Kim, Seconded by Yasu Inoue.
4.1.66.2 Discussion: No discussion.
4.1.66.3 Result: Motion was accepted with no objection.

4.1.67 CR Motion #218 (MAC): Move to accept resolutions to CIDs; 3051, 3052, 3053, 3207, 3208, 3209, 3210, 3211, 3212, 7786, 7787, 9695, 9864 in doc 11-17/0384r2.

4.1.67.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.67.2 Discussion: No discussion.
4.1.67.3 Result: Motion was accepted with no objection.

4.1.68 CR Motion #219 (MAC): Move to accept resolutions to CIDs; 3018, 8190, 9494 in doc 11-17/283r5.

4.1.68.1 Moved by Raja Banerjea.
4.1.68.2 Discussion: This is duplicate of the previous motion.

4.1.69 CR Motion #220 (MU): Move to accept resolutions to CIDs; 5397, 5712 in doc 11-17/0448r4.

4.1.69.1 Moved by Jing Ma, Seconded by Yasu Inoue.
4.1.69.2 Discussion: No discussion.
4.1.69.3 Result: Motion was accepted with no objection.

4.1.70 CR Motion #221 (MAC): Move to accept resolutions to CIDs; 5403, 6184, 7044 in doc 11-17/0306r4.

4.1.70.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.70.2 Discussion: No discussion.
4.1.70.3 Result: Motion was accepted with no objection.

4.1.71 CR Motion #222 (MU): Move to accept resolutions to CIDs; 7103, 7106, 7412, 8152, 8221, 9103, 9533 in doc 11-17/0443r2.

4.1.71.1 Moved by Suhwook Kim, Seconded by Yasu Inoue.
4.1.71.2 Discussion: No discussion.
4.1.71.3 Result: Motion was accepted with no objection.

4.1.72 CR Motion #223 (MAC): Move to accept resolutions to CIDs; 4782, 5975, 5976, 7161, 7789, 8267, 9698, 7661, 6567 in doc 11-17/0421r1.

4.1.72.1 Moved by Chao-Chun Wang, Seconded by Yasu Inoue.
4.1.72.2 Discussion: No discussion.
4.1.72.3 Result: Motion was accepted with no objection.

4.1.73 CR Motion #224 (MAC): Move to accept resolutions to CIDs; 6189, 7040, 9412 in doc 11-17/0088r2.

4.1.73.1 Moved by Woojin Ahn, Seconded by Yasu Inoue.
4.1.73.2 Discussion: A member expressed a concern on this motion and asked for deferral of this motion.
4.1.73.3 Result: Motion was deferred.

4.1.74 CR Motion #225 (MU): Move to accept resolution to CID 8142 in doc 11-17/0335r0.

4.1.74.1 Moved by Rojan Chitrakar, Seconded by Yasu Inoue.
4.1.74.2 Discussion: No discussion.
4.1.74.3 Result: Motion was accepted with no objection.

4.1.75 CR Motion #226 (PHY): Move to accept resolutions to CIDs; 6569, 7790, 7791, 8690, 8691, 10192, 9683 (MAC) in doc 11-17/0271r4.

4.1.75.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.75.2 Discussion: No discussion.
4.1.75.3 Result: Motion was accepted with no objection.

4.1.76 CR Motion #227 (MU): Move to accept resolutions to CIDs; 3142, 5992, 4830, 7650, 8061, 9712, 9912, 9913, 9914, 10271, 10272, 9297, 10011, 4831, 7575, 10014, 3012 (MAC) in doc 11-17/0302r2.

4.1.76.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.76.2 Discussion: No discussion.
4.1.76.3 Result: Motion was accepted with no objection.

4.1.77 CR Motion #228 (MU): Move to accept resolutions to CIDs; 3235, 4829, 9339, 9911, 10013, 10172, 10270 in doc 11-17/0338r1.

4.1.77.1 Moved by Rojan Chitrakar, Seconded by Yasu Inoue.
4.1.77.2 Discussion: No discussion.
4.1.77.3 Result: Motion was accepted with no objection.

4.1.78 CR Motion #229 (MU): Move to accept resolutions to CIDs; 3231, 6690, 6691, 6692, 9637 in doc 11-17/0349r1.

4.1.78.1 Moved by Kiseon Ryu, Seconded by Yasu Inoue.
4.1.78.2 Discussion: No discussion.
4.1.78.3 Result: Motion was accepted with no objection.

4.1.79 CR Motion #230 (MU): Move to accept resolutions to CIDs; 4806, 4807, 5725, 5726, 5727, 6009, 6145, 6146, 6147, 6148, 6155, 6721, 6722, 8560, 9535, 9716, 9717, 9921, 9922 in doc 11-17/0403r1.

4.1.79.1 Moved by David Xun Yang, Seconded by Yasu Inoue.
4.1.79.2 Discussion: No discussion.
4.1.79.3 Result: Motion was accepted with no objection.

4.1.80 CR Motion #231 (PHY): Move to accept resolution to CID 7517 in doc 11-17/0436r0.

4.1.80.1 Moved by Bo Sun, Seconded by Ron Porat.
4.1.80.2 Discussion: No discussion.
4.1.80.3 Result: Motion was accepted with no objection.

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5 Recess @ 15:28 until 16:00.

Thursday, March 16th, 2017, PM2 TGax full Session (16:00-18:00)

6 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @16:00.

6.1 Agenda 17/0199r5 is on the server. Rev. 6 is the working document.

7 Agenda for today has been approved during the PM1 session.

8 Announcement/Reminder

8.1 Chair reminded IEEE 802 and 802.11 IPR P&P.
8.2 Chair asked people to state name and affiliation when addressing for the first time in the session.
8.3 Chair reminded people to do attendance.

9 Continue with Motions – TG documents

9.1 CR Motions

9.1.1 CR Motion #232 (PHY): Move to accept resolutions to CIDs; 9549, 10204 in doc 11-17/0231r2.

9.1.1.1 Moved by Robert Stacy, Seconded by Ron Porat.
9.1.1.2 Discussion: No discussion.
9.1.1.3 Result: Motion was accepted with no objection.

9.1.2 CR Motion #233 (PHY): Move to accept resolution to CID 7547 in doc 11-17/0471r1.

9.1.2.1 Moved by Xiaogang Chen, Seconded by Ron Porat.
9.1.2.2 Discussion: A member asked for deferral. Another member objected.
9.1.2.3 Result: Y/N/A = 28/5/12, motion passes.

9.1.3 CR Motion #234 (PHY): Move to accept resolutions to CIDs; 5381, 5383, 5783, 6880, 6881, 6883, 6884, 6886, 6887, 6889, 6890, 6891, 9041, 9042, 9043, 9044, 9045, 9046, 9047, 9049, 9051, 9089, 9609, 9610, 9733, 10134, 10135, 10228, 10231, 10232 in doc 11-17/0234r3.

9.1.3.1 Moved by Robert Stacy, Seconded by Ron Porat.
9.1.3.2 Discussion: No discussion.
9.1.3.3 Result: Motion was accepted with no objection.

9.1.4 CR Motion #235 (PHY): Move to accept resolution to CID 8136 in doc 11-17/0247r3.

9.1.4.1 Moved by Lochan Verma, Seconded by Ron Porat.
9.1.4.2 Discussion: No discussion.
9.1.4.3 Result: Motion was accepted with no objection.

9.1.5 CR Motion #236 (PHY): Move to accept resolution to CID 8839 in doc 11-17/0261r2.

9.1.5.1 Moved by Lochan Verma, Seconded by Ron Porat.
9.1.5.2 Discussion: No discussion.
9.1.5.3 Result: Motion was accepted with no objection.

9.1.6 CR Motion #237 (PHY): Move to accept resolutions to CIDs; 8897, 8898, 9064, 4870, 4907, 5256, 5265, 9487, 10405, 8899, 5105, 8900, 5257, 8901, 10403, 8902, 10401, 10402, 5258, 4898, 4915, 8927, 8928, 8933, 8934, 10214, 5106, 8929, 8930, 8931, 5263, 6116, 8932, 10215, 8944, 8945, 8946, 8947, 5270, 8169, 8948, 8949 in doc 11-17/0398r1.

9.1.6.1 Moved by Hongyuan Zhang, Seconded by Bin Tian.
9.1.6.2 Discussion: No discussion.
9.1.6.3 Result: Motion was accepted with no objection.

9.1.7 CR Motion #238 (PHY): Move to accept resolutions to CIDs; 8809, 9154, 8360, 8813, 9795, 8614, 7506, 9796, 7508, 8615, 9799, 9800, 8798, 9766, 8799, 8800, 8801, 8802, 8803, 8804, 8805, 5250, 8807, 10089, 9797, 9798, 4973, 10090, 9151, 10091, 10092, 9152, 6826, 6827, 8812, 9767, 9768, 6828, 6829, 6830 in doc 11-17/0400r3.

9.1.7.1 Moved by Sungeun Lee, Seconded by Ron Porat.
9.1.7.2 Discussion: No discussion.
9.1.7.3 Result: Motion was accepted with no objection.

9.1.8 CR Motion #239 (PHY): Move to accept resolutions to CIDs; 8774, 9142, 9143 in doc 11-17/0345r2.

9.1.8.1 Moved by Suhwook Kim, Seconded by Ron Porat.
9.1.8.2 Discussion: No discussion.
9.1.8.3 Result: Motion was accepted with no objection.

9.1.9 CR Motion #240 (PHY): Move to accept resolutions to CIDs; 10360, 8840 in doc 11-17/0404r1.

9.1.9.1 Moved by Ross Jian Yu, Seconded by Ron Porat.
9.1.9.2 Discussion: No discussion.
9.1.9.3 Result: Motion was accepted with no objection.

9.1.10 CR Motion #241 (PHY): Move to accept resolutions to CIDs; 8863, 4983, 8864, 8865, 8866, 8867, 8868, 8869, 8870, 8871, 8872, 8874, 9550, 10036, 4985, 4989, 8875, 8877, 8878, 8879, 10037, 10209, 4986, 4987, 7500, 7501,9321, 10234, 7244, 7245, 7246, 7502 in doc 11-17/0316r4.

9.1.10.1 Moved by Bin Tian, Seconded by Ron Porat.
9.1.10.2 Discussion: No discussion.
9.1.10.3 Result: Motion was accepted with no objection.

9.1.11 CR Motion #242 (PHY): Move to accept resolution to CID 3441 in doc 11-17/0465r5.

9.1.11.1 Moved by Bin Tian, Seconded by Ron Porat.
9.1.11.2 Discussion: No discussion.
9.1.11.3 Result: Motion was accepted with no objection.

9.1.12 CR Motion #243 (PHY): Move to accept resolutions to CIDs; 4347, 4883, 5304, 5379, 9074, 9014, 9073, 9011, 9010, 9009, 9008, 9007, 9006, 8991, 10224, 10055, 9754 in doc 11-17/0414r1.

9.1.12.1 Moved by Bo Sun, Seconded by Ron Porat.
9.1.12.2 Discussion: No discussion.
9.1.12.3 Result: Motion was accepted with no objection.

9.1.13 CR Motion #244 (SR): Move to accept resolutions to CIDs; 3198, 3199, 3200, 5204, 5205, 5207, 5208, 5484, 5489, 5494, 5496, 5497, 5499, 5500, 5502, 5503, 5690, 5691, 5870, 7122, 7123, 7129, 7406, 7612, 8073, 8104, 8232, 8239, 9315,9540, 9944, 9946, 9947, 10031, 10032, 7125, 3197, 5689, 9541, 3196, 6025, 7823, 8233 in doc 11-17/0267r5.

9.1.13.1 Moved by Laurent Cariou, Seconded by Alfred Asterjadhi.
9.1.13.2 Discussion: A member asked for a deferral of this motion since the power restriction is not clear.
Another member objects.
9.1.13.3 Result: Y/N/A = 23/9/24, motion failed.

9.1.14 CR Motion #245: Move to accept resolutions to CIDs; 3056, 3189, 3190, 5167, 5168, 5394, 5454, 5456, 5686, 5779, 5799, 6058, 6051,6152,6176, 6574,6575,6576,6579,6580,6581,6582,6583,7022,7071,7232,7659,8358,8693,9380,9585,9727,~~9739~~, 9747,9872,10007,10171,10241,10242,10243,10244,~~10319~~ in doc 11-17/389r3.

9.1.14.1 Moved by Kaiying Lv.
9.1.14.2 Discussion: Kaiying asked for deferral of this motion.
9.1.14.3 Result: This motion was deferred.

9.1.15 CR Motion #246: Move to accept resolutions to CIDs; 5402, 6183, 5403, 6184, 7044 in doc 11-17/0445r1.

9.1.15.1 Moved by Geonjung Ko.
9.1.15.2 Discussion: Those CIDs are covered by another motion.
9.1.15.3 Result: This motion was not conducted.

9.1.16 CR Motion #247: Move to accept resolutions to CIDs; 3241, 3350, 3454, 3762, 3848, 4284, 4753, 5404, 5571, 6967, 6968, 6969, 6970, 6971, 6972, 6973 in doc 11-17/0341r2.

9.1.16.1 Moved by Hongyuan Zhang, Seconded by Yasu Inoue.
9.1.16.2 Discussion: No discussion.
9.1.16.3 Result: Motion was accepted with no objection.

9.1.17 CR Motion #248: Move to accept resolutions to CIDs; 5036, 7254, 7546, 8140, 8520, 8157, 9332, 9119, 9120 in doc 11-17/0395r8.

9.1.17.1 Moved by Ming Gan, Seconded by Chittabrata Ghosh.
9.1.17.2 Discussion: No discussion.
9.1.17.3 Result: Motion was accepted with no objection.

9.1.18 CR Motion #249 (SR): Move to accept resolutions to CIDs;
6178, 5043, 5873, 5940, 7117, 7174, 5385, 9508, 10040, 10039, 10080, 8094
5941, 7611, 5485, 5504, 8069, 8234, 7908, 8118
6760, 6020, 7116, 3195, 5482, 5680, 10194, 9760, 8068, 8231, 9730

8087, 8091, 8092,

6115, 6127, 6143, 6142, 6842, 5872, 5871, 6845, 5942, 6843, 6844, 3600, 4997, 5259, 5260, 5261, 9462, 9180, 9181, 9183, 9208, 9209, 9210, 10043, 10041, 10415, 10414, 10413, 10412, 10409, 10407, 10406, 10306, 10305, 8568, 8920, 8907, 8908, 8914, 8909

by adopting the proposed resolutions in 11-16-1476r21.

9.1.18.1 Moved by Matthew Fischer, Seconded by Sean Coffey.
9.1.18.2 A member requested vote count.
9.1.18.3 Result: Y/N/A = 31/4/21, motion passes.

9.1.19 CR Motion #250: Move to accept resolution to CID; 6768 by adopting the proposed resolutions in 11-17-0500r0.

9.1.19.1 Moved by Sean Coffey, Seconded by George Cherian.
9.1.19.2 A member requested vote count.
9.1.19.3 Result: Y/N/A = 33/4/17, motion passes.

9.2 TG Motions
9.2.1 A member mentioned 17/292r2 (Re: CR Motion #210) is a wrong document.
9.2.2 WG vice chair suggested motion to reconsider CR Motion #210.

9.2.3 Motion to reconsider CR Motion #210
9.2.3.1 Moved by Jon Rosdahl, Seconded by Al Petrick.
9.2.3.2 Result: Motion to reconsider CR Motion #210 passes with no objection.
9.2.3.3 Back to the CR Motion #210.

9.2.4 CR Motion #210: Move to accept resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0232r3.
CIDs: 5101, 5102, 5103, 5297, 5298, 5299, 7513, 8848, 8849, 8850, 8851, 8852, 8853, 8854, 8855, 8856, 8857, 8858, 8985, 9158, 9159, 9160, 9166, 9167, and 10114.

9.2.4.1 Moved by Jon Rosdahl, Seconded by Al Petrick.
9.2.4.2 Discussion:

9.2.4.3 Motion to table this motion
9.2.4.3.1 Moved by Jon Rosdahl, Seconded by Al Petrick.
9.2.4.3.2 Discussion:
9.2.4.3.2.1 Q: Table to when? → Conference call.
9.2.4.3.3 Result: Motion to table passes with no objection.

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10 Timeline update

10.1 Proposed modification to the current timeline.

10.1.1 May 2014: start of the TG

10.1.2 Nov. 2014: First draft of the TG SFD was approved

10.1.3 Jan. 2016: proposed TG draft

10.1.4 March 2016: Draft D0.1 was approved and CC started

10.1.5 November 2016: Draft 1.0 and WG letter ballot

10.1.6 September 2017: Draft 2.0 and recirculation

10.1.7 May 2018: MDR (Mandatory Document Review)

10.1.8 May 2018: Formation of SB pool

10.1.9 November 2018: Sponsor Ballot

10.1.10 July 2019: RevCom

11 Goals for the May 2017

11.1 Continue with the comment resolution and development of the TG draft.

12 Ad Hoc Meeting

12.1 After some discussions, PHY ad hoc decided to have a 1-day ad hoc meeting on Friday.

12.2 Motion: Authorize TGax to hold an ad-hoc meeting on May 3-5 in Seoul, Korea, for the purpose of working on comment resolution.

12.2.1 Moved by Hongyuan Zhang, Seconded by Bo Sun.

12.2.2 Result: Y/N/A = 20/2/9, motion passes.

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13 Conference Calls

13.1 Already approved.

13.1.1 Thursday, March 30th, 2017: 10:00-12:00 (ET)

13.1.2 Thursday, March 23rd, April 6th, 2017: 20:00-22:00 (ET)

13.2 New calls:

13.2.1 Thursday, April 13th, 27th, May 25th, 2017: 10:00 – 12:00 (ET)

13.2.2 Thursday, April 20th, May 18th, 2017: 20:00 – 22:00 (ET)

13.3 Chair asked if there is any objection to this plan. → No objection.

13.4 The above plan will be approved during the WG closing plenary tomorrow.

14 Motion from the floor

14.1 A member proposed a motion to adjourn.

14.2 Move to adjourn TGax Meeting for the week.

14.2.1 Moved by Bin Tian, Seconded by David Xun Yang.

14.2.2 Result: Y/N/A = 47/3/1, motion passes.

15 Adjournment

15.1 TGax adjourned for the week @ 16:42.

APPENDIX BJ

[STDS-802-11-TGAX] Draft 1.0

- *To*: STDS-802-11-TGAX@xxxxxxxxxxxxxxxx
- *Subject*: [STDS-802-11-TGAX] Draft 1.0
- *From*: Osama AboulMagd <Osama.AboulMagd@xxxxxxxxxx>
- *Date*: Thu, 1 Dec 2016 18:41:48 +0000

Hello All,

Draft D1.0 is available in the member area. The WG Chair will announce the start of the 30-day WG letter ballot shortly.

Regards;

Osama.

If you wish to be removed from this reflector, do not send your request to this reflector - it will have no effect.

Instead, go to http://listserv.ieee.org/cgi-bin/wa?SUBED1=STDS-802-11-TGAX and then press the LEAVE button.

Further information can be found at: http://www.ieee802.org/11/Email_Subscribe.html

- Prev by Date: **[STDS-802-11-TGAX] TGax Telecon 20161208 is Cancelled**
- Next by Date: **[STDS-802-11-TGAX] TGax Telecon on Dec. 1st Cancelled**
- Previous by thread: **[STDS-802-11-TGAX] TGax Telecon on Dec. 1st Cancelled**
- Next by thread: **[STDS-802-11-TGAX] TGax Telecon 20161208 is Cancelled**
- Index(es):
  - **Date**
  - **Thread**

APPENDIX BK

[STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today

- *To*: STDS-802-11@xxxxxxxxxxxxxxxx
- *Subject*: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today
- *From*: Adrian Stephens <adrian.p.stephens@xxxxxxxx>
- *Date*: Thu, 1 Dec 2016 19:16:52 +0000

--- This message came from the IEEE 802.11 Working Group Reflector ---

IEEE 802.11(TM) Letter Ballot 225

To: IEEE 802.11 Voters,

With this email, the 802.11 Working Group is officially beginning WG Technical Letter Ballot 225 (LB225), which is a Letter Ballot on the question "Should P802.11ax D1.0 be forwarded to Sponsor Ballot?".

This Letter Ballot opens Thu Dec 01, 2016 at 23:59 Eastern Time USA (11:59PM) and will close 30 days later on Sat Dec 31, 2016 at 23:59 Eastern Time USA (11:59pm). All necessary documents are available in the instructions that can be found on the IEEE 802.11 web site at http://www.ieee802.org/11/LetterBallots/LB225ax/LB225_instructions.html.

