UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., AND
SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioners,

v.

HANNIBAL IP, LLC,
Patent Owner.

U.S. Patent No. 11,057,896
U.S. Patent No. 11,641,661
Case Nos. 2025-01187, 2025-01190

**DECLARATION OF FRIEDHELM RODERMUND
IN SUPPORT OF PETITIONS FOR *INTER PARTES* REVIEW OF
U.S. PATENT NOS. 11,057,896 AND 11,641,661**

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I, Friedhelm Rodermund, do hereby declare as follows:

I. INTRODUCTION AND ENGAGEMENT

1. I have been retained in this matter by the Petitioner to provide testimony regarding the standard business practices of 3rd Generation Partnership Project ("3GPP") for record keeping and publishing technical specifications, change request proposals, reports, and other documents developed during the course of standards activities carried out by 3GPP and the European Telecommunications Standards Institute ("ETSI").

2. I have been asked to provide my opinions regarding the authenticity and dates of public accessibility of the following 3GPP documents:

- TDoc R1-1808197, which represents a 3GPP document with the title "Maintenance for Reference signals and QCL" (hereinafter "R1-1808197") (Ex. 1011)
- TDoc R1-1809758, which represents a 3GPP document with the title "Maintenance for Reference signals and QCL" (hereinafter "R1-1809758") (Ex. 1016)
- TDoc R1-1808490, which represents a 3GPP document with the title "Remaining issues on downlink control channel" (hereinafter "R1-1808490") (Ex. 1017)

- TDoc R1-1808330, which represents a 3GPP document with the title "Remaining issues on beam management and beam failure recovery" (hereinafter "R1-1808330") (Ex. 1024)
- TDoc R1-1810366, which represents a 3GPP document with the title "Maintenance for beam management" (hereinafter "R1-1810366") (Ex. 1015)
- TDoc R1-1810751, which represents a 3GPP document with the title "Remaining Issues on Beam Management" (hereinafter "R1-1810751") (Ex. 1006)
- TDoc R1-1810369, which represents a 3GPP document with the title "Remaining issues on physical downlink control channel" (hereinafter "R1-1810369") (Ex. 1022)
- TDoc R1-1811634, which represents a 3GPP document with the title "Text proposals for Beam management" (hereinafter "R1-1811634") (Ex. 1023)
- TDoc R1-1811820, which represents a 3GPP document with the title "Offline summary for PDCCH structure and search space" (hereinafter "R1-1811820") (Ex. 1025)

- TDoc R1-1810256, which represents a 3GPP document with the title "Remaining issues on downlink control channel" (hereinafter "R1-1810256") (Ex. 1026)
- TDoc R1-1810520, which represents a 3GPP document with the title "Open issues and corrections for NR PDCCH." (hereinafter "R1-1810520") (Ex. 1027)
- 3GPP TS 38.214 V15.3.0 (2018-09) ("3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical layer procedures for data (Release 15)") (hereinafter "TS 38.214 V15.3.0") (Ex. 1012)
- 3GPP TS 38.211 V15.3.0 ("3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical channels and modulation (Release 15)" (hereinafter "TS 38.211 V15.3.0") (Ex. 1018)
- 3GPP TS 38.213 V15.3.0 ("Technical Specification Group Radio Access Network; NR; Physical layer procedures for control (Release 15)") (hereinafter "TS 38.213 v15.3.0") (Ex. 1019)
- 3GPP TS 38.321 V15.3.0 ("3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Medium

Access Control (MAC) protocol specification (Release 15)") (hereinafter "TS 38.321 V15.3.0") (Ex. 1020)

- 3GPP TS 38.331 V15.3.0 ("3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Radio Resource Control (RRC) protocol specification; Stage 2 (Release 15)" (hereinafter "TS 38.331 V15.3.0") (Ex. 1021)

3. As an ETSI Project Manager and Secretary, from June 1998 to December 2004, I have personal knowledge of 3GPP's standard business and records keeping practices. I continued following 3GPP's work ever since. Thus, based on my experience, personal knowledge, and review of 3GPP's business records, I am able to testify regarding the authenticity of certain documents published by 3GPP and the timing of their publication.

4. I am being compensated for my time spent on this matter at my usual rate of €500 per hour. My fee is not contingent on the outcome of this or any matter, or on the content of any of the testimony I give in this declaration. I have no financial interest in the Petitioner.

5. I have been informed that Hannibal IP, LLC ("Hannibal" or "Patent Owner") is the current assignee of U.S. Patent Nos. 11,057,896 ("the '896 Patent") and 11,641,661 ("the '661 Patent"). I have no financial interest in the Patent Owner or the '896 Patent or the '661 Patent.

6. In forming my opinions, I have considered the cited exhibits, including the exhibits identified in Appendix B, and my academic and professional training and experience in the field of wireless communications and standards development as described herein.

II. BACKGROUND AND QUALIFICATIONS

7. I have more than 25 years of experience working with standards development organizations including 3GPP, ETSI, and the Open Mobile Alliance ("OMA"). I have particular experience with the development of standards related to cellular telecommunications, including the standards for the Universal Mobile Telecommunications System ("UMTS"), Long Term Evolution ("LTE"), and 5G, which are all standards developed by the 3GPP.

8. I attended the University of Technology Aachen in Aachen, Germany, where I performed graduate studies in Electrical Engineering with a focus on telecommunications technologies ("Dipl.-Ing. TH" degree). I also attended the University of Technology Trondheim in Trondheim, Norway, and completed my Diploma thesis, "Design of a dual processor computer for digital signal processing in power electronics," in 1993.

9. From December 1993 to June 1998, I worked at Mannesmann Mobilfunk as a System Engineer and Project Manager in Quality Assurance and Technical Standards. One of my responsibilities was to ensure by managing and

performing related test activities that cellular network equipment was compatible with the Global System for Mobile Communications ("GSM") standard developed by ETSI. During that time, I also started working as a standards delegate. I attended my first ETSI meeting in 1996 (although I was already following ETSI developments from 1992 during my studies).

10. From June 1998 to December 2004, I worked at ETSI as a project manager for various ETSI Special Mobile Group ("SMG") and 3GPP working groups. First, I served as a secretary of SMG4 "Data Services" and SMG8 "Base Stations Testing." Then, as a project manager with the ETSI Mobile Competence Center ("MCC"), I supported establishing 3GPP as the new international standards development organization for cellular telecommunications. One of my roles was acting as Secretary for 3GPP's Technical Specifications Group Terminals, Working Group ("T2"), the group which played a leading role in the creation of standards for Multimedia such as the Multimedia Messaging Service ("MMS").

11. Later, I was a secretary of the highest-level Technical Specifications Group Terminals which was besides other things responsible for the development of test specifications including tests for the radio interface.

12. I edited all technical specifications produced by my working groups and presented results to the parent body for approval. I attended all meetings (apart from some sub-working group meetings) and was also responsible for compiling meeting

reports, for handling all the meeting documents, and managing the work plan. It was also my role to guide the groups and to advise the chairmen regarding 3GPP working methods and procedures including document handling, and to make sure delegates were aware of their company's obligations under the 3GPP Intellectual Property Rights policy.

13. As part of my responsibilities at ETSI, I acted as a 3GPP custodian of records by personally managing 3GPP's public File Transfer Protocol (FTP) folders, which I used to make publicly accessible various 3GPP documents, including versions of 3GPP specifications, technical reports, liaison statements, change requests, contributions, agendas, meeting reports, and other 3GPP documents from my working groups. I am also knowledgeable about document management practices used in other working groups and within 3GPP in general with regard to making documents publicly accessible through the same public FTP server of 3GPP.

14. Since I left ETSI as a staff member in 2005, I have been continuously involved in standardization activities, including with OMA, ETSI, and 3GPP. Since 2017, I also have been attending the ETSI Intellectual Property Rights ("IPR") Special Committee, which is responsible for the maintenance of the ETSI IPR Policy.

15. After I left ETSI, I worked from January 2005 to October 2014 at Vodafone, first as a Project Manager for Mobile Broadcast Standards, and then as

Vice Chairman of the Device Management working group of the Open Mobile Alliance, and then as a Senior Standards Strategist, all with responsibilities as described on my curriculum vitae. At Vodafone, I was deeply involved in standards work with ETSI and 3GPP and other standards setting organizations, including as a delegate to 3GPP SA1 "Services." As part of my responsibilities, I attended selected 3GPP meetings, submitted documents to 3GPP, used 3GPP resources (including 3GPP's FTP server) extensively, and remained knowledgeable about 3GPP policies and procedures with regard to document management and public accessibility. I was also involved in the creation of patents, defense activities related to patent litigations, and patent evaluation, mostly in the context of standards development.