Important:
o This is a 30-day Technical letter ballot and the ballot group (i.e., those that may vote) for this ballot is all IEEE 802.11 voter members as of the start of this letter ballot. o All current voter members of 802.11 are required to vote on this ballot series. o If you cast a "Do not approve" vote on this ballot, it must be accompanied by comments for your vote to be valid. o You must follow these instructions to vote. Do not send an email to vote. Voting by any method other than the web-based process described here will invalidate your vote. o Failure to follow these instructions will result in your vote being discarded as an invalid vote. o Not voting on a letter ballot series or sending an invalid vote can affect your voting privileges. o The draft is password protected in accordance with IEEE 802 Policies and Procedures. To obtain the draft, use the username and the password supplied to active members for the 802.11 WG private area.

(The attached file contains a reminder set for 4 days before the close of the ballot. You may find it helpful to import this into or open this with your calendar client in order to get an automated reminder.)

Thank you for participating in Letter Ballot 225.

Adrian Stephens, IEEE 802.11 Working Group Chair
E-mail: Adrian.P.Stephens@xxxxxxxx

Osama Aboul-Magd, IEEE 802.11 TGax Chair
E-mail: Osama.AboulMagd@xxxxxxxxxx

_____

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If there is no LEAVE button here, try http://listserv.ieee.org/cgi-bin/wa?SUBED1=STDS-802-11-RO.

Further information can be found at: http://www.ieee802.org/11/Email_Subscribe.html

_____

BEGIN:VCALENDAR
VERSION:2.0
METHOD:PUBLISH

```
BEGIN:VEVENT
DTSTART:20161227T000000Z
DTEND:20161227T235959Z
LOCATION:http://www.ieee802.org/11/LetterBallots/LB225ax/LB225_instructions.html
TRANSP:TRANSPARENT
SEQUENCE:0
UID:225@802.11
DTSTAMP:20161201
SUMMARY;ENCODING=QUOTED-PRINTABLE:Reminder - IEEE 802.11 LB225 for TGax finishes on Sat Dec 31, 2016
CLASS:PUBLIC
BEGIN:VALARM
TRIGGER:-PT0M
ACTION:DISPLAY
DESCRIPTION:Reminder
END:VALARM
END:VEVENT
END:VCALENDAR
```

- **Follow-Ups**:
  - **Re: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today**
    - *From:* Sigurd Schelstraete
  - **Re: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today**
    - *From:* Adrian Stephens

- Prev by Date: **Re: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today**
- Next by Date: **[STDS-802-11] TGax special measures declaration doc**
- Previous by thread: **[STDS-802-11] TGax special measures declaration doc**
- Next by thread: **Re: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today**
- Index(es):
  - **Date**
  - **Thread**

APPENDIX BL

IEEE 802.11™ TGax Technical Letter Ballot 225 Instructions

Motion: " Should P802.11ax D1.0 be forwarded to Sponsor Ballot? "

(Type of Motion: Technical)

Cast your vote here

This Letter Ballot opens on: Thu Dec 01, 2016 at 23:59 Eastern Time USA and closes 38 days later on Sun Jan 08, 2017 at 23:59 Eastern Time USA. (Add reminder to calendar).

Show detailed instructions Show detailed description of how to provide comments

The draft and the supporting documentation:

Document	Hyperlink
Draft	Draft P802.11ax_D1.0.pdf
Redlined Doc	n/a
Resolution Doc	n/a
Comment Template	.xls format or .csv format NOTE - you must be already signed into Mentor for these links to work.
Ballot Group	LB225 Voters
CA Document	11-16-1348-02-00ax-coexistence-assurance.docx
CSD Document	11-14-0169-01-0hew-ieee-802-11-hew-sg-proposed-csd.docx

Notes

- This is a 38-day Technical letter ballot and the ballot group (i.e., those that may vote) for this ballot is all IEEE 802.11 voters as of the start of this letter ballot.
  All current voter members of 802.11 are required to vote on this letter ballot series, even if they are subject to TGax "special measures".
- If you cast a "Do not approve" vote on this ballot, it must be accompanied by "must be satisfied = yes" comments for your vote to be valid.
- You must follow these instructions to vote. Do not send an email to vote. Voting by any method other than the web-based process described here will invalidate your vote. Failure to follow these instructions will result in your vote being discarded as an invalid vote. Not voting on letter ballots or sending an invalid vote can affect your voting privileges.
- The draft is password protected in accordance with IEEE 802 Policies and Procedures. To obtain the draft, use the username and the password supplied to active members for the 802.11 WG private area.
- You need an IEEE-SA web account to vote. Instructions for getting an account, changing the registered email address and affiliation are here. If you get a new IEEE-SA web account, you will need to record an interest in C/LM/WG802.11, and let the WG chair know your new SA pin before you can vote using this account.

IEEE 802.11 Working Group Chair
E-mail: adrian.p.stephens@ieee.org

Osama Aboul-Magd
IEEE 802.11 TGax Chair
E-mail: Osama.AboulMagd@huawei.com

Thu Dec 01, 2016 - Updated 2016-12-09

APPENDIX BM

The Wayback Machine - https://web.archive.org/web/20170521192427/http://www.ieee802.org:80/11/LetterBallots.shtml

IEEE 802.11, The Working Group for Wireless LANs Standards

This page is maintained by Adrian Stephens . Comments are welcome.

IEEE 802.11 WG LETTER BALLOTS

Note - percentage results are rounded to the nearest integer

Note - Links to documents in the voting members' private area (such as drafts) will stop functioning once the project is complete, e.g., whe its output document has been published by the IEEE-SA.

ONGOING BALLOTS/COMMENT COLLECTIONS

CC	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
25	TGmd	Comments TGmd Draft 0.1	CC25	Draft	Draft P802.11REVmd_D0.1.pdf	Wed May 10, 2017	Wed Jun 14, 2017	35	Ballot Group	N/A
				Redlined Doc	n/a				Approve	n/a
				Resolution Doc	n/a				Abstain	n/a
				Comments Templates	.xls format .csv format NOTE - you must be already signed into Mentor for these links to work.				Return%	n/a
				Ballot Group	n/a				Approve%	n/a
				CA Document	n/a					
				CSD Document	n/a					
26	LC_TIG	Comments LC_TIG Draft 8	CC26	Draft	11-17/23r08	Wed May 17, 2017	Fri Jun 09, 2017	23	Ballot Group	N/A
				Redlined Doc	n/a				Approve	n/a
				Resolution Doc	n/a				Abstain	n/a
				Comments Templates	.xls format .csv format NOTE - you must be already signed into Mentor for these links to work.				Return%	n/a
				Ballot Group	n/a				Approve%	n/a
				CA Document	n/a					
				CSD Document	n/a					

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
229	TGak	Recirculation TGak Draft 4.00	LB# 229	Draft	Draft P802.11ak_D4.0.pdf	2017-03-15	2017-03-30	15	Pool	359
									Approve	202
				Redlined Doc	Draft P802.11ak_D4.0 Redline.pdf				Disapprove	10
				Resolution Doc	11-17-0025-09-00ak-11ak-wg-lb-comments.xlsx				Abstain	41
									Return%	70
				Comment	Template				Approve%	95
				Pool	LB# 229 Voters					
228	TGaj	Recirculation TGaj Draft 5.00	LB# 228	Draft	Draft P802.11aj_D5.0.pdf	2017-02-17	2017-03-04	15	Pool	377
									Approve	247
				Redlined Doc	Draft P802.11aj_D5.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-16-1639-02-00aj-lb226-comments-database.xlsx				Abstain	51
									Return%	83
				Comment	Template				Approve%	95
				Pool	LB# 228 Voters					
227	TGak	Recirculation TGak Draft 3.00	LB# 227	Draft	Draft P802.11ak_D3.0.pdf	2016-12-21	2017-01-10	20	Pool	359
									Approve	198
				Redlined Doc	Draft P802.11ak_D3.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-15-0556-34-00ak-lb212-working-group-ballot-comments.xlsx				Abstain	43
									Return%	70
				Comment	Template				Approve%	94
				Pool	LB# 227 Voters					
226	TGaj	Recirculation TGaj Draft 4.00	LB# 226	Draft	Draft P802.11aj_D4.0.pdf	2016-12-06	2016-12-21	15	Pool	377
									Approve	234
				Redlined Doc	Draft P802.11aj_D4.0 Redline.pdf				Disapprove	21
				Resolution Doc	11-16-1129-02-00aj-lb223-comments-database.xlsx				Abstain	55
									Return%	82
				Comment	Template				Approve%	92
				Pool	LB# 226 Voters					
225	TGax	Technical TGax Draft 1.00	LB# 225	Draft	Draft P802.11ax_D1.0.pdf	2016-12-01	2017-01-08	38	Pool	371
									Approve	145
				Redlined Doc	N/A				Disapprove	106
				Resolution Doc	N/A				Abstain	25
									Return%	74

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	58
				Pool	LB# 225 Voters					
224	TGaq	Recirculation TGaq Draft 7.00	LB# 224	Draft	Draft P802.11aq_D7.0.pdf	2016-09-10	2016-09-25	15	Pool	357
									Approve	226
				Redlined Doc	Draft P802.11aq_D7.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-16-1108-03-00aq-lb222-wg-comments-for-11aq-draft-6-0.xlsx				Abstain	47
									Return%	78
				Comment	Template				Approve%	97
				Pool	LB# 224 Voters					
223	TGaj	Recirculation TGaj Draft 3.00	LB# 223	Draft	Draft P802.11aj_D3.0.pdf	2016-08-15	2016-08-30	15	Pool	377
									Approve	221
				Redlined Doc	Draft P802.11aj_D3.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-16-0811-02-00aj-lb220-comments-database.xlsx				Abstain	57
									Return%	81
				Comment	Template				Approve%	89
				Pool	LB# 223 Voters					
222	TGaq	Recirculation TGaq Draft 6.00	LB# 222	Draft	Draft P802.11aq_D6.0.pdf	2016-08-04	2016-08-19	15	Pool	357
									Approve	223
				Redlined Doc	Draft P802.11aq_D6.0 Redline.pdf				Disapprove	10
				Resolution Doc	11-16-0982-04-00aq-lb221-wg-comments-for-11aq-draft-5-0.xlsx				Abstain	47
									Return%	78
				Comment	Template				Approve%	96
				Pool	LB# 222 Voters					
221	TGaq	Recirculation TGaq Draft 5.00	LB# 221	Draft	Draft P802.11aq_D5.0.pdf	2016-07-04	2016-07-19	15	Pool	357
									Approve	218
				Redlined Doc	Draft P802.11aq_D5.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-16-0553-04-00aq-lb219-wg-comments-for-11aq-draft-4-0.xlsx				Abstain	46
									Return%	78
				Comment	Template				Approve%	93
				Pool	LB# 221 Voters					
220	TGaj	Recirculation TGaj Draft 2.00	LB# 220	Draft	Draft P802.11aj_D2.0.pdf	2016-06-15	2016-06-30	15	Pool	377
									Approve	218
				Redlined Doc	Draft P802.11aj_D2.0 Redline.pdf				Disapprove	28
				Resolution Doc	11-16-0193-04-00aj-lb217-comments-database.xlsx				Abstain	53
									Return%	79
				Comment	Template				Approve%	89
				Pool	LB# 220 Voters					
219	TGaq	Recirculation TGaq Draft 4.00	LB# 219	Draft	Draft P802.11aq_D4.0.pdf	2016-04-06	2016-04-21	15	Pool	357
									Approve	213
				Redlined Doc	Draft P802.11aq_D4.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-15-1377-17-00aq-lb216-wg-ballot-comments-for-11aq-draft-3-0.xlsx				Abstain	45
									Return%	77
				Comment	Template				Approve%	93
				Pool	LB# 219 Voters					
218	TGak	Recirculation TGak Draft 2.00	LB# 218	Draft	Draft P802.11ak_D2.0.pdf	2016-02-24	2016-03-10	15	Pool	361
									Approve	174
				Redlined Doc	Draft P802.11ak_D2.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-15-0556-19-00ak-lb212-working-group-ballot-comments.xlsx				Abstain	33
									Return%	62
				Comment	Template				Approve%	91
				Pool	LB# 218 Voters					
217	TGaj	Technical TGaj Draft 1.00	LB# 217	Draft	Draft P802.11aj_D1.0.pdf	2015-12-21	2016-01-20	30	Pool	368
									Approve	221
				Redlined Doc	N/A				Disapprove	30
				Resolution Doc	N/A				Abstain	31
									Return%	77
				Comment	Template				Approve%	88
				Pool	LB# 217 Voters					
216	TGaq	Technical TGaq Draft 3.00	LB# 216	Draft	Draft P802.11aq_D3.0.pdf	2015-10-08	2015-11-07	30	Pool	358
									Approve	202
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	39
									Return%	72
				Comment	Template				Approve%	93
				Pool	LB# 216 Voters					
215	TGah	Recirculation TGah Draft 5.00	LB# 215	Draft	Draft P802.11ah_D5.0.pdf	2015-09-18	2015-10-03	15	Pool	330
									Approve	262
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	11-15-0525-02-00ah-tgah-lb211-comments-on-d5-0.xlsx				Abstain	15
									Return%	86
				Comment	Template				Approve%	98
				Pool	LB# 215 Voters					
214	TGai	Recirculation TGai Draft 6.00	LB# 214	Draft	Draft P802.11ai_D6.0.pdf	2015-07-16	2015-07-31	15	Pool	336
									Approve	252
				Redlined Doc	Draft P802.11ai_D6.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-15-0772-08-00ai-lb213comments-for-draft-5-0.xlsx				Abstain	21
									Return%	83

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	97
				Pool	LB# 214 Voters					
213	TGai	Recirculation TGai Draft 5.00	LB# 213	Draft	Draft P802.11ai_D5.0.pdf	2015-06-11	2015-06-26	15	Pool	336
									Approve	238
				Redlined Doc	Draft P802.11ai_D5.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-15-0281-20-00ai-tbai-lb209-comments-on-draft-d4-0.xlsx				Abstain	21
									Return%	83
				Comment	Template				Approve%	92
				Pool	LB# 213 Voters					
212	TGak	Technical TGak Draft 1.00	LB# 212	Draft	Draft P802.11ak_D1.0.pdf	2015-04-06	2015-05-06	30	Pool	361
									Approve	134
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	27
									Return%	51
				Comment	Template				Approve%	85
				Pool	LB# 212 Voters					
211	TGah	Recirculation TGah Draft 5.00	LB# 211	Draft	Draft P802.11ah_D5.0.pdf	2015-04-01	2015-04-16	15	Pool	330
									Approve	248
				Redlined Doc	Draft P802.11ah_D5.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-15-0261-07-00ah-tgah-lb207-comments-on-d4-0.xlsx				Abstain	16
									Return%	86
				Comment	Template				Approve%	93
				Pool	LB# 211 Voters					
210	TGmc	Recirculation TGmc Draft 4.00	LB# 210	Draft	Draft P802.11REVmc_D4.0.pdf	2015-03-11	2015-03-26	15	Pool	325
									Approve	241
				Redlined Doc	N/A				Disapprove	10
				Resolution Doc	11-13-0233-56-0000-revmc-wg-ballot-comments.xls				Abstain	18
									Return%	83
				Comment	Template				Approve%	96
				Pool	LB# 210 Voters					
209	TGai	Recirculation TGai Draft 4.00	LB# 209	Draft	Draft P802.11ai_D4.0.pdf	2015-02-09	2015-02-24	15	Pool	336
									Approve	230
				Redlined Doc	Draft P802.11ai_D4.0 Redline.pdf				Disapprove	25
				Resolution Doc	11-14-1351-30-00ai-tgai-lb204-comments-for-draft-3-0.xlsx				Abstain	22
									Return%	82
				Comment	Template				Approve%	90
				Pool	LB# 209 Voters					
208	TGaq	Technical TGaq Draft 1.00	LB# 208	Draft	Draft P802.11aq_D1.0.pdf	2015-02-02	2015-03-04	30	Pool	363
									Approve	139
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	42
									Return%	64
				Comment	Template				Approve%	73
				Pool	LB# 208 Voters					
207	TGah	Recirculation TGah Draft 4.00	LB# 207	Draft	Draft P802.11ah_D4.0.pdf	2015-01-30	2015-02-14	15	Pool	330
									Approve	245
				Redlined Doc	Draft P802.11ah_D4.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-14-1372-09-00ah-tgah-lb205-comments-on-d3-0.xlsx				Abstain	18
									Return%	85
				Comment	Template				Approve%	93
				Pool	LB# 207 Voters					
206	TGmc	Recirculation TGmc Draft 4.00	LB# 206	Draft	Draft P802.11REVmc_D4.0.pdf	2015-01-28	2015-02-17	20	Pool	325
									Approve	237
				Redlined Doc	Draft P802.11REVmc_D4.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-13-0233-51-0000-revmc-wg-ballot-comments.xls				Abstain	18
									Return%	83
				Comment	Template				Approve%	94
				Pool	LB# 206 Voters					
205	TGah	Recirculation TGah Draft 3.00	LB# 205	Draft	Draft P802.11ah_D3.0.pdf	2014-10-10	2014-10-25	15	Pool	330
									Approve	234
				Redlined Doc	Draft P802.11ah_D3.0_Redline.pdf				Disapprove	27
				Resolution Doc	11-14-0796-11-00ah-tgah-lb203-comments-on-d2-0.xlsx				Abstain	17
									Return%	84
				Comment	Template				Approve%	90
				Pool	LB# 205 Voters					
204	TGai	Recirculation TGai Draft 3.00	LB# 204	Draft	Draft P802.11ai_D3.0.pdf	2014-09-29	2014-10-14	15	Pool	336
									Approve	214
				Redlined Doc	Draft P802.11ai_D3.0 Redline.pdf				Disapprove	28
				Resolution Doc	11-14-0565-24-00ai-tgai-lb201-comments-for-draft-2-0.xlsx				Abstain	28
									Return%	80
				Comment	Template				Approve%	88
				Pool	LB# 204 Voters					
203	TGah	Technical TGah Draft 2.00	LB# 203	Draft	Draft P802.11ah_D2.0.pdf	2014-06-05	2014-07-05	30	Pool	330
									Approve	204
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	11-13-1336-16-00ah-tgah-lb200-comments-on-d1-0.xlsx				Abstain	24
									Return%	82

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	83
				Pool	LB# 203 Voters					
202	TGmc	Recirculation TGmc Draft 3.00	LB# 202	Draft	Draft P802.11REVmc_D3.0.pdf	2014-06-03	2014-06-23	20	Pool	325
									Approve	219
				Redlined Doc	Draft P802.11REVmc_D3.0 Redline.pdf				Disapprove	24
				Resolution Doc	11-13-0233-32-0000-revmc-wg-ballot-comments.xls				Abstain	19
									Return%	81
				Comment	Template				Approve%	90
				Pool	LB# 202 Voters					
201	TGai	Technical TGai Draft 2.00	LB# 201	Draft	Draft P802.11ai_D2.0.pdf	2014-04-07	2014-05-07	30	Pool	336
									Approve	195
				Redlined Doc	Draft P802.11ai_D2.0 Redline.pdf				Disapprove	34
				Resolution Doc	11-13-1076-34-00ai-tgai-lb-198-comments-for-d1-0.xlsx				Abstain	28
									Return%	76
				Comment	Template				Approve%	85
				Pool	LB# 201 Voters					
200	TGah	Technical TGah Draft 1.00	LB# 200	Draft	Draft P802.11ah_D1.0.pdf	2013-10-05	2013-11-04	30	Pool	323
									Approve	144
				Redlined Doc	N/A				Disapprove	54
				Resolution Doc	N/A				Abstain	18
									Return%	67
				Comment	Template				Approve%	73
				Pool	LB# 200 Voters					
199	TGmc	Recirculation TGmc Draft 2.00	LB# 199	Draft	Draft P802.11REVmc_D2.0.pdf	2013-10-03	2013-10-23	20	Pool	325
									Approve	207
				Redlined Doc	Draft P802.11REVmc_D2.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-13-0233-18-0000-revmc-wg-ballot-comments.xls				Abstain	22
									Return%	78
				Comment	Template				Approve%	90
				Pool	LB# 199 Voters					
198	TGai	Technical TGai Draft 1.00	LB# 198	Draft	Draft P802.11ai_D1.0.pdf	2013-08-13	2013-09-12	30	Pool	334
									Approve	147
				Redlined Doc	N/A				Disapprove	51
				Resolution Doc	N/A				Abstain	22
									Return%	66
				Comment	Template				Approve%	74
				Pool	LB# 198 Voters					
197	TGaf	Recirculation TGaf Draft 5.00	LB# 197	Draft	Draft P802.11af_D5.0.pdf	2013-07-17	2013-08-01	15	Pool	300
									Approve	228
				Redlined Doc	N/A				Disapprove	3
				Resolution Doc	11-12-1017-50-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	7
									Return%	79
				Comment	Template				Approve%	99
				Pool	LB# 197 Voters					
196	TGaf	Recirculation TGaf Draft 5.00	LB# 196	Draft	Draft P802.11af_D5.0.pdf	2013-05-30	2013-06-14	15	Pool	300
									Approve	215
				Redlined Doc	Draft P802.11af_D5.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-12-1017-46-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	8
									Return%	79
				Comment	Template				Approve%	94
				Pool	LB# 196 Voters					
195	TGaf	Recirculation TGaf Draft 4.00	LB# 195	Draft	Draft P802.11af_D4.0.pdf	2013-04-02	2013-04-17	15	Pool	300
									Approve	211
				Redlined Doc	Draft P802.11af_D4.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-12-1017-38-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	7
									Return%	79
				Comment	Template				Approve%	92
				Pool	LB# 195 Voters					
194	TGac	Recirculation TGac Draft 5.00	LB# 194	Draft	Draft P802.11ac_D5.0.pdf	2013-03-20	2013-04-04	15	Pool	300
									Approve	252
				Redlined Doc	N/A				Disapprove	10
				Resolution Doc	11-13-0199-03-00ac-lb191-comments-tgac-d5-0.xls				Abstain	10
									Return%	91
				Comment	Template				Approve%	96
				Pool	LB# 194 Voters					
193	TGmc	Technical TGmc Draft 1.00	LB# 193	Draft	Draft P802.11REVmc_D1.0.pdf	2013-01-31	2013-03-02	30	Pool	325
									Approve	197
				Redlined Doc	N/A				Disapprove	26
				Resolution Doc	N/A				Abstain	22
									Return%	75
				Comment	Template				Approve%	88
				Pool	LB# 193 Voters					
192	TGaf	Recirculation TGaf Draft 3.00	LB# 192	Draft	Draft P802.11af_D3.0.pdf	2013-01-24	2013-02-08	15	Pool	300
									Approve	194
				Redlined Doc	Draft P802.11af_D3.0 Redline.pdf				Disapprove	30
				Resolution Doc	11-12-1017-30-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	8
									Return%	77