16. Since leaving Vodafone in 2014, I have performed consulting work regarding Internet of Things (IoT) and Machine to Machine (M2M) technology and standards, first at Friedhelm Rodermund Consulting and then as the Founder and Director of IOTECC GmbH. In connection with my work, I regularly deal with standards such as OMA's Lightweight M2M (LwM2M) and 3GPP's LTE, Narrowband IoT (NB-IoT) and 5G standards. And I have extensively used 3GPP resources and have remained knowledgeable about 3GPP policies and procedures with regard to document management and public accessibility.

17. I also provide consulting services related to patents, in particular around 3GPP Standard Essential Patents ("SEPs"), and I have worked as an expert witness

on a number of occasions. I continue to closely follow the maintenance of the ETSI IPR Policy as a delegate to the ETSI IPR Special Committee. Furthermore, I am conducting a seminar on SEPs and the Internet of Things at the Technical University of Ilmenau, Germany.

18. At the time of writing this declaration, I am following – including attending selected meetings – the following standards committees: ETSI oneM2M, ETSI IPR Special Committee, OMA, and 3GPP.

19. A copy of my curriculum vitae, which includes a detailed description of my experience and education, is attached as Appendix A. A list of litigation matters on which I have worked over the last five years is also included in my curriculum vitae.

III. SUMMARY OF MY OPINIONS

20. It is my opinion that Ex. 1011 is an authentic copy of 3GPP T-doc R1-1808197 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by August 11, 2018, at the latest.

21. It is my opinion that Ex. 1016 is an authentic copy of 3GPP T-doc R1-1809758 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by August 22, 2018, at the latest.

22. It is my opinion that Ex. 1017 is an authentic copy of 3GPP T-doc R1-1808490 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by August 11, 2018, at the latest.

23. It is my opinion that Ex. 1024 is an authentic copy of 3GPP T-doc R1-1808330 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by August 11, 2018, at the latest.

24. It is my opinion that Ex. 1015 is an authentic copy of 3GPP T-doc R1-1810366 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by September 29, 2018, at the latest.

25. It is my opinion that Ex. 1006 is an authentic copy of 3GPP T-doc R1-1810751 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by September 29, 2018, at the latest.

26. It is my opinion that Ex. 1022 is an authentic copy of 3GPP T-doc R1-1810369 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by September 29, 2018, at the latest.

27. It is my opinion that Ex. 1023 is an authentic copy of 3GPP T-doc R1-1811634 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by October 1, 2018, at the latest.

28. It is my opinion that Ex. 1025 is an authentic copy of 3GPP T-doc R1-1811820 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by October 9, 2018, at the latest.

29. It is my opinion that Ex. 1026 is an authentic copy of 3GPP T-doc R1-1810256 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by September 29, 2018, at the latest.

30. It is my opinion that Ex. 1027 is an authentic copy of 3GPP T-doc R1-1810520 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by September 29, 2018, at the latest.

31. It is my opinion that Ex. 1012 is an authentic copy of 3GPP TS 38.214 V15.3.0 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by October 1, 2018, at the latest.

32. It is my opinion that Ex. 1018 is an authentic copy of 3GPP TS 38.211 V15.3.0 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by September 27, 2018, at the latest.

33. It is my opinion that Ex. 1019 is an authentic copy of 3GPP TS 38.213 V15.3.0 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by October 1, 2018, at the latest.

34. It is my opinion that Ex. 1020 is an authentic copy of 3GPP TS 38.321 V15.3.0 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by September 25, 2018, at the latest.

35. It is my opinion that Ex. 1021 is an authentic copy of 3GPP TS 38.331 V15.3.0 that was uploaded and made available via the 3GPP FTP server to 3GPP delegates and the general public by September 26, 2018, at the latest.

IV. PUBLICATION OF 3GPP SPECIFICATIONS AND RELATED DOCUMENTS

A. General Practices

36. Unless otherwise noted, the foregoing and following is an accurate description of 3GPP general practices from 1998 to the present, including in 2018, regardless of whether I use the present or past tense to describe those practices.