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	87
				Pool	LB# 192 Voters					
191	TGac	Recirculation TGac Draft 5.00	LB# 191	Draft	Draft P802.11ac_D5.0.pdf	2013-01-17	2013-02-01	15	Pool	300
									Approve	249
				Redlined Doc	Draft P802.11ac_D5.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-12-1277-10-00ac-lb190-comments-tgac-d4-0.xls				Abstain	10
									Return%	90
				Comment	Template				Approve%	95
				Pool	LB# 191 Voters					
190	TGac	Recirculation TGac Draft 4.00	LB# 190	Draft	Draft P802.11ac_D4.0.pdf	2012-10-17	2012-11-01	15	Pool	300
									Approve	242
				Redlined Doc	Draft P802.11ac_D4.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-12-0752-17-00ac-lb188-comments-tgac-d3-0.xls				Abstain	14
									Return%	90
				Comment	Template				Approve%	94
				Pool	LB# 190 Voters					
189	TGaf	Technical TGaf Draft 2.00	LB# 189	Draft	Draft P802.11af_D2.0.pdf	2012-07-20	2012-08-19	30	Pool	300
									Approve	163
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	N/A				Abstain	14
									Return%	73
				Comment	Template				Approve%	79
				Pool	LB# 189 Voters					
188	TGac	Recirculation TGac Draft 3.00	LB# 188	Draft	Draft P802.11ac_D3.0.pdf	2012-06-05	2012-06-25	20	Pool	300
									Approve	233
				Redlined Doc	Draft P802.11ac_D3.0 Redline.pdf				Disapprove	24
				Resolution Doc	11-12-0223-24-00ac-lb187-comment-tgac-d2-0.xls				Abstain	14
									Return%	90
				Comment	Template				Approve%	91
				Pool	LB# 188 Voters					
187	TGac	Technical TGac Draft 2.00	LB# 187	Draft	Draft P802.11ac_D2.0.pdf	2012-01-19	2012-02-18	30	Pool	300
									Approve	223
				Redlined Doc	N/A				Disapprove	28
				Resolution Doc	N/A				Abstain	19
									Return%	90
				Comment	Template				Approve%	89
				Pool	LB# 187 Voters					
186	TGad	Recirculation TGad Draft 5.00	LB# 186	Draft	Draft P802.11ad_D5.0.pdf	2011-11-09	2011-11-24	15	Pool	278
									Approve	197
				Redlined Doc	N/A				Disapprove	11
				Resolution Doc	11-11-1374-02-00ad-lb185-comment-database.xlsx				Abstain	21
									Return%	82
				Comment	Template				Approve%	95
				Pool	LB# 186 Voters					
185	TGad	Recirculation TGad Draft 5.00	LB# 185	Draft	Draft P802.11ad_D5.0.pdf	2011-09-21	2011-10-06	15	Pool	278
									Approve	196
				Redlined Doc	Draft P802.11ad_D5.0 Redline.pdf				Disapprove	13
				Resolution Doc	11-11-1113-05-00ad-lb183-comment-database.xlsx				Abstain	19
									Return%	82
				Comment	Template				Approve%	94
				Pool	LB# 185 Voters					
184	TGaa	Recirculation TGaa Draft 6.00	LB# 184	Draft	Draft P802.11aa_D6.0.pdf	2011-08-16	2011-08-31	15	Pool	257
									Approve	151
				Redlined Doc	N/A				Disapprove	8
				Resolution Doc	11-11-1118-01-00aa-proposed-resolutions-to-lb182-comments.xls				Abstain	38
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 184 Voters					
183	TGad	Recirculation TGad Draft 4.00	LB# 183	Draft	Draft P802.11ad_D4.0.pdf	2011-07-25	2011-08-09	15	Pool	278
									Approve	195
				Redlined Doc	Draft P802.11ad_D4.0 Redline.pdf				Disapprove	11
				Resolution Doc	11-11-0850-06-00ad-lb177-comment-database.xlsx				Abstain	22
									Return%	82
				Comment	Template				Approve%	95
				Pool	LB# 183 Voters					
182	TGaa	Recirculation TGaa Draft 6.00	LB# 182	Draft	Draft P802.11aa_D6.0.pdf	2011-07-25	2011-08-09	15	Pool	257
									Approve	149
				Redlined Doc	Draft P802.11aa_D6.0 Redline.pdf				Disapprove	9
				Resolution Doc	11-11-0876-07-00aa-lb179-comments.xlsx				Abstain	38
									Return%	76
				Comment	Template				Approve%	94
				Pool	LB# 182 Voters					
181	TGae	Recirculation TGae Draft 5.00	LB# 181	Draft	Draft P802.11ae_D5.0.pdf	2011-07-20	2011-08-04	15	Pool	278
									Approve	182
				Redlined Doc	Draft P802.11ae_D5.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-11-0888-08-00ae-lb-180-comment-resolutions.xls				Abstain	35
									Return%	81

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	96
				Pool	LB# 181 Voters					
180	TGae	Recirculation TGae Draft 4.00	LB# 180	Draft	Draft P802.11ae_D4.0.pdf	2011-06-03	2011-06-18	15	Pool	278
									Approve	180
				Redlined Doc	Draft P802.11ae_D4.0 Redline.pdf				Disapprove	8
				Resolution Doc	11-11-0598-07-00ae-tgae-lb-176-comment-resolutions.xls				Abstain	35
									Return%	80
				Comment	Template				Approve%	96
				Pool	LB# 180 Voters					
179	TGaa	Recirculation TGaa Draft 5.00	LB# 179	Draft	Draft P802.11aa_D5.0.pdf	2011-06-02	2011-06-17	15	Pool	257
									Approve	142
				Redlined Doc	Draft P802.11aa_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-11-0523-08-00aa-lb175-comments.xls				Abstain	39
									Return%	76
				Comment	Template				Approve%	90
				Pool	LB# 179 Voters					
178	TGac	Technical TGac Draft 1.00	LB# 178	Draft	Draft P802.11ac_D1.0.pdf	2011-05-26	2011-06-25	30	Pool	315
									Approve	148
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	16
									Return%	69
				Comment	Template				Approve%	74
				Pool	LB# 178 Voters					
177	TGad	Recirculation TGad Draft 3.00	LB# 177	Draft	Draft P802.11ad_D3.0.pdf	2011-05-17	2011-06-01	15	Pool	278
									Approve	188
				Redlined Doc	Draft P802.11ad_D3.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-11-0508-07-00ad-lb174-comment-database.xlsx				Abstain	24
									Return%	82
				Comment	Template				Approve%	92
				Pool	LB# 177 Voters					
176	TGae	Recirculation TGae Draft 3.00	LB# 176	Draft	Draft P802.11ae_D3.0.pdf	2011-04-11	2011-04-26	15	Pool	278
									Approve	163
				Redlined Doc	Draft P802.11ae_D3.0 Redline.pdf				Disapprove	21
				Resolution Doc	11-11-0255-03-00ae-tgae-lb-172-comment-resolutions.xls				Abstain	37
									Return%	79
				Comment	Template				Approve%	89
				Pool	LB# 176 Voters					
175	TGaa	Recirculation TGaa Draft 4.00	LB# 175	Draft	Draft P802.11aa_D4.0.pdf	2011-03-25	2011-04-09	15	Pool	257
									Approve	135
				Redlined Doc	Draft P802.11aa_D4.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-11-0267-03-00aa-lb173-comments.xls				Abstain	37
									Return%	76
				Comment	Template				Approve%	85
				Pool	LB# 175 Voters					
174	TGad	Recirculation TGad Draft 2.00	LB# 174	Draft	Draft P802.11ad_D2.0.pdf	2011-03-21	2011-04-05	15	Pool	278
									Approve	175
				Redlined Doc	Draft P802.11ad_D2.0 Redline.pdf				Disapprove	25
				Resolution Doc	11-10-1220-21-00ad-lb168-comment-database.xlsx				Abstain	25
									Return%	81
				Comment	Template				Approve%	88
				Pool	LB# 174 Voters					
173	TGaa	Recirculation TGaa Draft 3.00	LB# 173	Draft	Draft P802.11aa_D3.0.pdf	2011-02-09	2011-02-24	15	Pool	257
									Approve	127
				Redlined Doc	Draft P802.11aa_D3.0 Redline.pdf				Disapprove	30
				Resolution Doc	11-10-1441-10-00aa-lb170-comments.xls				Abstain	37
									Return%	75
				Comment	Template				Approve%	81
				Pool	LB# 173 Voters					
172	TGae	Recirculation TGae Draft 2.00	LB# 172	Draft	Draft P802.11ae_D2.0.pdf	2011-02-03	2011-02-18	15	Pool	278
									Approve	155
				Redlined Doc	Draft P802.11ae_D2.0 Redline.pdf				Disapprove	26
				Resolution Doc	11-10-1221-24-00ae-tgae-lb169-comment-resolutions.xls				Abstain	38
									Return%	79
				Comment	Template				Approve%	86
				Pool	LB# 172 Voters					
171	TGaf	Technical TGaf Draft 1.00	LB# 171	Draft	Draft P802.11af_D1.0.pdf	2011-01-25	2011-02-24	30	Pool	300
									Approve	125
				Redlined Doc	N/A				Disapprove	76
				Resolution Doc	N/A				Abstain	35
									Return%	79
				Comment	Template				Approve%	62
				Pool	LB# 171 Voters					
170	TGaa	Recirculation TGaa Draft 2.00	LB# 170	Draft	Draft P802.11aa_D2.0.pdf	2010-11-23	2010-12-08	15	Pool	257
									Approve	117
				Redlined Doc	Draft P802.11aa_D2.0 Redline.pdf				Disapprove	32
				Resolution Doc	11-10-1395-02-00aa-lb164-consolidated-comments-editorial-notes.xls				Abstain	36
									Return%	72

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	79
				Pool	LB# 170 Voters					
169	TGae	Technical TGae Draft 1.00	LB# 169	Draft	Draft P802.11ae_D1.0.pdf	2010-09-27	2010-10-27	30	Pool	278
									Approve	134
				Redlined Doc	N/A				Disapprove	32
				Resolution Doc	N/A				Abstain	40
									Return%	74
				Comment	Template				Approve%	81
				Pool	LB# 169 Voters					
168	TGad	Technical TGad Draft 1.00	LB# 168	Draft	Draft P802.11ad_D1.0.pdf	2010-09-24	2010-10-24	30	Pool	278
									Approve	163
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	26
									Return%	77
				Comment	Template				Approve%	87
				Pool	LB# 168 Voters					
167	TGmb	Recirculation TGmb Draft 5.00	LB# 167	Draft	Draft P802.11REVmb_D5.0.pdf	2010-08-04	2010-08-19	15	Pool	246
									Approve	172
				Redlined Doc	Draft P802.11REVmb_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0706-15-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	92
				Pool	LB# 167 Voters					
166	TGs	Recirculation TGs Draft 7.00	LB# 166	Draft	Draft P802.11s_D7.0.pdf	2010-07-29	2010-08-13	15	Pool	248
									Approve	167
				Redlined Doc	Draft P802.11s_D7.0 Redline.pdf				Disapprove	9
				Resolution Doc	11-10-0725-09-000s-lb-165-comment-resolutions.xls				Abstain	34
									Return%	85
				Comment	Template				Approve%	95
				Pool	LB# 166 Voters					
165	TGs	Recirculation TGs Draft 6.00	LB# 165	Draft	Draft P802.11s_D6.0.pdf	2010-06-13	2010-06-28	15	Pool	248
									Approve	157
				Redlined Doc	Draft P802.11s_D6.0 Redline Compared to P802.11s_D5.0.pdf				Disapprove	20
				Resolution Doc	11-10-0478-09-000s-lb-161-comment-resolutions.xls				Abstain	33
									Return%	85
				Comment	Template				Approve%	89
				Pool	LB# 165 Voters					
164	TGaa	Technical TGaa Draft 1.00	LB# 164	Draft	Draft P802.11aa_D1.0.pdf	2010-06-10	2010-07-10	30	Pool	257
									Approve	112
				Redlined Doc	N/A				Disapprove	31
				Resolution Doc	N/A				Abstain	37
									Return%	70
				Comment	Template				Approve%	78
				Pool	LB# 164 Voters					
163	TGmb	Recirculation TGmb Draft 4.00	LB# 163	Draft	Draft P802.11REVmb_D4.0.pdf	2010-06-10	2010-06-25	15	Pool	246
									Approve	164
				Redlined Doc	Draft P802.11REVmb_D4.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-12-000m-revmb-wg-ballot-comments.xls				Abstain	28
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 163 Voters					
162	TGmb	Recirculation TGmb Draft 3.00	LB# 162	Draft	Draft P802.11REVmb_D3.0.pdf	2010-03-31	2010-04-25	25	Pool	246
									Approve	167
				Redlined Doc	Draft P802.11REVmb_D3.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-10-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 162 Voters					
161	TGs	Recirculation TGs Draft 5.00	LB# 161	Draft	Draft P802.11s_D5.0.pdf	2010-03-31	2010-04-15	15	Pool	248
									Approve	159
				Redlined Doc	Draft P802.11s_D5.0 Redline Compared to P802.11s_D4.0.pdf				Disapprove	19
				Resolution Doc	11-10-0032-13-000s-lb-159-comment-resolutions.xls				Abstain	32
									Return%	85
				Comment	Template				Approve%	89
				Pool	LB# 161 Voters					
160	TGmb	Recirculation TGmb Draft 2.00	LB# 160	Draft	Draft P802.11REVmb_D2.0.pdf	2009-12-11	2010-01-08	28	Pool	246
									Approve	166
				Redlined Doc	Draft P802.11REVmb_D2.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-06-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 160 Voters					
159	TGs	Recirculation TGs Draft 4.00	LB# 159	Draft	Draft P802.11s_D4.0.pdf	2009-12-09	2010-01-08	30	Pool	248
									Approve	150
				Redlined Doc	Draft P802.11s_D4.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-09-0471-24-000s-lb-147-comment-resolutions.xls				Abstain	33
									Return%	85

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	85
				Pool	LB# 159 Voters					
158	TGp	Recirculation TGp Draft 9.00	LB# 158	Draft	Draft P802.11p_D9.0.pdf	2009-09-25	2009-10-10	15	Pool	232
									Approve	171
				Redlined Doc	Draft P802.11p_D9.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-09-0927-03-000p-lb154-tgp-comment-resolution-master.xls				Abstain	29
									Return%	91
				Comment	Template				Approve%	93
				Pool	LB# 158 Voters					
157	TGz	Recirculation TGz Draft 6.00	LB# 157	Draft	Draft P802.11z_D6.0.pdf	2009-08-11	2009-08-26	15	Pool	254
									Approve	187
				Redlined Doc	Draft P802.11z_D6.0 Redline.pdf				Disapprove	8
				Resolution Doc	11-09-0739-04-000z-tgz-lb153-comment-spreadsheet.xls				Abstain	38
									Return%	92
				Comment	Template				Approve%	96
				Pool	LB# 157 Voters					
156	TGu	Recirculation TGu Draft 8.00	LB# 156	Draft	Draft P802.11u_D8.0.pdf	2009-08-03	2009-08-18	15	Pool	213
									Approve	148
				Redlined Doc	Draft P802.11u_D8.0 Redline.pdf				Disapprove	11
				Resolution Doc	11-09-0692-14-000u-lb152-comment-spreadsheet.xls				Abstain	35
									Return%	91
				Comment	Template				Approve%	93
				Pool	LB# 156 Voters					
155	TGv	Recirculation TGv Draft 7.00	LB# 155	Draft	Draft P802.11v_D7.0.pdf	2009-07-23	2009-08-07	15	Pool	254
									Approve	176
				Redlined Doc	Draft P802.11v_D7.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-09-0676-07-000v-lb-150-comments.xls				Abstain	38
									Return%	91
				Comment	Template				Approve%	92
				Pool	LB# 155 Voters					
154	TGp	Recirculation TGp Draft 8.00	LB# 154	Draft	Draft P802.11p_D8.0.pdf	2009-07-21	2009-08-05	15	Pool	232
									Approve	163
				Redlined Doc	Draft P802.11p_D8.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0688-03-000p-LB151-TGp Comment Resolution Master2.xls				Abstain	28
									Return%	91
				Comment	Template				Approve%	89
				Pool	LB# 154 Voters					
153	TGz	Recirculation TGz Draft 5.00	LB# 153	Draft	Draft P802.11z_D5.0.pdf	2009-06-08	2009-06-23	15	Pool	254
									Approve	183
				Redlined Doc	Draft P802.11z_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0313-03-000z-tgz-lb143-comment-spreadsheet.xls				Abstain	34
									Return%	91
				Comment	Template				Approve%	92
				Pool	LB# 153 Voters					
152	TGu	Recirculation TGu Draft 7.00	LB# 152	Draft	Draft P802.11u_D7.0.pdf	2009-06-04	2009-06-19	15	Pool	213
									Approve	142
				Redlined Doc	Draft P802.11u_D7.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-09-0489-13-000u-lb148-comment-spreadsheet.xls				Abstain	33
									Return%	91
				Comment	Template				Approve%	88
				Pool	LB# 152 Voters					
151	TGp	Recirculation TGp Draft 7.00	LB# 151	Draft	Draft P802.11p_D7.0.pdf	2009-05-29	2009-06-13	15	Pool	232
									Approve	158
				Redlined Doc	Draft P802.11p_D7.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-09-0432-05-000p-lb144-tgp-comment-resolution-master.xls				Abstain	26
									Return%	91
				Comment	Template				Approve%	85
				Pool	LB# 151 Voters					
150	TGv	Recirculation TGv Draft 6.00	LB# 150	Draft	Draft P802.11v_D6.0.pdf	2009-05-28	2009-06-12	15	Pool	254
									Approve	172
				Redlined Doc	Draft P802.11v_D6.0 Redline Compared to P802.11v_D5.0.pdf				Disapprove	20
				Resolution Doc	11-09-0434-04-000v-lb146.xls				Abstain	38
									Return%	91
				Comment	Template				Approve%	90
				Pool	LB# 150 Voters					
149	TGmb	Technical TGmb Draft 1.00	LB# 149	Draft	Draft P802.11REVmb_D1.0.pdf	2009-05-18	2009-06-27	40	Pool	246
									Approve	155
				Redlined Doc	N/A				Disapprove	23
				Resolution Doc	N/A				Abstain	29
									Return%	84
				Comment	Template				Approve%	87
				Pool	LB# 149 Voters					
148	TGu	Recirculation TGu Draft 6.00	LB# 148	Draft	Draft P802.11u_D6.0.pdf	2009-04-09	2009-04-24	15	Pool	213
									Approve	142
				Redlined Doc	Draft P802.11u_D6.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0245-10-000u-lb142-comment-spreadsheet.xls				Abstain	35
									Return%	90

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	90
				Pool	LB# 148 Voters					
147	TGs	Technical TGs Draft 3.00	LB# 147	Draft	Draft P802.11s_D3.0.pdf	2009-04-04	2009-05-04	30	Pool	248
									Approve	132
				Redlined Doc	N/A				Disapprove	35
				Resolution Doc	N/A				Abstain	34
									Return%	81
				Comment	Template				Approve%	79
				Pool	LB# 147 Voters					
146	TGv	Recirculation TGv Draft 5.00	LB# 146	Draft	Draft P802.11v_D5.0.pdf	2009-03-20	2009-04-04	15	Pool	254
									Approve	155
				Redlined Doc	Draft P802.11v_D5.0 Redline Compared to P802.11v_D4.0.pdf				Disapprove	32
				Resolution Doc	11-08-1467-04-000v-lb140-comments.xls				Abstain	41
									Return%	90
				Comment	Template				Approve%	83
				Pool	LB# 146 Voters					
145	TGs	Procedural TGs Draft 3.00	LB# 145	Draft	Draft P802.11s_D3.0.pdf	2009-03-19	2009-04-03	15	Pool	247
									Approve	166
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	N/A				Abstain	24
									Return%	79
				Comment	Template				Approve%	97
				Pool	LB# 145 Voters					
144	TGp	Recirculation TGp Draft 6.00	LB# 144	Draft	Draft P802.11p_D6.0.pdf	2009-03-16	2009-03-31	15	Pool	232
									Approve	161
				Redlined Doc	Draft P802.11p_6.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-08-1452-06-000p-lb141-tgp-comment-resolution-master.xls				Abstain	29
									Return%	91
				Comment	Template				Approve%	89
				Pool	LB# 144 Voters					
143	TGz	Recirculation TGz Draft 4.00	LB# 143	Draft	Draft P802.11z_D4.0.pdf	2009-02-18	2009-03-05	15	Pool	254
									Approve	170
				Redlined Doc	Draft P802.11z_D4.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-09-0097-02-000z-lb139-comment-resolution.xls				Abstain	37
									Return%	91
				Comment	Template				Approve%	88
				Pool	LB# 143 Voters					
142	TGu	Recirculation TGu Draft 5.00	LB# 142	Draft	Draft P802.11u_D5.0.pdf	2009-02-05	2009-02-20	15	Pool	213
									Approve	125
				Redlined Doc	Draft P802.11u_D5.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-08-1225-25-000u-lb137-comment-spreadsheet.xls				Abstain	39
									Return%	90
				Comment	Template				Approve%	82
				Pool	LB# 142 Voters					
141	TGp	Recirculation TGp Draft 5.00	LB# 141	Draft	Draft P802.11p_D5.0.pdf	2008-11-20	2008-12-05	15	Pool	232
									Approve	149
				Redlined Doc	Draft P802.11p_D5.0 Redline Compared to P802.11p_D4.0.pdf				Disapprove	26
				Resolution Doc	11-08-0514-06-000p-lb125-tgp-comment-resolution-master.xls				Abstain	35
									Return%	91
				Comment	Template				Approve%	85
				Pool	LB# 141 Voters					
140	TGv	Technical TGv Draft 4.00	LB# 140	Draft	Draft P802.11v_D4.0.pdf	2008-11-19	2008-12-19	30	Pool	254
									Approve	149
				Redlined Doc	Draft P802.11v_D4.0 Redline.pdf				Disapprove	36
				Resolution Doc	11-08-0801-05-000v-lb133-comments.xls				Abstain	40
									Return%	89
				Comment	Template				Approve%	81
				Pool	LB# 140 Voters					
139	TGz	Technical TGz Draft 3.00	LB# 139	Draft	Draft P802.11z_D3.0.pdf	2008-11-18	2008-12-18	30	Pool	254
									Approve	155
				Redlined Doc	N/A				Disapprove	29
				Resolution Doc	N/A				Abstain	41
									Return%	89
				Comment	Template				Approve%	84
				Pool	LB# 139 Voters					
138	TGn	Recirculation TGn Draft 7.00	LB# 138	Draft	Draft P802.11n_D7.0.pdf	2008-11-17	2008-12-02	15	Pool	325
									Approve	281
				Redlined Doc	N/A				Disapprove	14
				Resolution Doc	11-08-1417-00-000n-p802-11n-wg-ballot-unsatisfied-comments.xls				Abstain	20
									Return%	97
				Comment	Template				Approve%	95
				Pool	LB# 138 Voters					
137	TGu	Recirculation TGu Draft 4.00	LB# 137	Draft	Draft P802.11u_D4.0.pdf	2008-09-23	2008-10-08	15	Pool	213
									Approve	118
				Redlined Doc	Draft P802.11u_D4.0 Redline.pdf				Disapprove	34
				Resolution Doc	11-08-0722-27-000u-lb-132-comment-spreadsheet.xls				Abstain	37
									Return%	89

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	78
				Pool	LB# 137 Voters					
136	TGn	Recirculation TGn Draft 7.00	LB# 136	Draft	Draft P802.11n_D7.0.pdf	2008-09-15	2008-09-30	15	Pool	325
									Approve	276
				Redlined Doc	Draft P802.11n_D7.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-08-0958-02-000n-tgn-lb134-composite-comments.xls				Abstain	21
									Return%	97
				Comment	Template				Approve%	94
				Pool	LB# 136 Voters					
135	TGz	Technical TGz Draft 2.00	LB# 135	Draft	Draft P802.11z_D2.0.pdf	2008-07-21	2008-08-20	30	Pool	242
									Approve	99
				Redlined Doc	N/A				Disapprove	51
				Resolution Doc	N/A				Abstain	48
									Return%	82
				Comment	Template				Approve%	66
				Pool	LB# 135 Voters					
134	TGn	Recirculation TGn Draft 6.00	LB# 134	Draft	Draft P802.11n_D6.0.pdf	2008-07-21	2008-08-05	15	Pool	325
									Approve	266
				Redlined Doc	Draft P802.11n_D6.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-08-0713-02-000n-tgn-lb129-composite-comments.xls				Abstain	21
									Return%	97
				Comment	Template				Approve%	91
				Pool	LB# 134 Voters					
133	TGv	Technical TGv Draft 3.00	LB# 133	Draft	Draft P802.11v_D3.0.pdf	2008-06-13	2008-07-13	30	Pool	213
									Approve	106
				Redlined Doc	Draft P802.11v_D3.0 Redline.pdf				Disapprove	47
				Resolution Doc	11-08-0265-04-000v-lb123-comments.xls				Abstain	28
									Return%	85
				Comment	Template				Approve%	69
				Pool	LB# 133 Voters					
132	TGu	Technical TGu Draft 3.00	LB# 132	Draft	Draft P802.11u_D3.0.pdf	2008-06-12	2008-07-12	30	Pool	213
									Approve	113
				Redlined Doc	Draft P802.11u_D3.0 Redline.pdf				Disapprove	34
				Resolution Doc	N/A				Abstain	35
									Return%	85
				Comment	Template				Approve%	77
				Pool	LB# 132 Voters					
131	TGv	Procedural TGv Draft 2.02	LB# 131	Draft	Draft P802.11v_D2.02.pdf	2008-05-28	2008-06-12	15	Pool	213
									Approve	175
				Redlined Doc	Draft P802.11v_D2.02 Redline.pdf				Disapprove	14
				Resolution Doc	11-08-0265-04-000v-lb123-comments.xls				Abstain	18
									Return%	97
				Comment	Template				Approve%	93
				Pool	LB# 131 Voters					
130	TGu	Procedural TGu Draft 3.00	LB# 130	Draft	Draft P802.11u_D3.0.pdf	2008-05-27	2008-06-11	15	Pool	212
									Approve	159
				Redlined Doc	Draft P802.11u_D3.0 Redline.pdf				Disapprove	8
				Resolution Doc	N/A				Abstain	19
									Return%	88
				Comment	Template				Approve%	95
				Pool	LB# 130 Voters					
129	TGn	Recirculation TGn Draft 5.00	LB# 129	Draft	Draft P802.11n_D5.0.pdf	2008-05-23	2008-06-12	20	Pool	325
									Approve	261
				Redlined Doc	Draft P802.11n_D5.0 Redline.pdf				Disapprove	29
				Resolution Doc	11-08-0460-02-000n-tgn-lb124-composite-comments.xls				Abstain	23
									Return%	96
				Comment	Template				Approve%	90
				Pool	LB# 129 Voters					
128	TGw	Recirculation TGw Draft 6.00	LB# 128	Draft	Draft P802.11w_D6.0.pdf	2008-04-03	2008-04-18	15	Pool	427
									Approve	266
				Redlined Doc	11-08-0448-00-000w-Redlined Draft P802.11w_D6.0 Compared To Draft P802.11w_5.0.pdf				Disapprove	8
				Resolution Doc	11-08-0261-05-000w-lb121-comment-resolution.xls				Abstain	54
									Return%	77
				Comment	Template				Approve%	97
				Pool	LB# 128 Voters					
127	TGz	Technical TGz Draft 1.00	LB# 127	Draft	Draft P802.11z_D1.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	103
				Redlined Doc	N/A				Disapprove	59
				Resolution Doc	N/A				Abstain	47
									Return%	90
				Comment	Template				Approve%	64
				Pool	LB# 127 Voters					
126	TGs	Technical TGs Draft 2.00	LB# 126	Draft	Draft P802.11s_D2.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	103
				Redlined Doc	N/A				Disapprove	67
				Resolution Doc	N/A				Abstain	36
									Return%	88

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	61
				Pool	LB# 126 Voters					
125	TGp	Technical TGp Draft 4.00	LB# 125	Draft	Draft P802.11p D4.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	136
				Redlined Doc	index.html				Disapprove	37
				Resolution Doc	index.html				Abstain	32
									Return%	88
				Comment	Template				Approve%	79
				Pool	LB# 125 Voters					
124	TGn	Recirculation TGn Draft 4.00	LB# 124	Draft	index.html	2008-03-28	2008-04-12	15	Pool	325
									Approve	253
				Redlined Doc	index.html				Disapprove	34
				Resolution Doc	11-07-2783-08-000n-tgn-lb115-editor-comments.xls				Abstain	25
									Return%	96
				Comment	Template				Approve%	88
				Pool	LB# 124 Voters					
123	TGv	Technical TGv Draft 2.00	LB# 123	Draft	Draft P802.11v_D2.0.pdf	2008-02-14	2008-03-15	30	Pool	261
									Approve	126
				Redlined Doc	index.html				Disapprove	62
				Resolution Doc	index.html				Abstain	34
									Return%	85
				Comment	Template				Approve%	67
				Pool	LB# 123 Voters					
122	TGu	Technical TGu Draft 2.00	LB# 122	Draft	Draft P802.11u_D2.0.pdf	2008-02-14	2008-03-15	30	Pool	261
									Approve	125
				Redlined Doc	index.html				Disapprove	53
				Resolution Doc	index.html				Abstain	37
									Return%	82
				Comment	Template				Approve%	70
				Pool	LB# 122 Voters					
121	TGw	Recirculation TGw Draft 5.00	LB# 121	Draft	P802.11w_D5.0.pdf	2008-02-05	2008-02-20	15	Pool	427
									Approve	259
				Redlined Doc	index.html				Disapprove	14
				Resolution Doc	index.html				Abstain	55
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 121 Voters					
120	TGv	Procedural TGv Draft 1.04	LB# 120	Draft	Draft P802.11v_D1.04.pdf	2008-01-29	2008-02-13	15	Pool	297
									Approve	213
				Redlined Doc	index.html				Disapprove	13
				Resolution Doc	index.html				Abstain	27
									Return%	85
				Comment	Template				Approve%	94
				Pool	LB# 120 Voters					
119	TGu	Procedural TGu Draft 2.00	LB# 119	Draft	Draft P802.11u_D2.0.pdf	2008-01-27	2008-02-11	15	Pool	297
									Approve	203
				Redlined Doc	index.html				Disapprove	16
				Resolution Doc	index.html				Abstain	33
									Return%	85
				Comment	Template				Approve%	93
				Pool	LB# 119 Voters					
118	TGk	Technical TGk	LB# 118	Draft	11-07-2959-02-000k-11k-sponsor-ballot-recirc-2-comment-resolutions(1).xls	2007-12-13	2008-01-05	23	Pool	299
									Approve	175
				Redlined Doc	N/A				Disapprove	0
				Resolution Doc	N/A				Abstain	20
									Return%	65
				Comment	Template				Approve%	100
				Pool	LB# 118 Voters					
117	TGw	Recirculation TGw Draft 4.00	LB# 117	Draft	Draft P802.11w_D4.0.pdf	2007-12-12	2008-01-05	24	Pool	427
									Approve	245
				Redlined Doc	11-07-2943-00-000w-Redlined document D4.0-vs-3.0.pdf				Disapprove	21
				Resolution Doc	11-07-2697-07-000w-lb114-comment-resolutions.xls				Abstain	60
									Return%	76
				Comment	Template				Approve%	92
				Pool	LB# 117 Voters					
116	TGy	Recirculation TGy Draft 6.00	LB# 116	Draft	Draft P802.11y_D6.0.pdf	2007-11-23	2007-12-08	15	Pool	347
									Approve	271
				Redlined Doc	11-07-2902-00-000y Redlined Draft P802.11y_D6.0 Compared To Draft P802.11y_D5.0.pdf				Disapprove	2
				Resolution Doc	11-07-2623-05-000y-d5-comments.xls				Abstain	54
									Return%	94
				Comment	Template				Approve%	99
				Pool	LB# 116 Voters					
115	TGn	Recirculation TGn Draft 3.00	LB# 115	Draft	Draft P802.11n_D3.0.pdf	2007-10-07	2007-10-27	20	Pool	325
									Approve	240
				Redlined Doc	index.html				Disapprove	43
				Resolution Doc	index.html				Abstain	27
									Return%	95

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	85
				Pool	LB# 115 Voters					
114	TGw	Recirculation TGw Draft 3.00	LB# 114	Draft	Draft P802.11w_D3.0.pdf	2007-10-04	2007-10-19	15	Pool	427
									Approve	245
				Redlined Doc	11-07-2562-00-000w-D3.0-v-2.0-redline.pdf				Disapprove	21
				Resolution Doc	11-07-0714-13-000w-lb-102-comment-resolution-spreadsheet.xls				Abstain	59
									Return%	76
				Comment	Template				Approve%	92
				Pool	LB# 114 Voters					
112	TGy	Recirculation TGy Draft 5.00	LB# 112	Draft	Draft P802.11y_D5.0.pdf	2007-09-28	2007-10-13	15	Pool	347
									Approve	257
				Redlined Doc	11-07-2607-00-000y-tgy-redline-between-Draft-5.0-and-4.0.pdf				Disapprove	11
				Resolution Doc	11-07-2333-07-000y-d4-comments.xls				Abstain	59
									Return%	94
				Comment	Template				Approve%	96
				Pool	LB# 112 Voters					
111	TGk	Technical TGk	LB# 111	Draft	11-07-2289-05-000k-tgk-sponsor-ballot-comment-resolutions.xls	2007-08-27	2007-09-11	15	Pool	278
									Approve	196
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	N/A				Abstain	35
									Return%	91
				Comment	Template				Approve%	90
				Pool	LB# 111 Voters					
110	TGp	Technical TGp Draft 3.00	LB# 110	Draft	Draft P802.11p_D3.0.pdf	2007-08-13	2007-09-12	30	Pool	278
									Approve	143
				Redlined Doc	N/A				Disapprove	50
				Resolution Doc	N/A				Abstain	58
									Return%	90
				Comment	Template				Approve%	74
				Pool	LB# 110 Voters					
109	TGy	Recirculation TGy Draft 4.00	LB# 109	Draft	Draft P802.11y_D4.0.pdf	2007-08-06	2007-08-21	15	Pool	347
									Approve	250
				Redlined Doc	11-07-2268-00-000y-tgy-redline-between Draft 4.0 and 3.0.pdf				Disapprove	17
				Resolution Doc	11-07-2019-06-000y-d3-comments.xls				Abstain	60
									Return%	94
				Comment	Template				Approve%	94
				Pool	LB# 109 Voters					
108	TGv	Technical TGv Draft 1.00	LB# 108	Draft	Draft P802.11v_D1.0.pdf	2007-07-31	2007-08-30	30	Pool	278
									Approve	132
				Redlined Doc	N/A				Disapprove	77
				Resolution Doc	N/A				Abstain	38
									Return%	89
				Comment	Template				Approve%	63
				Pool	LB# 108 Voters					
107	TGu	Technical TGu Draft 1.00	LB# 107	Draft	Draft P802.11u_D1.0.pdf	2007-06-08	2007-07-08	30	Pool	299
									Approve	111
				Redlined Doc	index.html				Disapprove	62
				Resolution Doc	index.html				Abstain	48
									Return%	74
				Comment	Template				Approve%	64
				Pool	LB# 107 Voters					
106	TGy	Recirculation TGy Draft 3.00	LB# 106	Draft	Draft P802.11y_D3.0.pdf	2007-06-05	2007-06-20	15	Pool	347
									Approve	242
				Redlined Doc	index.html				Disapprove	24
				Resolution Doc	index.html				Abstain	60
									Return%	94
				Comment	Template				Approve%	91
				Pool	LB# 106 Voters					
105	TGr	Recirculation TGr Draft 6.00	LB# 105	Draft	Draft P802.11r_D6.0.pdf	2007-05-28	2007-06-13	16	Pool	518
									Approve	360
				Redlined Doc	index.html				Disapprove	11
				Resolution Doc	index.html				Abstain	65
									Return%	84
				Comment	Template				Approve%	97
				Pool	LB# 105 Voters					
104	TGy	Recirculation TGy Draft 2.00	LB# 104	Draft	Draft P802.11y_D2.0.pdf	2007-04-19	2007-05-05	16	Pool	347
									Approve	221
				Redlined Doc	index.html				Disapprove	41
				Resolution Doc	index.html				Abstain	62
									Return%	93
				Comment	Template				Approve%	84
				Pool	LB# 104 Voters					
103	TGk	Recirculation TGk Draft 7.00	LB# 103	Draft	Draft P802.11k_D7.0.pdf	2007-04-18	2007-05-05	17	Pool	514
									Approve	363
				Redlined Doc	index.html				Disapprove	29
				Resolution Doc	index.html				Abstain	39
									Return%	84