37. 3GPP was established in 1998 by a group of telecommunications standard development organizations from Japan, Korea, China, Europe, and the United States to jointly develop worldwide standards for mobile telecommunications. Today, 3GPP consists of seven partners: Association of Radio Industries and Businesses, Japan ("ARIB"), Alliance for Telecommunications Industry Solutions, USA ("ATIS"), China Communications Standards Association ("CCSA"), European Telecommunications Standards Institute ("ETSI"),

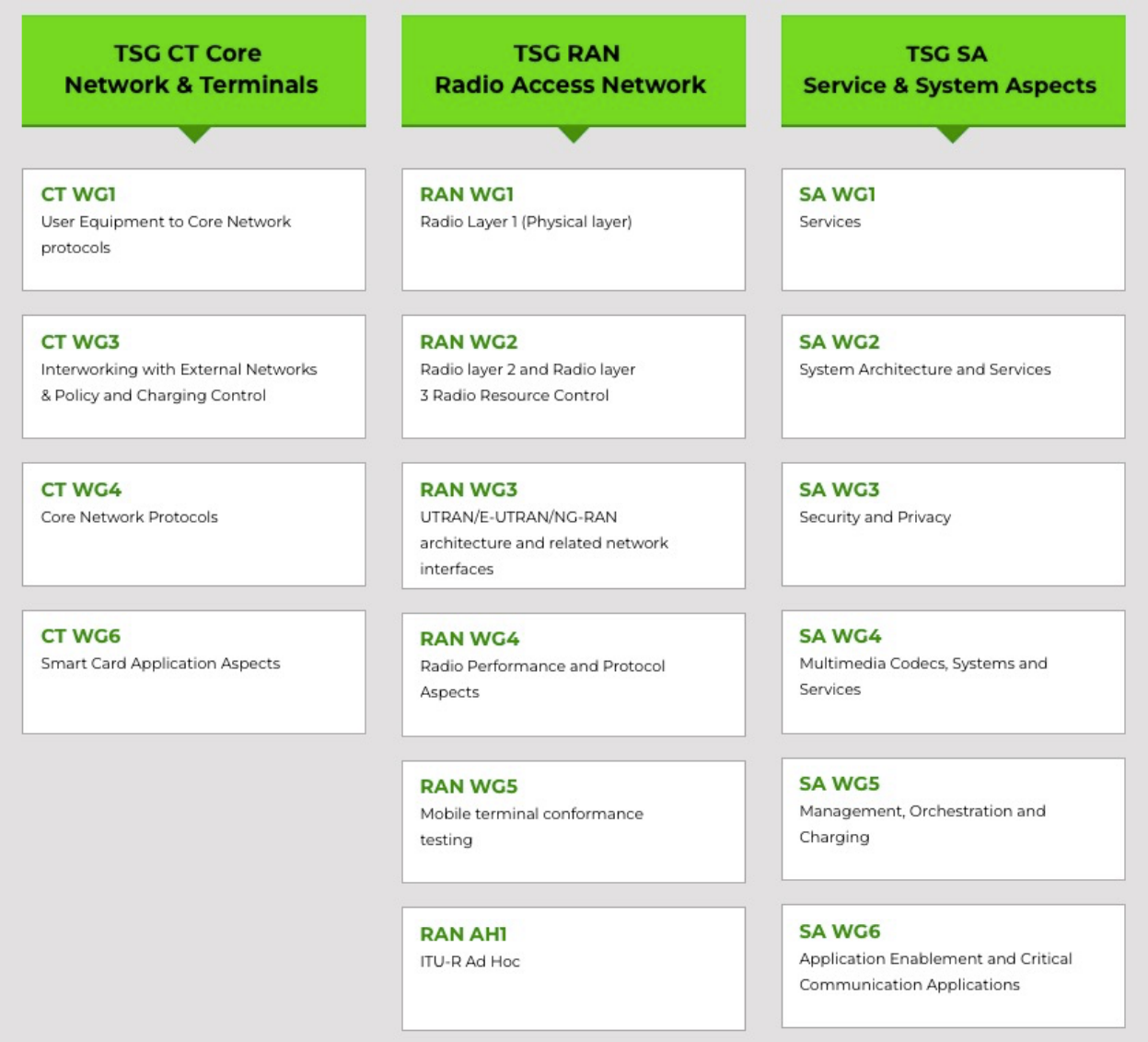
Telecommunications Standards Development Society, India ("TSDSI"), Telecommunications Technology Association, Korea ("TTA"), and Telecommunication Technology Committee, Japan ("TTC"). In addition to being one of the founding partners, ETSI hosts the Mobile Competence Centre ("MCC"), which provides administrative and technical support for the day-to-day work of 3GPP. Furthermore, ETSI manages 3GPP's IT services such as the 3GPP website, FTP server, and email exploders.