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	93
				Pool	LB# 103 Voters					
102	TGw	Recirculation TGw Draft 2.00	LB# 102	Draft	Draft P802.11w_D2.0.pdf	2007-04-07	2007-05-02	25	Pool	427
									Approve	227
				Redlined Doc	index.html				Disapprove	29
				Resolution Doc	index.html				Abstain	61
									Return%	74
				Comment	Template				Approve%	89
				Pool	LB# 102 Voters					
101	TGt	Technical TGt Draft 1.00	LB# 101	Draft	Draft-P802.11.2_D1.0.pdf	2007-04-16	2007-05-16	30	Pool	307
									Approve	163
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	57
									Return%	89
				Comment	Template				Approve%	76
				Pool	LB# 101 Voters					
99	TGt	Procedural TGt Draft 0.14	LB# 99	Draft	Draft P802.11.2_D0.14.pdf	2007-03-28	2007-04-12	15	Pool	323
									Approve	244
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	38
									Return%	92
				Comment	Template				Approve%	94
				Pool	LB# 99 Voters					
98	TGr	Recirculation TGr Draft 5.00	LB# 98	Draft	Draft P802.11r_D5.0.pdf	2007-03-20	2007-04-04	15	Pool	518
									Approve	350
				Redlined Doc	11-07-0471-00-000r-P802-11r-D5-0-redline.pdf				Disapprove	19
				Resolution Doc	11-06-1895-18-000r-d4-comments.xls				Abstain	67
									Return%	84
				Comment	Template				Approve%	95
				Pool	LB# 98 Voters					
97	TGn	Technical TGn Draft 2.00	LB# 97	Draft	Draft-P802.11n_D2.0.pdf	2007-02-07	2007-03-09	30	Pool	325
									Approve	231
				Redlined Doc	index.html				Disapprove	46
				Resolution Doc	N/A				Abstain	28
									Return%	94
				Comment	Template				Approve%	83
				Pool	LB# 97 Voters					
96	TGk	Recirculation TGk Draft 7.00	LB# 96	Draft	Draft P802.11k_D7.0.pdf	2007-01-29	2007-02-13	15	Pool	514
									Approve	361
				Redlined Doc	11-07-0119-00-000k-D7.0-Redlined-Changes-from-D6.0.pdf				Disapprove	30
				Resolution Doc	11-06-1739-18-000k-lb-90-EDITOR-comment-resolution-worksheet.xls				Abstain	38
									Return%	83
				Comment	Template				Approve%	92
				Pool	LB# 96 Voters					
95	TGn	Procedural TGn Draft 2.00	LB# 95	Draft	Draft P802.11n_D1.10.pdf	2007-01-22	2007-02-06	15	Pool	332
									Approve	293
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	N/A				Abstain	14
									Return%	94
				Comment	Template				Approve%	98
				Pool	LB# 95 Voters					
94	TGy	Technical TGy Draft 1.00	LB# 94	Draft	Draft P802.11y_D1.0.pdf	2006-12-08	2007-01-07	30	Pool	347
									Approve	182
				Redlined Doc	N/A				Disapprove	59
				Resolution Doc	N/A				Abstain	71
									Return%	90
				Comment	Template				Approve%	76
				Pool	LB# 94 Voters					
93	TGs	Technical TGs Draft 1.00	LB# 93	Draft	Draft P802.11s_D1.0.pdf	2006-12-07	2007-01-06	30	Pool	347
									Approve	128
				Redlined Doc	N/A				Disapprove	138
				Resolution Doc	N/A				Abstain	36
									Return%	87
				Comment	Template				Approve%	48
				Pool	LB# 93 Voters					
92	TGp	Technical TGp Draft 2.00	LB# 92	Draft	Draft P802.11p_D2.0.pdf	2006-12-06	2007-01-05	30	Pool	347
									Approve	166
				Redlined Doc	11-06-1885-00-000p-Draft P802.11p_D2.0-Redline.pdf				Disapprove	83
				Resolution Doc	11-06-0553-07-000p-lb81-11p-d1-0-comment-resolutions.xls				Abstain	62
									Return%	90
				Comment	Template				Approve%	67
				Pool	LB# 92 Voters					
91	TGr	Recirculation TGr Draft 4.00	LB# 91	Draft	Draft P802.11r_D4.0.pdf	2006-11-20	2006-12-04	14	Pool	518
									Approve	335
				Redlined Doc	11-06-1850-00-000r-P802.11r-D4.0-redline.pdf				Disapprove	30
				Resolution Doc	11-06-1576-11-000r-d3-comments.xls				Abstain	70
									Return%	84

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	92
				Pool	LB# 91 Voters					
90	TGk	Recirculation TGk Draft 6.00	LB# 90	Draft	P802.11k-D6.0.pdf	2006-11-01	2006-11-16	15	Pool	514
									Approve	354
				Redlined Doc	11-06-1583-00-000k-redlined-version-draft-d6.0.pdf				Disapprove	36
				Resolution Doc	11-06-1366-08-000k-tgk-lb86-comment-resolution-spreadsheet.xls				Abstain	39
									Return%	83
				Comment	Template				Approve%	91
				Pool	LB# 90 Voters					
89	TGk	Procedural TGk Draft 6.00	LB# 89	Draft	P802.11k-D6.0.pdf	2006-10-13	2006-10-30	17	Pool	424
									Approve	236
				Redlined Doc	11-06-1583-00-000k-redlined-version-draft-d6.0.pdf				Disapprove	14
				Resolution Doc	11-06-1366-08-000k-tgk-lb86-comment-resolution-spreadsheet.xls				Abstain	25
									Return%	65
				Comment	Template				Approve%	94
				Pool	LB# 89 Voters					
88	TGw	Technical TGw Draft 1.00	LB# 88	Draft	P802.11w-D1.0.pdf	2006-10-10	2006-11-19	40	Pool	427
									Approve	202
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	59
									Return%	69
				Comment	Template				Approve%	86
				Pool	LB# 88 Voters					
87	TGr	Recirculation TGr Draft 3.00	LB# 87	Draft	11-06-1540-00-000r-P802-11r-D3-0-redline.pdf	2006-09-29	2006-10-14	15	Pool	518
									Approve	318
				Redlined Doc	N/A				Disapprove	50
				Resolution Doc	11-06-0537-34-000r-d2-comments.xls				Abstain	65
									Return%	84
				Comment	Template				Approve%	86
				Pool	LB# 87 Voters					
86	TGk	Recirculation TGk Draft 5.00	LB# 86	Draft	P802.11k_D5.0.pdf	2006-09-01	2006-09-16	15	Pool	514
									Approve	325
				Redlined Doc	11-06-1311-00-0000-redlined-document-11k-draft-d5.0.doc				Disapprove	59
				Resolution Doc	11-06-0891-18-000k-LB83-may-to-jun-com-merge.xls				Abstain	44
									Return%	83
				Comment	Template				Approve%	85
				Pool	LB# 86 Voters					
85	TGk	Procedural TGk Draft 5.00	LB# 85	Draft	P802.11k_D5.0.pdf	2006-08-10	2006-08-26	16	Pool	452
									Approve	246
				Redlined Doc	11-06-1311-00-0000-redlined-document-11k-draft-d5.0.pdf				Disapprove	65
				Resolution Doc	11-06-0891-18-000k-LB83-may-to-jun-com-merge.xls				Abstain	46
									Return%	79
				Comment	Template				Approve%	79
				Pool	LB# 85 Voters					
84	TGn	Technical TGn Draft 1.00	LB# 84	Draft	P802.11n-D1.0.pdf	2006-03-19	2006-04-29	41	Pool	435
									Approve	149
				Redlined Doc	N/A				Disapprove	171
				Resolution Doc	N/A				Abstain	32
									Return%	81
				Comment	Template				Approve%	47
				Pool	LB# 84 Voters					
83	TGk	Recirculation TGk Draft 4.00	LB# 83	Draft	P802.11k-D4.0-changes.doc	2006-03-16	2006-03-31	15	Pool	514
									Approve	308
				Redlined Doc	N/A				Disapprove	73
				Resolution Doc	11-05-1049-69-000k-11k-lb78-comment-resolution-spreadsheet.xls				Abstain	44
									Return%	83
				Comment	Template				Approve%	81
				Pool	LB# 83 Voters					
82	TGr	Recirculation TGr Draft 2.00	LB# 82	Draft	P802.11r-D2.0-changes.pdf	2006-03-15	2006-04-04	20	Pool	518
									Approve	316
				Redlined Doc	N/A				Disapprove	44
				Resolution Doc	11-06-1284-29-000r-lb79-11r-d1-0-comment-resolutions.xls				Abstain	69
									Return%	83
				Comment	Template				Approve%	88
				Pool	LB# 82 Voters					
81	TGp	Technical TGp Draft 1.00	LB# 81	Draft	P802.11p_D1.0.pdf	2006-03-02	2006-04-11	40	Pool	486
									Approve	167
				Redlined Doc	N/A				Disapprove	117
				Resolution Doc	N/A				Abstain	63
									Return%	71
				Comment	Template				Approve%	59
				Pool	LB# 81 Voters					
80	TGp	Procedural TGp Draft 0.26	LB# 80	Draft	P802.11p_D0.26.pdf	2006-02-03	2006-02-18	15	Pool	486
									Approve	217
				Redlined Doc	N/A				Disapprove	72
				Resolution Doc	N/A				Abstain	56
									Return%	71

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	75
				Pool	LB# 80 Voters					
79	TGr	Technical TGr Draft 1.00	LB# 79	Draft	P802.11r-D1.0.pdf	2005-11-25	2006-01-04	40	Pool	518
									Approve	268
				Redlined Doc	N/A				Disapprove	64
				Resolution Doc	N/A				Abstain	72
									Return%	78
				Comment	Template				Approve%	81
				Pool	LB# 79 Voters					
78	TGk	Technical TGk Draft 3.00	LB# 78	Draft	P802.11k-D3.0.pdf	2005-10-03	2005-11-12	40	Pool	514
									Approve	295
				Redlined Doc	N/A				Disapprove	75
				Resolution Doc	N/A				Abstain	33
									Return%	78
				Comment	Template				Approve%	80
				Pool	LB# 78 Voters					
77	TGma	Technical TGma Draft 4.00	LB# 77	Draft	P802.11-REVma-D4.0.pdf	2005-09-09	2005-09-19	10	Pool	542
									Approve	411
				Redlined Doc	N/A				Disapprove	15
				Resolution Doc	N/A				Abstain	19
									Return%	82
				Comment	Template				Approve%	96
				Pool	LB# 77 Voters					
76	TGma	Technical TGma Draft 3.00	LB# 76	Draft	P802.11-REVma-D3.0.pdf	2005-08-08	2005-08-19	11	Pool	542
									Approve	397
				Redlined Doc	N/A				Disapprove	20
				Resolution Doc	N/A				Abstain	21
									Return%	81
				Comment	Template				Approve%	95
				Pool	LB# 76 Voters					
75	TGma	Technical TGma Draft 2.00	LB# 75	Draft	P802.11REV-ma-D2.0.pdf	2005-07-07	2005-07-17	10	Pool	542
									Approve	387
				Redlined Doc	N/A				Disapprove	26
				Resolution Doc	N/A				Abstain	19
									Return%	80
				Comment	Template				Approve%	94
				Pool	LB# 75 Voters					
74	TGma	Technical TGma Draft 1.00	LB# 74	Draft	P802.11REV-ma-D1.0.pdf	2005-03-29	2005-05-08	40	Pool	542
									Approve	348
				Redlined Doc	N/A				Disapprove	36
				Resolution Doc	N/A				Abstain	23
									Return%	75
				Comment	Template				Approve%	91
				Pool	LB# 74 Voters					
73	TGk	Technical TGk Draft 2.00	LB# 73	Draft	P802.11k-D2.0.pdf	2005-02-03	2005-03-15	40	Pool	493
									Approve	253
				Redlined Doc	N/A				Disapprove	42
				Resolution Doc	11-04-0964-37-000k-lb71-comment-spreadsheet.xls				Abstain	25
									Return%	65
				Comment	Template				Approve%	86
				Pool	LB# 73 Voters					
71	TGk	Technical TGk Draft 1.00	LB# 71	Draft	P802.11k-D1.0.pdf	2004-08-02	2004-09-11	40	Pool	412
									Approve	329
				Redlined Doc	N/A				Disapprove	18
				Resolution Doc	N/A				Abstain	27
									Return%	91
				Comment	Template				Approve%	95
				Pool	LB# 71 Voters					
68	TGj	Recirculation TGj Draft 1.40	LB# 68	Draft	P802_11j-D1.4-redlined.pdf	2004-04-05	2004-04-20	15	Pool	464
									Approve	273
				Redlined Doc	N/A				Disapprove	13
				Resolution Doc	11-04-0411-02-000j-tgj-comment-resolution-lb66.xls				Abstain	24
									Return%	67
				Comment	Template				Approve%	95
				Pool	LB# 68 Voters					
67	TGe	Recirculation TGe Draft 8.00	LB# 67	Draft	P802_11E-D8.0-redlined.pdf	2004-02-24	2004-03-10	15	Pool	321
									Approve	262
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	11-04-0181-05-000e-letter-ballot-65-comments.xls				Abstain	23
									Return%	94
				Comment	Template				Approve%	94
				Pool	LB# 67 Voters					
66	TGj	Recirculation TGj Draft 1.30	LB# 66	Draft	P802_11j-D1.3redlined.pdf	2004-02-04	2004-03-11	36	Pool	464
									Approve	258
				Redlined Doc	N/A				Disapprove	17
				Resolution Doc	11-04-0042-05-000j-tgj-comment-resolution-lb64.xls				Abstain	27
									Return%	65

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	94
				Pool	LB# 66 Voters					
65	TGe	Recirculation TGe Draft 7.00	LB# 65	Draft	P802_11E-D7.0-redlined.pdf	2004-01-31	2004-02-15	15	Pool	321
									Approve	258
				Redlined Doc	N/A				Disapprove	19
				Resolution Doc	11-04-1001-06-000e-letter-ballot-63-comments.xls				Abstain	24
									Return%	94
				Comment	Template				Approve%	93
				Pool	LB# 65 Voters					
64	TGj	Technical TGj Draft 1.20	LB# 64	Draft	P802_11j-D1.2.doc	2003-12-05	2004-01-14	40	Pool	463
									Approve	212
				Redlined Doc	N/A				Disapprove	27
				Resolution Doc	11-03-337r6-W-TGj_Letter_Ballot_Comment_Resolution_May_2003.xls				Abstain	24
									Return%	57
				Comment	Template				Approve%	89
				Pool	LB# 64 Voters					
63	TGe	Recirculation TGe Draft 6.00	LB# 63	Draft	P802_11E-D6.0-redlined.pdf	2003-12-04	2003-12-20	16	Pool	321
									Approve	248
				Redlined Doc	N/A				Disapprove	30
				Resolution Doc	11-03-0658-17-000e-letter-ballot-59-comments.xls				Abstain	23
									Return%	94
				Comment	Template				Approve%	89
				Pool	LB# 63 Voters					
62	TGi	Recirculation TGi Draft 7.00	LB# 62	Draft	802_11i-D7.0-redlined.doc	2003-10-20	2003-11-04	15	Pool	321
									Approve	264
				Redlined Doc	N/A				Disapprove	14
				Resolution Doc	11-03-0808-00-000i-LB61Comments.xls				Abstain	21
									Return%	93
				Comment	Template				Approve%	95
				Pool	LB# 62 Voters					
61	TGi	Recirculation TGi Draft 6.00	LB# 61	Draft	802.11i-D6.0-redlined.doc	2003-09-24	2003-10-09	15	Pool	321
									Approve	257
				Redlined Doc	N/A				Disapprove	21
				Resolution Doc	11-03-0659-04-000i-LB60-Comments.xls				Abstain	21
									Return%	93
				Comment	Template				Approve%	92
				Pool	LB# 61 Voters					
60	TGi	Recirculation TGi Draft 5.00	LB# 60	Draft	802.11i-D5.0-redlined.doc	2003-08-04	2003-08-19	15	Pool	321
									Approve	243
				Redlined Doc	N/A				Disapprove	36
				Resolution Doc	11-03-452r6-I-LB57-Comments.xls				Abstain	20
									Return%	93
				Comment	Template				Approve%	87
				Pool	LB# 60 Voters					
59	TGe	Recirculation TGe Draft 5.00	LB# 59	Draft	P802_11E-D5.0-changes-with-4.0-marked.pdf	2003-08-01	2003-08-22	21	Pool	321
									Approve	248
				Redlined Doc	N/A				Disapprove	7
				Resolution Doc	11-03-020r13-E-Merged_Letter_Ballot_51_Comments.xls				Abstain	8
									Return%	82
				Comment	Template				Approve%	97
				Pool	LB# 59 Voters					
57	TGi	Recirculation TGi Draft 4.00	LB# 57	Draft	802_11i-D4_0-redlined.doc	2003-05-22	2003-06-06	15	Pool	321
									Approve	218
				Redlined Doc	N/A				Disapprove	61
				Resolution Doc	11-03-033r10-I-LB52-Comments.xls				Abstain	19
									Return%	93
				Comment	Template				Approve%	78
				Pool	LB# 57 Voters					
56	TGj	Technical TGj Draft 1.00	LB# 56	Draft	P802_11j-D1_0.doc	2003-04-01	2003-05-12	41	Pool	394
									Approve	196
				Redlined Doc	N/A				Disapprove	93
				Resolution Doc	N/A				Abstain	5
									Return%	75
				Comment	Template				Approve%	68
				Pool	LB# 56 Voters					
54	TGg	Recirculation TGg Draft 6.10	LB# 54	Draft	802.11g-D6.1-tracking.doc	2003-01-20	2003-02-04	15	Pool	321
									Approve	184
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	11-03-068r12-G-LB50_Comment_Resolution.xls				Abstain	58
									Return%	82
				Comment	Template				Approve%	89
				Pool	LB# 54 Voters					
52	TGi	Technical TGi Draft 3.00	LB# 52	Draft	802.11i-D3.0.pdf	2002-12-02	2003-01-12	41	Pool	321
									Approve	209
				Redlined Doc	N/A				Disapprove	65
				Resolution Doc	N/A				Abstain	21
									Return%	92

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	76
				Pool	LB# 52 Voters					
51	TGe	Technical TGe Draft 4.00	LB# 51	Draft	P802_11E-D4_0.pdf	2002-11-28	2003-01-08	41	Pool	321
									Approve	228
				Redlined Doc	N/A				Disapprove	47
				Resolution Doc	N/A				Abstain	21
									Return%	92
				Comment	Template				Approve%	83
				Pool	LB# 51 Voters					
50	TGg	Technical TGg Draft 5.00	LB# 50	Draft	802.11g-D5.0.doc	2002-11-27	2003-01-08	42	Pool	321
									Approve	256
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	18
									Return%	96
				Comment	Template				Approve%	88
				Pool	LB# 50 Voters					
49	TGg	Recirculation TGg Draft 4.00	LB# 49	Draft	802.11g-D4.0.pdf	2002-10-17	2002-11-01	15	Pool	382
									Approve	217
				Redlined Doc	N/A				Disapprove	33
				Resolution Doc	2-535.zip				Abstain	25
									Return%	72
				Comment	Template				Approve%	87
				Pool	LB# 49 Voters					
48	TGh	Recirculation TGh Draft 2.20	LB# 48	Draft	802-11-h-D2.2.pdf	2002-10-17	2002-11-01	15	Pool	356
									Approve	241
				Redlined Doc	N/A				Disapprove	7
				Resolution Doc	11-02-515r7-H-Comments_form_LB42.xls				Abstain	17
									Return%	74
				Comment	Template				Approve%	97
				Pool	LB# 48 Voters					
42	TGh	Recirculation TGh	LB# 42	Draft	index.html	2002-07-23	2002-09-01	40	Pool	360
									Approve	208
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	39
									Return%	75
				Comment	Template				Approve%	90
				Pool	LB# 42 Voters					
41	TGg	Technical TGg	LB# 41	Draft	index.html	2002-07-23	2002-09-01	40	Pool	382
									Approve	194
				Redlined Doc	N/A				Disapprove	40
				Resolution Doc	N/A				Abstain	15
									Return%	65
				Comment	Template				Approve%	83
				Pool						
39	TGe	Technical TGe	LB# 39	Draft	P802_11E-D3_0.pdf	2002-05-23	2002-07-02	40	Pool	365
									Approve	106
				Redlined Doc	N/A				Disapprove	110
				Resolution Doc	N/A				Abstain	44
									Return%	71
				Comment					Approve%	49
				Pool						
38	TGf	Recirculation TGf	LB# 38	Draft	802.11f-D3.1.pdf	2002-05-08	2002-06-16	39	Pool	291
									Approve	221
				Redlined Doc	N/A				Disapprove	9
				Resolution Doc	N/A				Abstain	25
									Return%	88
				Comment	Template				Approve%	96
				Pool	LB# 38 Voters					
36	TGh	Technical TGh	LB# 36	Draft	P802_11H-D2_0.pdf	2002-03-26	2002-05-05	40	Pool	330
									Approve	165
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	53
									Return%	82
				Comment					Approve%	76
				Pool						
35	TGi	Technical TGi	LB# 35	Draft	P802_11i-D2_0.pdf	2002-03-25	2002-05-04	40	Pool	338
									Approve	143
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	N/A				Abstain	78
									Return%	78
				Comment					Approve%	77
				Pool						
33	TGg	Technical TGg	LB# 33	Draft		2002-01-31	2002-03-11	39	Pool	286
									Approve	86
				Redlined Doc	N/A				Disapprove	104
				Resolution Doc	N/A				Abstain	41
									Return%	81

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment					Approve%	45
				Pool						
32	TGf	Technical TGf	LB# 32	Draft		2002-01-29	2002-03-10	40	Pool	290
									Approve	145
				Redlined Doc	N/A				Disapprove	31
				Resolution Doc	N/A				Abstain	19
									Return%	67
				Comment					Approve%	82
				Pool						
30	TGe	Technical TGe	LB# 30	Draft		2001-12-05	2002-01-16	42	Pool	266
									Approve	101
				Redlined Doc	N/A				Disapprove	84
				Resolution Doc	N/A				Abstain	33
									Return%	82
				Comment					Approve%	55
				Pool						
29	TGh	Technical TGh	LB# 29	Draft		2001-07-25	2001-09-03	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
28	TGf	Technical TGf	LB# 28	Draft		2001-07-25	2001-09-03	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
27	TGe	Technical TGe	LB# 27	Draft		2001-04-05	2001-05-15	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
26	TGf	Technical TGf	LB# 26	Draft		2001-04-05	2001-05-15	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
22	TGd	Recirculation TGd	LB# 22	Draft		2000-06-12	2000-06-26	14	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
21	TGd	Recirculation TGd	LB# 21	Draft		2000-03-27	2000-04-04	8	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
15	TGb	Technical TGb	LB# 15	Draft		1998-09-30	1998-11-09	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						

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APPENDIX BN

The Wayback Machine - https://web.archive.org/web/20160113115407/http://www.ieee802.org/11/Me…

IEEE 802.11 FUTURE SESSION PLANS

IEEE 802.11 WLAN WORKING GROUP SESSIONS

All interested parties are welcome to attend our open Public meetings of the IEEE 802.11 Working Group, you do not have to be an IEEE member to attend. There is a registration fee, to defray the cost of the session. At Plenary sessions these are administered by the IEEE 802 LMSC organization. Interim sessions are administered by the IEEE 802.11/15 Working Groups. This is in-addition to your individual hotel accommodation, and travel expenses. Click here to view an Example Plenary and Interim Session Agenda, or review the latest Combined Tentative Agenda for the next IEEE 802.11 WG Session below.