38. 3GPP is the world's leading organization for developing and maintaining cellular telecommunications standards, which it has done since its foundation in 1998. As noted above and in my curriculum vitae, I began working for 3GPP, as part of my work at ETSI, the European-based organizational partner of 3GPP.

39. In the ordinary course of its regularly conducted business activities, and pursuant to its standard business practices, 3GPP publishes technical specifications, proposals, reports, and other documents related to the development of cellular telecommunications standards. Such documents are published for the purposes of discussion and establishment of industry standards for cellular telecommunications. This has been 3GPP's ordinary course of business since when I began working at ETSI in 1998.

40. In the ordinary course of 3GPP's regularly conducted business activities, and pursuant to its standard business practices, all draft technical specifications, proposals, reports, and other temporary documents to be discussed or considered in relation to 3GPP's telecommunications standards activities were, and continue to be, assigned a temporary document number and made publicly available, including on the FTP server associated with the 3GPP website, currently residing at ftp.3gpp.org. Such documents are referred to as "TDocs." Final versions of the technical specifications also were, and continue to be, publicly available from that same FTP server.

41. The names and the structure of 3GPP working groups, as of today, can be found at https://www.3gpp.org/3gpp-groups (reproduced below):



42. Each Technical Specification Group (TSG) or Working Group adopts a structured numbering system for the documents associated with their meetings, and those systems typically follow a consistent numbering system as shown in the following example: xminnzzzz. The numbering system normally comprises five logical elements: (1) x: a single letter corresponding to the TSG; wherein in 2018 x was one of R (Radio Access Network), C (Core and Terminals), or S (Service and

System Aspects); (2) m: a single character corresponding to the Working Group identity (typically 1, 2, 3, etc.) or, in the case of the TSG itself, the letter "P"; (3) i: normally the hyphen character "-"; (4) nn: the calendar year of the meeting to which the document was submitted; and (5) zzzz: a running number (some working groups use 5 digits).

43. In the ordinary course of 3GPP's regularly conducted business activities, and pursuant to its standard business practices, from December 1998 onwards, 3GPP published all of its TDocs and all final versions of its technical specifications on its FTP server, which has always been easily and publicly accessible from its website and currently resides at ftp.3gpp.org.

44. As early as December 1998, including in 2018, 3GPP's FTP server was freely accessible to the general public with no login, password, or membership requirement.

45. By 1999, at least 100 companies were members of 3GPP (719 companies by December 2020), ranging from Bosch to Ericsson to Nokia to Samsung and generally including those interested in the discussion, creation, and adoption of cellular telecommunications standards, including UMTS. Each of these companies typically delegated multiple individuals to regularly participate in 3GPP meetings. Further, pursuant to 3GPP's standard business practices, 3GPP working groups sent emails notifying these individuals as soon as new or additional

documents had been uploaded to 3GPP's FTP server. Thus, not only did the general public have access to the documents on the FTP server, but some of the most interested members of the public—those working to develop standards for cellular telecommunication or working to implement the standards—were personally informed of their availability by email.

46. Based on my experience with 3GPP and the telecommunications industry, I would expect any person implementing a cellular network or device, e.g., an LTE or 5G network, to consult the corresponding specifications on the 3GPP FTP server, as well as other related documents. The whole purpose of 3GPP creating and making these specifications available was so that engineers and other individuals would have ready access to them when developing and implementing cellular networks and devices.