For Year 2016		Session	Type
January 17-22	Hyatt Regency Atlanta, Atlanta, GA, USA Session Information Registration Hotel Room Reservation	155	Interim*

Registration Fees & Deadlines

Early: Before 6:00 PM Pacific Time, Friday, December 4, 2015
* $US 375.00 for attendees staying at the Hyatt Regency Atlanta
* $US 575.00 for all others (including local attendees not staying at the group hotel)

Standard: After Early Registration and before 6:00 PM Pacific Time, Friday January 8, 2016
* $US 575.00 for attendees staying at the Hyatt Regency Atlanta
* $US 775.00 for all others (including local attendees not staying at the group hotel)

Late/On-site: After 6:00 PM Pacific Time Friday January 8, 2016
* $US 775.00 for attendees staying at the Hyatt Regency Atlanta
* $US 975.00 for all others (including local attendees not staying at the group hotel)

Student Registration: $US 150 (college students at the bachelor or post-graduate level)
* The Student meeting fee is available only one time per person.
* The person using the Student meeting fee will not be able to use meeting attendance to gain or maintain voting rights.
* A valid current student ID must be shown when picking up the meeting badge.

Hotel Room Rates

EARLY RATE: $US 179.00/Night (plus applicable taxes)*
Rate applies to first 50% of Room Block or until November 30, 2015 which ever comes first.
Single/Double Occupancy Run of House Rooms, Internet access included.

IEEE 802 RATE: $US 189.00/Night (plus applicable taxes)*
Rate applies to last 50% of Room Block or until January 4, 2016 which ever comes first.
Single/Double Occupancy Run of House Rooms, Internet access included.

EXTRA ADULTS: $US 10.00/Night (plus applicable taxes)
Rate applies to Extra Adults (>2).
Per Person,Per Night.

EXTENDED DATES:
Subject to availability the IEEE 802 Group Rate is available January 8th to 29th, 2016.

SUBJECT TO AVAILABILITY:
Rates subject to the deadline and availability of rooms in the IEEE 802 Group Room Block.

ROOM BLOCK DEADLINE:
January 4, 2016. If the block is sold out before the January 4, 2016 rates may no longer be available.

HOTEL CANCELLATION POLICY:
No penalty if reservation is cancelled prior to 6:00 PM Central Time on anticipated date of arrival.

Harbin, China

Hotel Details:
Hotel Name: Heilongjiang Trade Union Business Hotel (http://www.hljghds.com/h-index.html)
Hotel address: No. 333, Guogeli Street, Nan Gang, 150001 Harbin, China
Hotel contact: Mr. Shoudu SUN , shoudu263@263.net, +86-18686840022
Conference contact: Ms. Sha WEI, weisha@cesi.cn , +86-13810785724
Hotel Price: Business Queen Room:780RMB, Business Twin Room:880 RMB
For hotel reservation, please email to Mr. Shoudu SUN, and cc to Ms. Sha WEI

January 27-28 155.5 China Interim

Meeting Registration Details
Meeting registration fee :1800 RMB
Pay upon hotel check-in

Invitation Letter for Visa Application
Contact person: Ms. Meng ZHAO, meng.zhao@ieee.org , +86-15801384410
If you need an invitation letter for Visa application, please send your request to Ms. Meng ZHAO.

March 13-18 156 Plenary

Sands Venetian Hotel, Macau, PRC
Register for the sesion
Hotel Reservations
Session Information

Registration Fees & Deadlines

Standard Registration: Before 6:00 PM Pacific Time, Friday January 29, 2016
* $US 600.00 for attendees staying at the Sands Venetian Macao Hotel
* $US 1050.00 for all others (including local attendees not staying at the group hotel)

Late/On-site Registration: After 6:00 PM Pacific Time Friday January 29, 2016
* $US 800.00 for attendees staying at the Sands Venetian Macao Hotel
* $US 1250.00 for all others (including local attendees not staying at the group hotel)

Student Registration: $US 150 (college students at the bachelor or post-graduate level)
* The Student meeting fee is available only one time per person.
* The person using the Student meeting fee will not be able to use meeting attendance to gain or maintain voting rights.
* A valid current student ID must be shown when picking up the meeting badge.

Terms and conditions can be found on the information page.

IEEE 802 GROUP HOTEL ROOM RATE:

Single/Double Occupancy Royal Suite Rooms, Internet access included.

Friday March 11, 2016
* 1,700.00 HKD/MOP

Saturday March 12, 2016
* 2,300.00 HKD/MOP

Sunday March 13 - Thursday March 17, 2016
* 1,550.00 HKD/MOP

Friday March 18, 2016
* 1,700.00 HKD/MOP

Saturday March 19, 2016
* 2,300.00 HKD/MOP

Sunday March 20, 2016
* 1,550.00 HKD/MOP

These rates do not include any applicable service charges, Macau room tax, tourism tax and/or other taxes with similar application at the rate applicable at time of occupancy. Hotel will charge a 10% service charge and 5% Government Tax.

ROOM BLOCK DEADLINE:
If the block is sold out before February 12, 2016 IEEE 802 Group rates may no longer be available.

HOTEL CANCELLATION/CHANGE POLICY:
* Individual Guest Room Reservations may be changed or cancelled without charge up until 6:00 PM Pacific Time Friday February 12, 2016.
* A charge equivalent to full nights' accommodation, plus service charge and government tax, will be imposed on guest's guaranteed credit card for no show, amendments or cancellations received after 12 February 2016. No Refunds after February 12, 2016.

EXTENDED DATES:
Delegates request to extend their stay outside the agreed room block (Friday March 11th through Sunday March 20th), based upon hotel availability.

SUBJECT TO AVAILABILITY: *Rates are subject to the deadline and availability of rooms in the IEEE 802 Group Room Block.

How to Make a Room Reservation at Sands Venetian Macao Hotel

Reserve room online

Reserve a room by phone or email:
Phone# 853 2882 8852 Email: group.reservations@sands.com.mo
Ask for reservations and then ask for IEEE 802 Plenary Session Group Rate, code = "IEEE 802"

Do you Need A VISA to enter Macau?
A Visa is not required for most participants traveling to Macau. However we recommend visiting the following Macau government sites to determine if you need to obtain such a visa.
* Entrance Visa Required Countries List (http://www.fsm.gov.mo/psp/eng/AfMV.html)
* Exempt Countries List (http://www.fsm.gov.mo/psp/eng/EDoN.html#EDoN_VII)

May 15-20	Hilton Waikoloa Village, HI, USA	157	Interim*
May 25-26	Beijing, China	157.7	China Interim
July 24-29	Manchester Grand Hyatt, San Diego, CA, USA	158	Plenary
September 11-16	Marriott Warsaw	159	Interim*
September 28-29	Chongqing, China	159.5	China Interim
November 6-11	Grand Hyatt San Antonio, San Antonio, TX, USA	160	Plenary

For Year 2017		Session	Type
January 15-20	Hyatt Regency, Atlanta, GA, USA	161	Interim*
March 12-17	Hyatt Regency, Vancouver, BC, Canada	162	Plenary
May 14-19	Daejeon Convention Center, Daejeon, Korea (TBC)	163	Interim*
July 9-14	Estrel Hotel and Convention Center, Berlin, Germany	164	Plenary
September 10-15	Hilton Waikoloa Village, Kona, HI, USA	165	Interim*
November 5-10	Caribe Hotel and Convention Center, Orlando, FL, USA	166	Plenary

For Year 2018		Session	Type
January		167	Interim*
March 4-9 (TBC)	Hyatt Regency O'Hare, Rosemont, Illinois, USA	168	Plenary
May		169	Interim*
July	Manchester Grand Hyatt, San Diego, CA, USA	170	Plenary
September 9-14	Hilton Waikoloa Village, Kona, HI, USA	171	Interim*
November 11-16		172	Plenary

NOTES

China Interm - denotes an interim meeting of the IEEE 802.11 Working Group held in China, at which the only task group meeting is TGaj (China Millimetre Wave).

* *Denotes* - The IEEE 802.11 Working Group for Wireless Area Networks (WLANs) session is co-located with the IEEE 802.15 Working Group for Wireless Personal Area Networks (WPANs), IEEE 802.18 Technical Advisory Group for Radio Regulatory (R-REG), IEEE 802.19 Technical Advisory Group for Wireless Coexistence (COEX), IEEE 802.20 Working Group for Mobile Broadband Wireless Access (MBWA), IEEE 802.21 Working Group for Media Independent Handover Interoperability (MIHI), and IEEE 802.22 Working Group for Wireless Regional Area Networks (WRAN) sessions. A joint opening session with the five Working Groups and both the Technical Advisory Groups is normally carried out, at all Interim sessions.

GENERAL SESSION INFORMATION

- New attendees should check the agenda file for any new members orientation session. This session typically takes place on Sunday afternoon or Monday morning, and is intended to bring new attendees rapidly up to speed with how to operate effectively within the group.
- The Online Tentative Session Agenda displayed is always subject to change, after review at the start of the Full Working Group session for each meeting, and may be revised during the week to incorporate any necessary work.
- All Working Group sessions start promptly on time, as detailed in the session agenda.
- Attendees should bring a Laptop computer (or other small form factor computing device) equipped with 802.11 connectivity for use at the meetings. This is needed to access meeting documents and draft standards and to record meeting attendance.
- The Working Group operates under a hierarchy of IEEE, IEEE-SA, IEEE LMSC and 802.11 policies and procedures as described in http://www.ieee802.org/11/Rules/rules.shtml. You are deemed to be aware of and compliant to these rules by your participation in an 802.11 meeting.

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APPENDIX BO

SUMMARY REPORTS & MINUTES OF 802.11 WG SESSIONS

IEEE 802.11 WLAN WORKING GROUP SESSIONS

As our sessions are open to the public, all interested parties are welcome to attend IEEE P802.11 Working Group sessions, for which there is a registration fee, to defray the cost of the session. At Plenary sessions this is administered by the IEEE P802 LMSC organization. Whereas, the Interim sessions are normally managed by our sponsoring host. This is in-addition to your individual hotel accommodation, and travel expenses. Click here to view Example Plenary and Interim Session Agenda.

Session	Date	Month	File URL or Doc# Report	Minutes	Location	Place	Type
For Year 2025							
210	8th - 14th	March	Report		Hilton Atlanta	Atlanta GA USA	Plenary
209	12th - 17th	January	Report	Minutes	Kobe Convention Center	Kobe Japan	Interim
For Year 2024							
208	10th - 15th	November	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
207	8th - 13th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
206	14th - 19th	July	Report	Minutes	Sheraton Le Centre	Montreal QC Canada	Plenary
205	12th - 17th	May	Report	Minutes	Warsaw Marriott	Warsaw Poland	Interim
204	10th - 15th	March	Report	Minutes	Hyatt Regency	Denver CO USA	Plenary
203	14th - 19th	January	Report	Minutes	Hilton Panama	Panama City Panama	Interim
For Year 2023							
202	12th - 17th	November	Report	Minutes	Hilton Hawaiian Village Waikiki	Honolulu HI USA	Plenary
201	10th - 15th	September	Report	Minutes	Grand Hyatt	Atlanta GA USA	Interim
200	9th - 14th	July	Report	Minutes	Estrel	Berlin Germany	Plenary
199	14th - 19th	May	Report	Minutes	Hilton Orlando Lake Buena Vista	Orlando FL USA	Interim
198	12th - 17th	March	Report	Minutes	Hilton Atlanta	Atlanta GA USA	Plenary
197	15th - 20th	January	Report	Minutes	Hilton Inner Harbor	Baltimore MD USA	Interim
For Year 2022							
196	13th - 18th	November	Report	Minutes	Marriott Marquis Queen's Park	Bangkok Thailand	Plenary
195	11th - 16th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
194	10th - 15th	July	Report	Minutes	Marriott	Montreal QC Canada	Plenary
193	8th - 13th	May	Report	Minutes	Online	Online	Interim
192	7th - 15th	March	Report	Minutes	Online	Online	Plenary
191	17th - 25th	January	Report	Minutes	Online	Online	Interim
For Year 2021							
190	8th - 16th	November	Report	Minutes	Online	Online	Plenary
189	13th - 21st	September	Report	Minutes	Online	Online	Interim
188	12th - 20th	July	Report	Minutes	Online	Online	Plenary
187	10th - 18th	May	Report	Minutes	Online	Online	Interim
186	8th - 16th	March	Report	Minutes	Online	Online	Plenary
185	11th - 15th	January	Report	Minutes	Online	Online	Interim
For Year 2020							
184	2nd - 10th	November	Report	Minutes	Online	Online	Plenary
183	13th - 17th	September	Report	Minutes	Online	Online	Interim
182	13th - 16th	July	Report	Minutes	Online	Online	Plenary
181	10th - 15th	May	Cancelled Session		Marriott	Warsaw Poland	Interim
180	15th - 20th	March	Cancelled Session		Hilton Atlanta	Atlanta GA USA	Plenary
179	12th - 17th	January	Report	Minutes	Hotel Irvine	Irvine CA USA	Interim
For Year 2019							
178	11th - 15th	November	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Plenary
177	16th - 20th	September	Report	Minutes	JW Marriott	Hanoi Vietnam	Interim
176	15th - 19th	July	Report	Minutes	Austria Center Vienna	Vienna Austria	Plenary
175	13th - 17th	May	Report	Minutes	Grand Hyatt	Atlanta GA USA	Interim

n/a Denotes - Not Applicable.

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			File URL or Doc#				
Session	Date	Month	Report	Minutes	Location	Place	Type
174	11th - 15th	March	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
173	14th - 18th	January	Report	Minutes	Hilton at the ball park	St Louis MO USA	Interim
			For Year 2018				
172	12th - 16th	November	Report	Minutes	Marriott Marquis Queen's Park	Bangkok Thailand	Plenary
171	10th - 14th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
170	9th - 13th	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
169	7th - 11th	May	Report	Minutes	Marriott	Warsaw Poland	Interim
168	5th - 9th	March	Report	Minutes	Hyatt Regency O'Hare	Rosemont IL USA	Plenary
167	15th - 19th	January	Report	Minutes	Hotel Irvine	Irvine CA USA	Interim
			For Year 2017				
166	6th - 10th	November	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
165	11th - 15th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
164	9th - 14th	July	Report	Minutes	Estrel	Berlin Germany	Plenary
163	8th - 12th	May	Report	Minutes	Lotte	Daejeon South Korea	Interim
162	13th - 17th	March	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
161	16th - 20th	January	Report	Minutes	Grand Hyatt	Atlanta GA USA	Interim
			For Year 2016				
160	7th - 11th	November	Report	Minutes	Grand Hyatt	San Antonio TX USA	Plenary
159	12th - 16th	September	Report	Minutes	Marriott	Warsaw Poland	Interim
158	25th - 29th	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
157	16th - 20th	May	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
156	14th - 18th	March	Report	Minutes	Venetian	Macau	Plenary
155.5	27th - 27th	January	Report	Minutes	Heilongjiang Trade Union Hotel	Harbin China	Interim
155	18th - 22nd	January	Report	Minutes	Hyatt Regency	Atlanta GA USA	Interim
			For Year 2015				
154	9th - 13th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
153	14th - 18th	September	Report	Minutes	Centara Grand	Bangkok Thailand	Interim
152	13th - 17th	July	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Plenary
151.5	19th - 20th	May	Report	Minutes	Zhuhai Dehan	Zhuhai China	Interim
151	11th - 15th	May	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Interim
150	9th - 13th	March	Report	Minutes	Estrel	Berlin Germany	Plenary
149.5	21st - 22nd	January	Report	Minutes	Kempinski	Xiamen China	Interim
149	11th - 16th	January	Report	Minutes	Hyatt Regency	Atlanta GA USA	Interim
			For Year 2014				
148	2nd - 7th	November	Report	Minutes	Grand Hyatt	San Antonio TX USA	Plenary
147	14th - 19th	September	Report	Minutes	Hilton Athens	Athens Greece	Interim
146.5	9th - 10th	September	Report	Minutes	Sofitel Luxury	Chengdu China	Interim
146	13th - 18th	July	Report	Minutes	Manchester Hyatt	San Diego CA USA	Plenary
145.5	21st - 22nd	May	Report	Minutes	New Century	Beijing China	Interim
145	11th - 16th	May	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
144	16th - 21st	March	Report	Minutes	China World	Beijing China	Plenary
143.5	8th - 9th	January	Report	Minutes	Howard Johnson Resort	Sanya China	Interim
143	19th - 24th	January	Report	Minutes	Hyatt Century Plaza	Los Angeles CA USA	Interim
			For Year 2013				
142	10th - 15th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
141	15th - 20th	September	Report	Minutes	Zhong Shan	Nanjing China	Interim

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			File URL or Doc#				
Session	Date	Month	Report	Minutes	Location	Place	Type
140	14th - 19th	July	Report	Minutes	ITU Headquarters	Geneva Switzerland	Plenary
139	11th - 17th	May	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
138.5	24th - 25th	April	Report	Minutes	Nikko New Century	Beijing China	Interim
138	17th - 22nd	March	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
137.5	23rd - 24th	January	Report	Minutes	Grand Mercure Oriental Ginza	Shenzhen China	Interim
137	12th - 18th	January	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Interim
			For Year 2012				
136	12th - 16th	November	Report	Minutes	Grand Hyatt	San Antonio TX USA	Plenary
135.5	26th - 27th	September	Report	Minutes	Nikko New Century	Beijing China	Interim
135	16th - 21st	September	Report	Minutes	Hyatt Regency	Indian Wells CA USA	Interim
134	14th - 20th	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
133	13th - 18th	May	Report	Minutes	Hyatt Regency	Atlanta GA USA	Interim
132	11th - 16th	March	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Plenary
131	15th - 20th	January	Report	Minutes	Hyatt Regency	Jacksonville FL USA	Interim
			For Year 2011				
130	6th - 11th	November	Report	Minutes	Hyatt Regency	Atlanta GA USA	Plenary
129	18th - 23rd	September	Report	Minutes	Okinawa Convention Center	Okinawa Japan	Interim
128	17th - 22nd	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary
127	8th - 13th	May	Report	Minutes	Hyatt Grand Champion	Indian Wells CA USA	Interim
126	13th - 18th	March	Report	Minutes	Marina Bay Sands	Singapore	Plenary
125	16th - 21st	January	Report	Minutes	Hyatt Century Plaza	Los Angeles CA USA	Interim
			For Year 2010				
124	7th - 12th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
123	12th - 17th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
122	11th - 16th	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
121	16th - 21st	May	Report	Minutes	China World	Beijing PRC	Interim
120	14th - 19th	March	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
119	17th - 22nd	January	Report	Minutes	Hyatt Century Plaza	Los Angeles CA USA	Interim
			For Year 2009				
118	15th - 20th	November	Report	Minutes	Hyatt Regency	Atlanta GA USA	Plenary
117	20th - 25th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
116	12th - 17th	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary
115	10th - 15th	May	Report	Minutes	Fairmont The Queen Elizabeth	Montreal PQ Canada	Interim
114	8th - 13th	March	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
113	18th - 23rd	January	Report	Minutes	Hyatt Century Plaza	Los Angeles CA USA	Interim
			For Year 2008				
112	9th - 14th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
111	7th - 12th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
110	13th - 18th	July	Report	Minutes	Hyatt Regency	Denver CO USA	Plenary
109	11th - 16th	May	Report	Minutes	Hyatt Regency	Jacksonville FL USA	Interim
108	16th - 21st	March	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
107	13th - 18th	January	Report	Minutes	Howard Plaza	Taipei Taiwan ROC	Interim
			For Year 2007				
106	11th - 16th	November	Report	Minutes	Hyatt Regency	Atlanta GA USA	Plenary
105	16th - 21st	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
104	15th - 20th	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary

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			File URL or Doc#				
Session	Date	Month	Report	Minutes	Location	Place	Type
103	13th - 18th	May	Report	Minutes	Fairmont The Queen Elizabeth	Montreal PQ Canada	Interim
102	11th - 16th	March	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
101	14th - 19th	January	Report	Minutes	Hilton London Metropole	London United Kingdom	Interim
			For Year 2006				
100	13th - 17th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
99	17th - 22nd	September	Report	Minutes	Exhibition Convention Centre	Melbourne Victoria Australia	Interim
98	16th - 21st	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
97	15th - 19th	May	Report	Minutes	Hyatt Regency	Jacksonville FL USA	Interim
96	6th - 10th	March	Report	Minutes	Hyatt Regency	Denver CO USA	Plenary
95	15th - 20th	January	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
			For Year 2005				
94	13th - 18th	November	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
93	18th - 23rd	September	Report	Minutes	Hyatt Regency	Garden Grove CA USA	Interim
92	17th - 22nd	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary
91	15th - 20th	May	Report	Minutes	Cairns Convention Centre	Cairns Queensland Australia	Interim
90	13th - 18th	March	Report	Minutes	Hyatt Regency	Atlanta GA USA	Plenary
89	16th - 21st	January	Report	Minutes	Hyatt Regency	Monterey CA USA	Interim
			For Year 2004				
88	15th - 19th	November	Report	Minutes	Hyatt Regency	San Antonio TX USA	Plenary
87	12th - 17th	September	Report	Minutes	Estrel Hotel Berlin	Berlin Germany	Interim
86	12th - 16th	July	Report	Minutes	Portland Hilton	Portland OR USA	Plenary
85	9th - 14th	May	Report	Minutes	Hyatt Regency	Garden Grove CA USA	Interim
84	14th - 19th	March	Report	Minutes	Hilton in Walt Disney World	Lake Buena Vista FL USA	Plenary
83	11th - 16th	January	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Interim
			For Year 2003				
82	10th - 14th	November	Report	Minutes	Hyatt Regency	Albuquerque NM USA	Plenary
81	15th - 19th	September	Report	Minutes	Swisstel The Stamford	Singapore	Interim
80	20th - 25th	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary
79	12th - 16th	May	Report	Minutes	Hyatt Regency	Dallas/Ft Worth Airport TX USA	Interim
78	10th - 14th	March	Report	Minutes	Hyatt Regency	Dallas/Ft Worth Airport TX USA	Plenary
77	13th - 17th	January	Report	Minutes	Fort Lauderdale Marina Marriott	Fort Lauderdale FL USA	Interim
			For Year 2002				
76	11th - 15th	November	Report	Minutes	Hyatt Regency	Kauai HI USA	Plenary
75	9th - 13th	September	Report	Minutes	Hyatt Regency	Monterey CA USA	Interim
74	8th - 12th	July	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
73	13th - 17th	May	Report	Minutes	Wentworth Sydney Hotel	Sydney NSW Australia	Interim
72	11th - 15th	March	Report	Minutes	Hyatt Regency	St. Louis MO USA	Plenary
71	21st - 25th	January	Report	Minutes	Wyndham Anatole Hotel	Dallas TX USA	Interim
			For Year 2001				
70	11th - 16th	November	Report	Minutes	Hyatt Regency	Austin TX USA	Plenary
69	17th - 21st	September	Cancelled Session		Hyatt Regency	Bellevue WA USA	Interim
68	9th - 13th	July	Report	Minutes	Portland Marriott Downtown	Portland OR USA	Plenary
67	14th - 18th	May	Report	Minutes	Radisson at Universal Orlando	Orlando FL USA	Interim
66	12th - 16th	March	Report	Minutes	Marriott Resort	Hilton Head SC USA	Plenary
65	15th - 19th	January	Report	Minutes	Hyatt Regency Resort	Monterey CA USA	Interim
			For Year 2000				

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			File URL or Doc#				
Session	Date	Month	Report	Minutes	Location	Place	Type
64	13th - 17th	November	Report	Minutes	Hyatt Regency	Tampa FL USA	Plenary
63	18th - 22nd	September	Report	Minutes	Radisson Resort Spa	Scottsdale AZ USA	Interim
62	10th - 14th	July	Report	Minutes	Hyatt Regency	La Jolla CA USA	Plenary
61	8th - 12th	May	Report	Minutes	Renaissance Madison Hotel	Seattle WA USA	Interim
60	6th - 10th	March	Report	Minutes	Hyatt Regency	Albuquerque NM USA	Plenary
59	10th - 14th	January	Report	Minutes	David Intercontinental Hotel	Tel Aviv Israel	Interim
			For Year 1999				
58	8th - 12th	November	Report	Minutes	Hyatt Regency	Kauai HI USA	Plenary
57	13th - 17th	September	Report	Minutes	Hilton Sonoma County	Santa Rosa CA USA	Interim
56	5th - 9th	July	Report	Minutes	Queen Elizabeth	Montreal PQ Canada	Plenary
55	3rd - 7th	May	Report	Minutes	Makuhari Prince Hotel	Chiba Japan	Interim
54	8th - 12th	March	Report	Minutes	Hyatt Regency	Austin TX USA	Plenary
53	11th - 15th	January	Report	Minutes	Grosvenor	Lake Buena Vista FL USA	Interim
			For Year 1998				
52	9th - 13th	November	n/a	Minutes	Hyatt Regency	Albuquerque NM USA	Plenary
51	1st - 1st	October	n/a	Minutes	Hyatt Regency	Atlanta GA USA	Special
50	14th - 18th	September	n/a	Minutes	Westford Regency Inn	Westford MA USA	Interim
49	6th - 11th	July	n/a	Minutes	Hyatt Regency	La Jolla CA USA	Plenary
48	19th - 21st	May	n/a	Minutes	Sheraton Grand	Irving TX USA	Special
47	8th - 9th	April	n/a	Minutes	Boston Marriott	Cambridge MA USA	Special
46	4th - 8th	May	n/a	Minutes	Holiday Inn	Utrecht Nederlands	Interim
45	9th - 13th	March	n/a	Minutes	Hyatt Regency	Irvine CA USA	Plenary
44	19th - 23rd	January	n/a	Minutes	Embassy Suites	Lynnwood WA USA	Interim
			For Year 1997				
43	10th - 14th	November	n/a	Minutes	Queen Elizabeth	Montreal PQ Canada	Plenary
42	8th - 12th	September	n/a	Minutes	Grafton Radisson Edwardian	London United Kingdom	Interim
41	6th - 11th	July	n/a	Minutes	Hyatt Regency	Maui HI USA	Plenary
40	7th - 9th	May	n/a	Minutes	AMD Facility	Sunnyvale CA USA	Interim
39	10th - 14th	March	n/a	Minutes	Marriott	Irvine CA USA	Plenary
38	13th - 17th	January	n/a	Minutes	Harris Facility	Palm Bay FL USA	Interim
			For Year 1996				
37	11th - 14th	November	n/a	Minutes	Hotel Vancouver	Vancouver BC Canada	Plenary
36	8th - 12th	July	n/a	Minutes	Various Campus Locations	Twente University Nederlands	Plenary
35	6th - 9th	May	n/a	Minutes	Westin	Waltham MA USA	Interim
34	11th - 15th	March	n/a	Minutes	Hyatt Regency	La Jolla CA USA	Plenary
33	8th - 12th	January	n/a	Minutes	Westgate Hotel	San Diego CA USA	Interim
			For Year 1995				
32	6th - 9th	November	n/a	Minutes	Queen Elizabeth	Montreal PQ Canada	Plenary
31	28th - 31st	August	n/a	Minutes	Marriott	Schaumburg IL USA	Interim
30	10th - 13th	July	n/a	Minutes	Hyatt Regency	Maui HI USA	Plenary
29	8th - 11th	May	n/a	Minutes	Hilton Inn	Salt Lake City UT USA	Interim
28	6th - 10th	March	n/a	Minutes	Ramada Resort	West Palm Beach FL USA	Plenary
27	9th - 12th	January	n/a	Minutes	LeBaron	San Jose CA USA	Interim
			For Year 1994				
26	7th - 11th	November	n/a	Minutes	Hyatt Regency	Incline Village NV USA	Plenary
25	29th - 1st	Aug / Sep	n/a	Minutes	Marriott Rivercenter	San Antonio TX USA	Interim

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Session	Date	Month	File URL or Doc# Report	Minutes	Location	Place	Type
24	11th - 15th	July	n/a	Minutes	Walt Disney World Swan	Orlando FL USA	Plenary
23	9th - 12th	May	n/a	Minutes	Holiday Inn	Oshawa ON Canada	Interim
22	7th - 11th	March	n/a	Minutes	Hotel Vancouver	Vancouver BC Canada	Plenary
21	10th - 13th	January	n/a	Minutes	LeBaron	San Jose CA USA	Interim
For Year 1993							
20	8th - 12th	November	n/a	Minutes	Ramada	West Palm Beach FL USA	Plenary
19	20th - 23rd	September	n/a	Minutes	Wyndham Garden	Atlanta GA USA	Interim
18	12th - 15th	July	n/a	Minutes	Sheraton	Denver CO USA	Plenary
17	10th - 13th	May	n/a	Minutes	Holiday Inn	Wilmington DE USA	Interim
16	8th - 12th	March	n/a	Minutes	Omni Inner Harbor	Baltimore MD USA	Plenary
15	11th - 14th	January	n/a	Minutes	Ramada	Agoura Hills CA USA	Interim
For Year 1992							
14	9th - 12th	November	n/a	.doc .pdf	Hyatt Regency	La Jolla CA USA	Plenary
13	14th - 17th	September	n/a	.doc .pdf	Hilton	Dayton OH USA	Interim
12	6th - 9th	July	n/a	.doc .pdf	Radisson	Minneapolis MN USA	Plenary
11	11th - 14th	May	n/a	.doc .pdf	Holiday Inn	Leiden Nederlands	Interim
10	9th - 12th	March	n/a	.doc .pdf	Marriott	Irvine CA USA	Plenary
9	13th - 16th	January	n/a	.doc .pdf	Omni Europe	Chapel Hill NC USA	Interim
For Year 1991							
8	11th - 15th	November	n/a	.doc .pdf	Crown Sterling Suites	Ft. Lauderdale FL USA	Plenary
7	8th - 12th	September	n/a	.doc .pdf	Hyatt Regency	Palo Alto CA USA	Interim
6	8th - 11th	July	n/a	.doc .pdf	Hyatt Regency	Kauai HI USA	Plenary
5	6th - 9th	May	n/a	.doc .pdf	Marriott	Worcester MA USA	Interim
4	11th - 14th	March	n/a	.doc .pdf	Westin Resort	Hilton Head SC USA	Plenary
3	7th - 10th	January	n/a	.doc .pdf	Compri hotel	Gaithersburg MD USA	Interim
For Year 1990							
2	12th - 16th	November	n/a	.doc .pdf	Hyatt Regency	La Jolla CA USA	Plenary
1	10th - 14th	September	n/a	.doc .pdf	Holiday Inn	Oshawa ON Canada	Interim

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APPENDIX BP

Explanations for CR on 27.5.2.7 NDP feedback report

Date: 2017-03-06

Authors:

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Leonid Epstein	Huawei			
Avi Weitzman	Huawei			
Shimi Shilo	Huawei			
Yunbo Li	Huawei			

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Background (1)

- **It is well accepted that being able to get a very short simultaneous feedback from a high number of STAs (all STAs) improve the 11ax system and power efficiencies [1], [3]**
  - Many feedbacks require 1 bit: PS-Poll (power efficiency), Channel Availability (collisions avoidance)
  - Other feedbacks could be 2 bit. For example: “How many buffered Bytes for transmission: 0, 1 to 1000, 1000 to 5000, > 5000 ?”
  - A short simultaneous resource request feedback (1 or several bits) capable of supporting a high number of STAs is needed for an efficient UL MU simultaneous scheduling in addition to the existing (or enhanced) piggybacked buffer information
  - Less overhead for resource request feedback than polling method
  - Low and stable latency for resource request feedback, compared to possibly high and unpredictable latency with CSMA-CA in dense environments

Background (2)

- In Nov. 2016, added subclause 25.5.2.7 to the spec:

25.5.2.7 NDP feedback report procedure

The NDP feedback report is a mechanism for an HE AP to collect short feedbacks from a very high number of HE STAs, in an efficient manner. The feedbacks (e.g. resource requests) are sent without data payloads in response to a Trigger frame. The feedbacks are not for channel sounding. This mechanism is optional for non-AP STA.

2030

- But details of the NDP feedback mechanism are TBD

- Contribution 44r1 proposes a signaling technique for the NDP feedback mechanism that can handle a high number of STAs and is power and air time efficient
- This contribution proposes to define a new trigger type for NDP feedback report and the procedure for an HE non-AP STA to know, based on the trigger frame, if it can respond and what parameters to use to respond

Trigger frame proposal

- We propose to define a new trigger type for NDP feedback report
  - This is the cleanest solution, as specific common info field parameters are needed for this mechanism and as this mechanism should be generic and work for multiple types of feedbacks

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- We propose that this trigger type contains all the information so that:
  - STAs can know if they are scheduled
  - STAs can know on which allocation they can transmit their response, that allocation being unique
  - STAs can know what is the type of feedback that is requested and how many bits for the feedback

Proposed design for the trigger frame

- Use information in common info field and trigger dependent common info field.

2032

	Feedback type	Feedback size	Scheduling Type	GroupID	Starting STA	Probe request option	Target RSSI	Number of users per set of tones	Duplicate	Ressource request buffer threshold
Bits:	4	8		6	11	1	7	2	1	4

Trigger dependent common info field

Feedback types

- We propose to define types of feedback, and a field to identify the type
  - We define the resource request type
  - We can then easily define others

- For each feedback type, we can define and limit the modes of operation:
  - number of bits of feedback
    - For instance, if feedback type is resource request, it has to be a 1-bit feedback and the mapping is the following
    - For a 1-bit feedback, PHY design allows to have 3 states
      - a state with no-response
      - A state with a bit received with a value of 0
        - Defines a resource request for a small payload
      - A state with a bit received with a value of 1
        - Defines a resource request for a larger payload
  - Mode for selecting the scheduled users
    - Range of AIDs
    - GroupID

b0 Value	Description
0	Resource request with buffered bytes for transmission between 1 and "resource_request_buffer_threshold"
1	Resource request with buffered bytes for transmission above "resource_request_buffer_threshold"

2033

Feedback types

- With this solution, it is also possible to define multiple feedbacks
  - Some feedback type indexes are associated with a single pre-defined feedback
  - Some feedback type indexes can be associated with multiple pre-defined feedbacks
- For each index, there is a clear spec sub-section that describes how the bits are assigned to each feedback (including the number of bits) and how to encode them

2034

Scheduling the STAs with range of AID

- *If Scheduling type field is set to zero, the STAs are scheduled with a range of AIDs*
- The trigger frame identifies the group of STAs that can respond:
- This is done by defining a range of consecutive AIDs, by using:
  - Starting STA field in the trigger frame
  - And the parameters to know how many AIDs are scheduled (NAIDs)
- The STAs whose AID is between Starting STA and Starting STA + NAIDs are scheduled
  - The index of the STA AID compared to Starting STA is used to know the allocation
- This allows:
  - Unique allocation per AID
  - No need for assigning the allocation in a static manner with any other frame exchanges
  - Starting STA field allows to define different groups of STAs and target the AID range that associated STAs are using

2035

Scheduling the STAs with groupID

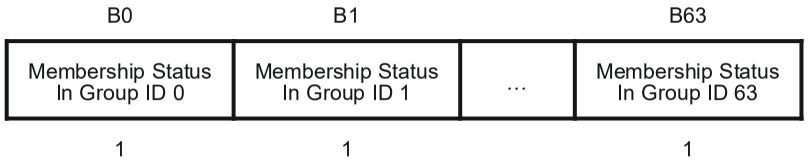
- *If Scheduling type field is set to 1, the STAs are scheduled with groupID*
- The trigger frame identifies the group of STAs that can respond:
  - The groupID field is set to a predefined group ID
  - The Starting STA field indicates at which index in the group the range of STAs are scheduled
  - STAs that belong to the group and whose index is between Starting STA and Starting STA + NAIDs are scheduled
  - The index of the STA in the groupID compared to Starting STA is used to know the allocation

2036

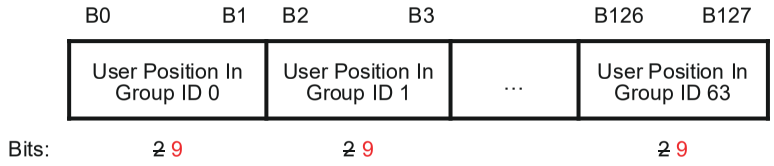
GroupID management

- We propose to enable group management as in 11ac
  - Frame unicasted to a STA to indicate to which group it is a member and the position of that STA in these groups.
  - 9 bits to indicate groups positions (instead of 2 with 11ac)

- For this, we propose to define a new HE Group ID Management frame (HE action frame)
  - It replicates 11ax groupID management
  - It includes Membership status array field already defined in 9.4.1.54
  - It includes a new HE user Position Array field (see below with the changes compared to User Position Array field used in 11ac)



Membership Status Array field



HE User Position Array field

Deriving parameters for transmission of the response (allocation)

- The response follows the UL MU operation
- The parameters of the trigger-based PPDU are derived from the trigger frame, and each AID has a unique combination of:
  - 242 RU allocation
  - Tone sets allocations within each RU
  - NUM_STS

2038

- These are calculated based on:
  - AID range option: index "AID-AID start" and parameters from trigger frame: feedback size, BW, number of users per set of tones
  - Group ID: index "STA position in the group – Index start" and parameters from trigger frame: feedback size, BW, number of users per set of tones

Deriving parameters for transmission of the response (allocation)

- STAs are assigned in order depending on their AID or GroupID index, starting from Starting STA:
  - Assign all frequency allocations on the whole bandwidth using SS1 first
    - 18 first STAs for a 20MHz BW
    - 36 first STAs for a 40MHz BW (if duplicate =0)
  - Then assign the following STAs using incremented SSs.
    - Next 18 STAs are assigned the same allocations but with SS2

- For BW > 20MHz:
  - If duplicate field is equal to 0, allocations in frequency are done in order on the whole bandwidth
    - 18 first STAs in the first 20MHz, 18 following STAs in the second 20MHz…
  - If duplicate field is equal to 1, the same set of users are assigned the same allocation in each 20MHz

2039

Example of user mapping

		Pm-c1	Pm-c2
	TS0	0	36
	TS1	1	37
242	…	…	…
RU1	TS18	17	53
	TS0	18	54
	TS1	19	55
242	…	…	…
RU2	TS18	35	71

40MHz – 2 P-matrix codes

		Pm-c1	Pm-c2
	TS0	0	72
	TS1	1	73
	…	…	…
RU1	TS18	17	89
	TS0	18	90
	TS1	19	91
	…	…	…
RU2	TS18	35	107
	TS0	36	108
	TS1	37	109
	…	…	…
RU3	TS18	53	125
	TS0	54	126
	TS1	55	127
	…	…	…
RU4	TS18	71	143

80MHz – 2 P-matrix codes

2040

Power control

- TargetRSSI is included in the trigger dependent common info field
- This enables power control with the same target for all STAs

2041

Specific mode for request for probe response

- *groupID* field set to the value of a groupID
- Associated STAs belonging to the signaled group ID shall respond as explained in previous slides.
- If the field "probe request option" is set to 1, it indicates that the last available allocation is assigned for non-associated STAs to **send single bit indicating probe request**.
  - This may be useful in HD/VHD deployments, such as stadiums or malls.
- The AP shall make sure that there is one allocation at the end of the bitmap not assigned to the STAs belonging to the groupID
- Non-zero value of the allocation assigned for probe requests in the received NDP feedback indicates that at least one STA requested a Probe Response frame.
- A single Probe Response shall be transmitted by the AP with the Addr1 set to Broadcast Address allowing all the non-associated STAs that transmitted the single-bit probe request to receive the probe response, preventing multiple APs from transmitting a probe-response.