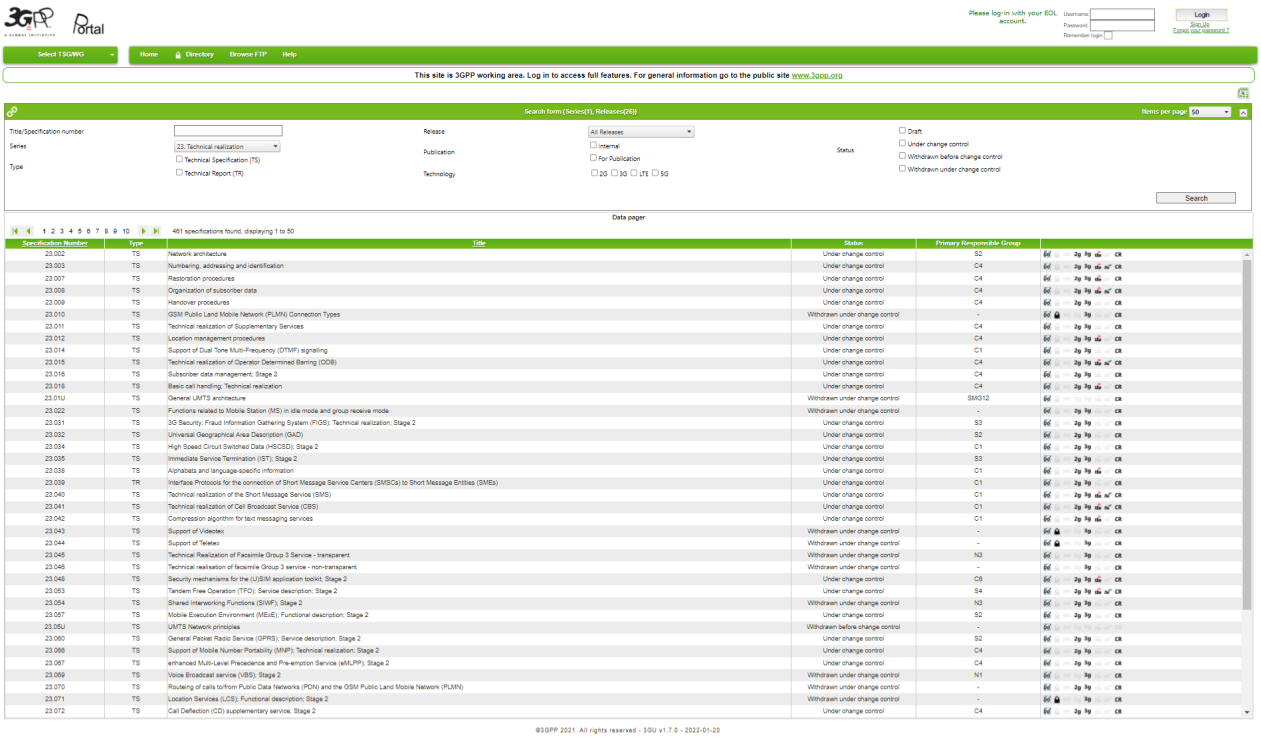
47. Since 3GPP was created, its FTP server was well-known to persons in the cellular telecommunications industry as a source of public information regarding industry standards and technological advances.

48. 3GPP specifications bear a specification number consisting of four or five digits, e.g., 09.02 or 29.002. The first two digits define the specification series which are defined to group the different aspects of the 3GPP system into, e.g., requirements, service aspects, radio aspects codecs, security aspects, and test specifications. The series digits are followed by two additional digits for the 01 to

13 series or three further digits for the 21 to 55 series. The subjects of the individual specification series are explained on 3GPP's website at https://www.3gpp.org/specifications-technologies/specifications-by-series, and reproduced below.

Subject of specification series	3G and beyond / GSM (R99 and later)	GSM only (Rel-4 and later)	GSM only (before Rel-4)
Requirements	21 series	41 series	01 series
Service aspects ("stage 1")	22 series	42 series	02 series
Technical realization ("stage 2")	23 series	43 series	03 series
Signalling protocols ("stage 3") - user equipment to network	24 series	44 series	04 series
Radio aspects	25 series	45 series	05 series
CODECs	26 series	46 series	06 series
Data	27 series	47 series (none exists)	07 series
Signalling protocols ("stage 3") -(RSS-CN) and OAM&P and Charging (overflow from 32.- range)	28 series	48 series	08 series
Signalling protocols ("stage 3") - intra-fixed-network	29 series	49 series	09 series
Programme management	30 series	50 series	10 series
Subscriber Identity Module (SIM / USIM), IC Cards. Test specs.	31 series	51 series	11 series
OAM&P and Charging	32 series	52 series	12 series
Access requirements and test specifications		13 series [1]	13 series [1]
Security aspects	33 series	(2)	(2)
UE and (U)SIM test specifications	34 series	(2)	11 series
Security algorithms [3]	35 series	55 series	(4)
LTE (Evolved UTRA), LTE-Advanced, LTE-Advanced Pro radio technology	36 series		
Multiple radio access technology aspects	37 series		
Radio technology beyond LTE	38 series		

49. Following a link for a series (e.g., "23 series" link) leads to a 3GPP web page providing access to all specifications in a series, as shown by the screenshot below:



50. As another example of a series, the LTE radio standard is covered in the "36 series" and is further subdivided into separate sections or specifications. The LTE radio specification series starts at TS 36.101 and ends at TR 36.978. Excluding withdrawn specifications, the LTE standard consists of more than 250 specifications.

51. As another example of a series, the 5G New Radio (NR) standard is covered in the "38 series" and is further subdivided into separate sections or specifications. Selecting the "38 series" link on the website shown in paragraph 34 leads to the 3GPP portal (portal.3gpp.org) page for all of the 38 series technical specifications.[1] These 5G NR specifications start at TS 38.101 and end at TR 38.922. Excluding withdrawn specifications, the 5G NR standard consists of more than 140 specifications.

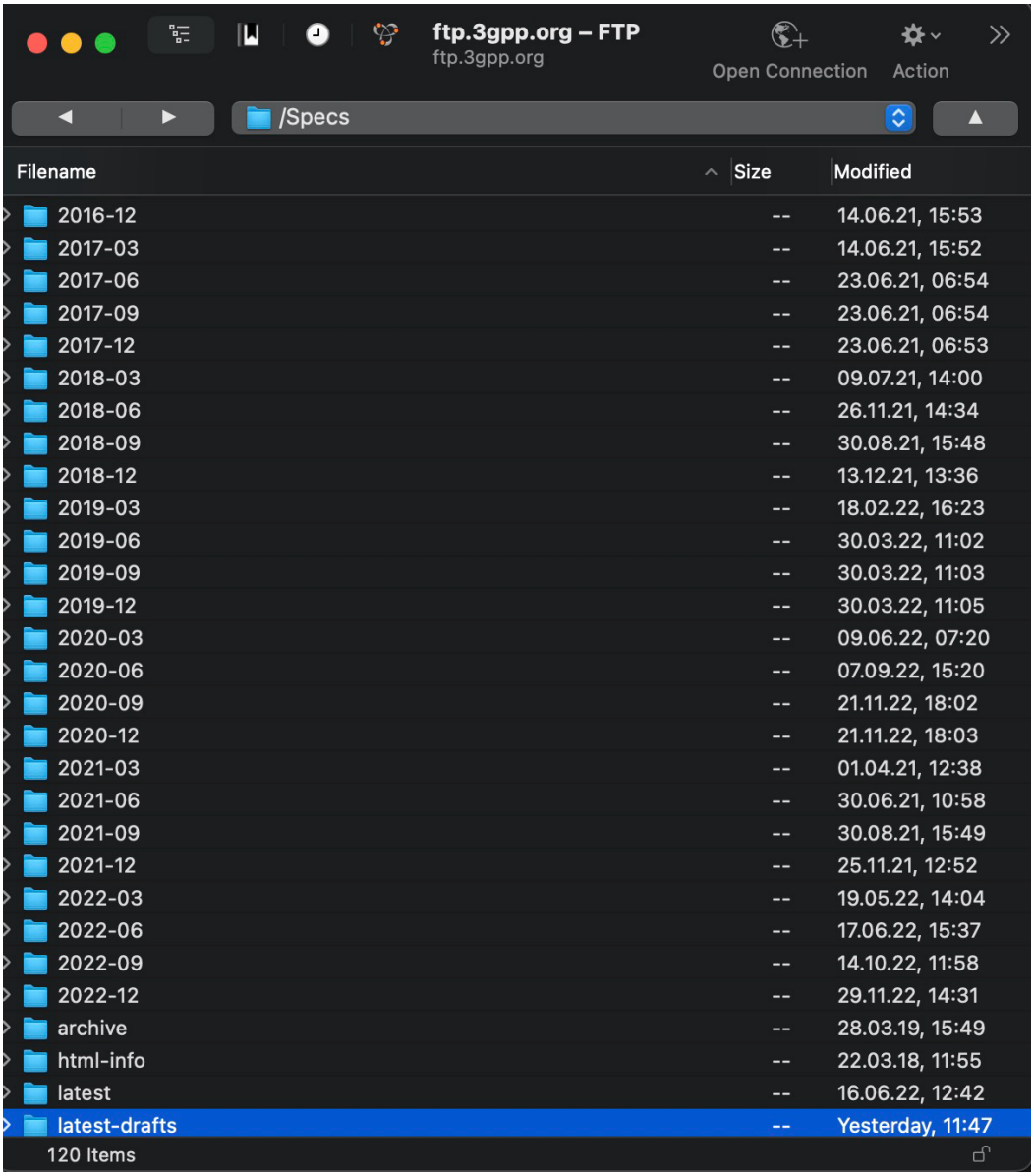
52. Each LTE or 5G specification can span from a few pages to hundreds of pages. One full version of the LTE or 5G standard is massive, spanning tens of thousands of pages across the particular series of technical specifications.