2042

Summary

- We propose to progress on the definition of the NDP feedback report procedure
  - New trigger type
  - Parameters to identify the scheduled STAs
  - Parameters for scheduled STAs to derive the parameters for the response
  - Resource request type

2043

Straw Poll 2bis

- Which option do you prefer?
  - STAs scheduled by a NDP feedback report trigger frame variant with a feedback type set to “resource request” are identified by:
    - Option 1: a single mode: a range of AIDs
    - Option 2: 2 modes: a mode with a range of AIDs and a mode with groupID

2044

Straw Poll 2

- Do you agree to define a new NDP feedback report trigger frame variant

Strawpoll #3

- Do you agree to define that the STAs scheduled by a NDP feedback report trigger frame variant with a feedback type set to “resource request” are identified by
  - Option 1: one range of AIDs
  - Option 2: one or multiple ranges of AIDs

  Note: A range of AIDs is defined to be between AID start and AID start + NAIDs - 1. The trigger frame includes the AID start parameter and the needed parameters to calculate NAIDs

2046

2047

Straw Poll #3

- Do you agree that the RU allocation, RU tone set allocation and starting_STS_num for the NDP feedback response from an HE non-AP STA are calculated based on common parameters in the new NDP feedback report trigger frame variant. A “duplicate” field is defined in the new NDP feedback report trigger frame variant to indicate that STAs allocation are calculated on with a 20MHz bandwidth and are duplicated on the other 20MHz channels

2048

Straw Poll #4

- Do you agree that, for resource request feedback type:
  - The feedback size is set to “1 bit” only
  - The NDP feedback report trigger frame variant has a field called “resource request buffer threshold”
  - Scheduled STAs send a 0 for the NDP feedback report to indicate a resource request with buffer size below the “resource request buffer threshold”
  - Scheduled STAs send a 1 for the NDP feedback report to indicate a resource request with buffer size above the “resource request buffer threshold”

2049

Straw Poll #5

- Do you agree with the mode defined in slide 20 to allocate one allocation to all unassociated STAs to make a request for a transmission by the AP of a probe response.

2050

References

[1] IEEE 802.11-16/1367r0: NDP feedback report

[2] IEEE 802.11-15/1334r1: HE-LTF sequence design

[3] IEEE 11-17-0044-00-00ax-NDP short feedback design

2051

Straw Poll #4bis

- Which option do you prefer:
- The “resource request buffer threshold” allows to make 2 levels of resource requests, one for a payload smaller than the threshold, one for a payload higher than the threshold
  - Option 1: The “resource request buffer threshold” is indicated in the eliciting NDP feedback report poll trigger frame
  - Option 2: The “resource request buffer threshold” is indicated in an IE sent by the AP

2052

Annex – PHY design currently proposed

How to define the NDP feedback mechanism?

- UL MU transmission in response to a trigger frame
- Use frequency dimension for many small orthogonal allocations
- To avoid collisions, assign orthogonal allocations to users
- No data payload (NDP), STAs transmit energy on one orthogonal allocation for feedback
  - with spreading gain in time domain for PHY robustness
- For minimal changes to the current PHY, we propose
  - to use UL MU NDP simultaneous transmissions in response to a trigger frame
  - and to define orthogonal allocations (resource block RBs) to multiplex different STAs' feedbacks
  - These orthogonal allocations (RBs) are defined by using different frequency tone sets

2054

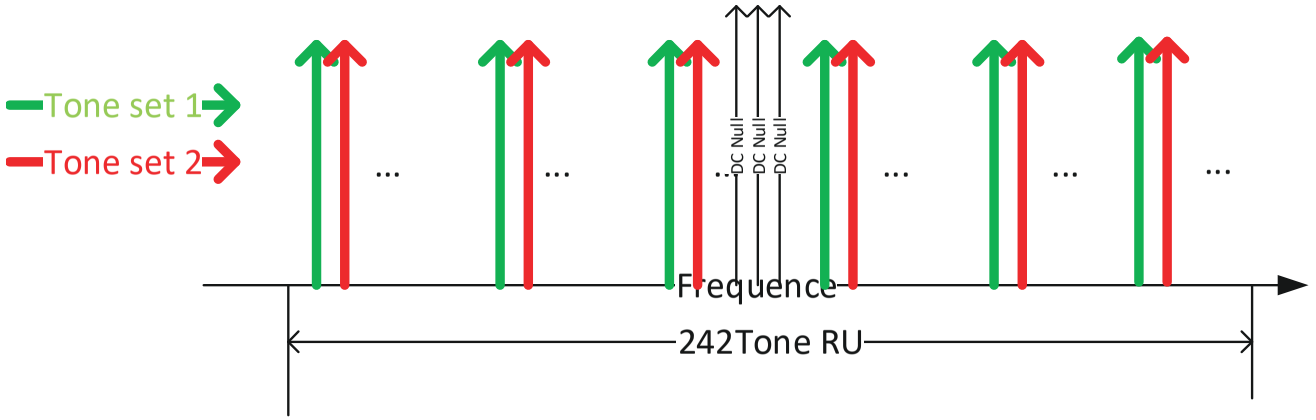
Overview of proposed signaling for Short Feedback

- For each 20MHz, the 242 tones RU are divided into 18 tones sets. Each tone set is made of 12 tones that are equally distributed over the RU (2 tones adjacent to each other)
- 1 allocation is made of 1 tone sets and a SS
  - 1 or multiple allocations can be uniquely assigned to one STA
  - 1 bit can be transmitted using 1 allocation (1 tone sets, made of 2 subsets of 6 tones)
    - 1 is sent by modulating to first tone subset and not the second one
    - 0 is sent by modumation the second subtone set and not the first one

- Channel estimation is not needed for detection
- AP and STAs must have a prior agreement on allocation assignement

2055

Proposed distribution of tones over 242 tones



2056

Tone set indices for each 20 MHz: I_{ULf}

P-Matrix 1x1	P-Matrix 2x2	P-Matrix 4x4	2 bit or 1 bit high power			
			1 bit			
Tone sets	Tone sets	Tone sets	b0 = 1	b0 = 0	b1 = 1	b1 = 0
1	1,2	1,2,3,4	-113,-77,-41,6,42,78	-112,-76,-40,7,43,79	-95,-59,-23,24,60,96	-94,-58,-22,25,61,97
2	:	:	-111,-75,-39,8,44,80	-110,-74,-38,9,45,81	-93,-57,-21,26,62,98	-92,-56,-20,27,63,99
3	:	:	-109,-73,-37,10,46,82	-108,-72,-36,11,47,83	-91,-55,-19,28,64,100	-90,-54,-18,29,65,101
4	:	:	-107,-71,-35,12,48,84	-106,-70,-34,13,49,85	-89,-53,-17,30,66,102	-88,-52,-16,31,67,103
5	:	:	-105,-69,-33,14,50,86	-104,-68,-32,15,51,87	-87,-51,-15,32,68,104	-86,-50,-14,33,69,105
6	:	:	-103,-67,-31,16,52,88	-102,-66,-30,17,53,89	-85,-49,-13,34,70,106	-84,-48,-12,35,71,107
7	:	:	-101,-65,-29,18,54,90	-100,-64,-28,19,55,91	-83,-47,-11,36,72,108	-82,-46,-10,37,73,109
8	:	:	-99,-63,-27,20,56,92	-98,-62,-26,21,57,93	-81,-45,-9,38,74,110	-80,-44,-8,39,75,111
9	17,18	33,34,35,36	-97,-61,-25,22,58,94	-96,-60,-24,23,59,95	-79,-43,-7,40,76,112	-78,-42,-6,41,77,113
10	19,20	37,38,39,40	-95,-59,-23,24,60,96	-94,-58,-22,25,61,97		
11	:	:	-93,-57,-21,26,62,98	-92,-56,-20,27,63,99		
12	:	:	-91,-55,-19,28,64,100	-90,-54,-18,29,65,101		
13	:	:	-89,-53,-17,30,66,102	-88,-52,-16,31,67,103		
14	:	:	-87,-51,-15,32,68,104	-86,-50,-14,33,69,105		
15	:	:	-85,-49,-13,34,70,106	-84,-48,-12,35,71,107		
16	:	:	-83,-47,-11,36,72,108	-82,-46,-10,37,73,109		
17	:	:	-81,-45,-9,38,74,110	-80,-44,-8,39,75,111		
18	35,36	69,70,71,72	-79,-43,-7,40,76,112	-78,-42,-6,41,77,113		

2057

Max # of STAs that can simultaneously send the UL Short Feedback

BW	Response = 1 bit			Response = 2 bit		
	$N_{ss} = 1$	$N_{ss} = 2$	$N_{ss} = 4$	$N_{ss} = 1$	$N_{ss} = 2$	$N_{ss} = 4$
20 MHz	18	36	72	9	18	36
40 MHz	36	72	144	18	36	72
80 MHz	72	144	288	36	72	144
160 MHz	144	288	576	72	144	288

2058

Straw Poll 1

- Do you agree to modify the spec following the comment resolutions in document 17-073r1?

2059

APPENDIX BQ

The Wayback Machine - https://web.archive.org/web/20161121130640/http://www.ieee802.org/11/Voters/voti…

IEEE P802.11 - WORKING GROUP MEMBERSHIP LISTS

This page shows information for IEEE P802.11 Voter, Potential Voter, Aspirant, Ex Officio members, and Ex Voters as of 2016-11-11.

Note that this information is updated only after each 802.11 face-to-face session or working group letter ballot series.

The fields in the membership list have the following meaning

Column	Description
Status	The Status column has the following meaning: • Voter - the member can vote • Potential voter - the member will have a voting token at the next face-to-face meeting and will become a voter after that meeting • Aspirant - the member has recorded attendance at one qualifying meeting • Ex Officio - the member is a voter by virtue of their membership of the IEEE 802 executive committee (EC) • Ex Voter - the member was previously a voter member of 802.11. If you wish to be recognized as an Ex Voter, and are not recorded below, please furnish evidence of former voter status to the WG officers. Members of all these status are entitled to join 802.11 email reflectors and submit documents to the 802.11 document server.
Expires	This column shows the meeting number (which is necessarily a Plenary meeting) and approximate starting date of the meeting after which a voting member's voting status expires, if member does not attend any qualifying meetings between now and the end of that meeting. For "potential voter" members, this shows the meeting after which their status reverts to "aspirant". For "aspirant" members, this shows the meeting after which they lose "aspirant" status (and disappear from this listing). An asterisk after a meeting number (e.g., "142* (2013-11-07)") indicates that a voting member needs to attend one additional meeting before the cited meeting, or they will lose their voting membership at the cited meeting, regardless of whether they attend it or not. This occurs when the last two meetings attended by the member were a plenary and the interim following it. NOTE--the "Expires" entry for some voting members is blank. This signifies that the chair has granted them voting membership without an attendance requirement.
Expired	The Expired column indicates the date when the member became an Ex Voter, if that is known.
Last Invalid Ballot	This column indicates the ballot number any last invalid or missed ballot (see http://www.ieee802.org/11/LetterBallots.shtml for the list of working group ballots). It is present only for Voter members. An invalid ballot is a failure to return a vote in a Working Group letter ballot series (i.e., the initial ballot and all recirculations for a particular project), or returning an invalid vote (voting "no" with

	no "must be satisfied" comments, or voting abstain for a reason other than "lack of expertise"). Invalid ballots are counted over up to the last three letter ballot series since the member gained Voter status. Transition arrangements: For ballots starting before August 2016, a voter's response to a letter ballot series is determined by their response to the initial ballot. After then, a voter's resonse will be determined when the letter ballot series is known to have terminated (i.e., when the project is approved by the EC, or meets the terms of conditional approval by the EC, to proceed to sponsor ballot). Voters who failed to meet the updated OM were granted a waiver of the most recent ballot they missed so that the change in the application of the rules resulted in no loss of voting membership. According to the 802.11 operations manual, a Voter must return a valid vote in 2 of the last 3 letter ballot series to maintain their status. This means the voter can miss or return an invalid vote at most 1 such ballot series. A Voter that has missed a ballot series and fails to return a valid vote by the end of the next letter ballot series loses their Voter status and becomes an Ex Voter.

Please verify your affiliation.

There is a specific requirement in the IEEE-SA policies and procedures that attendees at its meetings disclose their affiliation. Attendees failing properly to do so risk losing the privileges of membership (i.e., voting rights).

For information from the IEEE-SA on affiliations please click here**.**

Affiliation is not shown for Ex-Voters. For other membership statuses, if there is no affiliation beside your name or if the affiliation is incorrect please follow these instructions.

If you have any related questions, please contact Adrian P Stephens at adrian.p.stephens@ieee.org.

Member Status	Count
Aspirant	115
ExOfficio	12
Ex Voter	785
Potential Voter	32
Voter	359

Detail

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Abdallah	Ramy		Sony Corporation	Aspirant	162 (2017-	Hyatt Regency, Vancouver, BC,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					03-12)	Canada		
Aboba	Bernard			Ex Voter				
Aboulmagd	Osama	S	Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Abraham	Santosh	P	Qualcomm Technologies Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Abu Surra	Shadi	A	SAMSUNG	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Adachi	Tomoko		TOSHIBA Corporation	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Agardh	Kare		Sony Mobile Communications	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Aggarwal	Alok			Ex Voter			2009-07-20	
Agre	Jonathan	R		Ex Voter				
Ahn	Jaehyun			Ex Voter			2016-01-21	
Ahn	Jinsoo		Yonsei University	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ahn	Seung Hyeok		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ahn	Woojin		WILUS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Aiello	Roberto			Ex Voter			2015-07-28	
Aio	Kosuke		Sony Corporation	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Akhmetov	Dmitry		Intel Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Aldana	Carlos	H	Intel Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Alexander	Thomas			Ex Voter			2015-03-13	
Alimian	Areg			Ex Voter				
Alpert	Yaron		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Al-Taleb	Sajaa		telekom research and development/malaysia	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Amann	Keith			Ex Voter			2008-11-17	
Amini	Peiman			Ex Voter			2013-07-19	
An	Song-Haur		INDEPENDENT	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Andrade	Merwyn	B		Ex Voter				
Andren	Carl	F		Ex Voter				
Andrus	David	C		Ex Voter			2011-11-11	
Ansley	Carol		ARRIS Group	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Anton	Butch			Ex Voter				
Anwyl	Gary			Ex Voter			2010-03-22	
Aoki	Tsuguhide		TOSHIBA Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		217
Aramaki	Takashi			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Arita	Takashi			Ex Voter			2008-05-05	
Ariyavisitakul	Sirikiat Lek	L		Ex Voter			2014-11-07	
Armstrong	Lee	R	US Department of Transportation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Arndt	Manfred		Hewlett Packard Enterprise	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Arnett	Larry			Ex Voter				
Arnold	James		US Department of Transportation	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Asai	Yusuke		NTT	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ashley	Alex			Ex Voter			2013-07-19	
Asterjadhi	Alfred		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Atcitty	Torrey			Ex Voter			2012-05-01	
Au	Kwok Shum	S	Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Audeh	Malik			Ex Voter			2009-11-23	
Auluck	Vijay		Intel Corporation	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Aust	Stefan			Ex Voter			2015-11-13	
Avera	Drayton		Ratrix Technologies	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Awater	Geert	A	Qualcomm Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Azizi	Shahrnaz		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Babaei	Alireza			Ex Voter			2016-01-21	
Backes	Floyd			Ex Voter			2008-03-25	
Bagby	David		Calypso Ventures, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Bahr	Michael			Ex Voter			2012-07-20	
Bai	Fan			Ex Voter			2009-11-23	
Baik	Eugene		Qualcomm Incorporated	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Bain	David		TM Technologies	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Bajko	Gabor			Ex Voter			2016-03-18	
Baker	Dennis	J		Ex Voter			2008-12-21	
Banerjea	Raja			Ex Voter			2013-11-15	
Banerjee	Kaberi			Ex Voter			2011-03-18	
bang	saehee		LG ELECTRONICS	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Bansal	Amit			Ex Voter			2009-03-16	
Barber	Phillip			Ex Voter			2015-11-13	
Barber	Simon			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
baron	stephane		Canon Research Centre France	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Barr	David		Intel Corporation	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Barr	John	R		Ex Voter			2012-05-01	
Barriac	gwendolyn		Qualcomm Incorporated	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Barry	Kevin	M		Ex Voter				
Bartel	Charles	R		Ex Voter				
Basson	Gal			Ex Voter			2011-07-22	
Batra	Anuj		Apple, Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Bavafa	Moussa			Ex Voter			2009-05-05	
Baykas	Tuncer			Ex Voter			2013-03-04	
Baysal	Burak	H		Ex Voter				
Bei	Jianwei		Marvell Semiconductor, Inc.	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Benko	John	L		Ex Voter			2010-07-11	
Ben-Tovim	Erez			Ex Voter			2013-11-15	
Benveniste	Mathilde			Ex Voter			2009-11-23	
Berens	Friedbert		FBConsulting Sarl	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Berger	Christian		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Berkema	Alan			Ex Voter			2014-07-18	
Berry	Don			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Bhandaru	Nehru		Broadcom Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Bharadwaj	Arjun		Qualcomm Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Bhatt	Anirudh			Ex Voter			2012-05-01	
Bhukania	Bijoy			Ex Voter			2012-11-16	
Bims	Harry		Bims Laboratories, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Bjerke	Bjorn	A		Ex Voter			2009-03-16	
Black	Simon			Ex Voter				
Blanchard	Colin			Ex Voter			2008-05-05	
Blue	Scott			Ex Voter				
Bocus	Mohammud		Toshiba of Europe Ltd.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Boer	Jan			Ex Voter				
Booth	Ted			Ex Voter			2012-05-01	
Borges	Daniel			Ex Voter			2011-06-27	
Boucachard	Philippe			Ex Voter			2013-07-19	
Bourdoux	Andre		IMEC	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Brandt	David		Rockwell Automation	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Brasier	William	M		Ex Voter				
Braskich	Anthony			Ex Voter			2010-03-22	
Bray	Jennifer			Ex Voter				
Breit	Gregory			Ex Voter			2011-11-11	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Brennan	Joseph			Ex Voter			2010-03-22	
Britz	David			Ex Voter			2008-12-21	
Buffington	John		Itron Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Buga	Walter			Ex Voter			2010-07-16	
Bumiller	G			Ex Voter			2012-07-20	
Buttar	Alistair	G		Ex Voter			2008-02-13	
Bynum	Ann			Ex Voter			2016-03-18	
Cai	Lin			Ex Voter			2015-07-28	
CAI	YU			Ex Voter			2015-07-28	
Caillerie	Alain		Canon Research Centre France	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Calcev	George		Huawei R&D USA	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Calvert	Chris		Landis Gyr Group Worldwide	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Camps Mur	Daniel	C		Ex Voter			2012-05-01	
Cam-Winget	Nancy			Ex Voter			2010-07-16	
Canchi	Radhakrishna		Kyocera International, Inc.	ExOfficio	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Canpolat	Necati			Ex Voter			2011-07-22	
cao	fengming		Toshiba of Europe Ltd.	Aspirant	162 (2017-	Hyatt Regency, Vancouver, BC,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					03-12)	Canada		
Cao	Rui		Marvell Semiconductor, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Capar	Cagatay		Ericsson	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Cardona	Javier			Ex Voter			2010-03-22	
Cariou	Laurent		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Carlo	James			Ex Voter			2008-03-25	
Carney	William		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Carson	Pat			Ex Voter				
Centonza	Angelo			Ex Voter			2008-03-25	
Cha	Jaesun			Ex Voter			2013-07-19	
Chair	Ricky		Airgain	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Challans	Romana			Ex Voter			2013-03-22	
CHAMBELIN	Philippe			Ex Voter			2012-10-31	
Chan	Douglas	S		Ex Voter			2009-11-23	
Chang	Kapseok			Ex Voter			2011-07-22	
Chang	Kuor-Hsin			Ex Voter			2015-03-13	
CHANG	SANGHYUN		SAMSUNG ELECTRONICS	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Chang	Soo-Young		California State University, Sacramento (CSUS)	Voter	166* (2017-	Caribe Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Chang	Xin			Ex Voter			2014-07-08	
Chaplin	Clint	F	Imagicon	ExOfficio				
Chen	Bin			Ex Voter			2013-07-19	
Chen	Jiamin		HUAWEI	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Chen	Jiunn-Tsair			Ex Voter			2010-03-22	
Chen	Jixin			Ex Voter			2014-05-09	
CHEN	KWANG-CHENG		National Taiwan University	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Chen	Lidong		NIST	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Chen	Qian			Ex Voter			2014-11-07	
CHEN	Rory			Ex Voter			2008-02-13	
Chen	Spark		ARRIS Group	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Chen	Teyan		Huawei Technologies Co. Ltd	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
CHEN	Xi			Ex Voter			2014-03-21	
Chen	Xiaogang		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Chen	Ye			Ex Voter				
Chen	Yi-Ming			Ex Voter				
Cheng	Hong			Ex Voter			2008-05-05	
Cheng	Paul		MediaTek Inc.	Voter	164 (2017-	Estrel Hotel and Convention		