53. In the ordinary course of 3GPP's regularly conducted business activities, and pursuant to its standard business practices, TDocs are usually uploaded to 3GPP's FTP server and website before the meeting where they are to be discussed. Documents created or revised during the course of a meeting are normally uploaded at the latest during the week following the meeting (e.g., the meeting report of the meeting is usually published for review during the week following the meeting).

[1] https://portal.3gpp.org/Specifications.aspx?q=1&series=45&releases=all&draft=False&underCC=False&withACC=False&withBCC=False&numberNYA=False

54. In the ordinary course of 3GPP's regularly conducted business activities, and pursuant to its standard business practices, 3GPP maintains archives that include different versions of the specifications, as well as email communications to its membership, including emails announcing the uploading of new or additional documents to 3GPP's FTP server. These archives are created at the time the emails are initially sent.

55. 3GPP specifications almost always are duplicated in at least two and sometime more locations on the FTP server. One location corresponds to a "snapshot" of the specifications corresponding to a particular plenary meeting cycle—for instance, the 2018-12 snapshot contains a snapshot of numerous specifications after the December 2018 3GPP plenary meetings. The second location is an "archive" that contains all versions over time for a given specification. The screenshot below shows an excerpt of the "Spec" folder at ftp.3gpp.org:



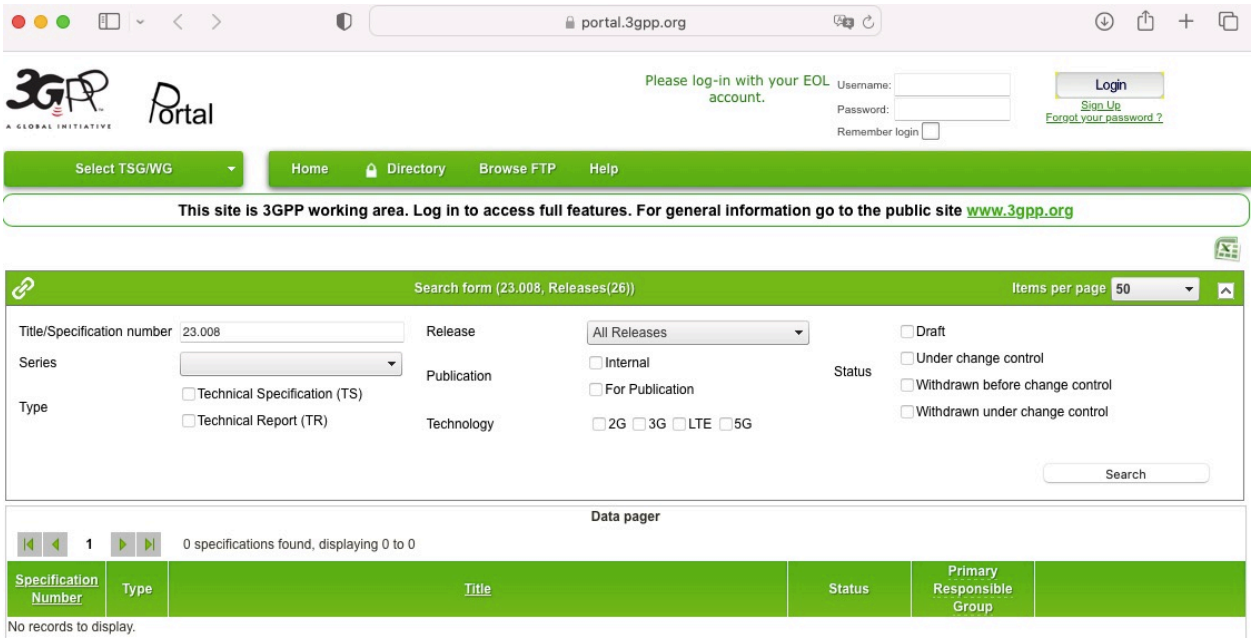
56. While 3GPP aims to upload the updated specifications to both locations at the same time, occasionally there may be a small difference in the upload date, and thus the date stamp, for the same specification uploaded to the two locations. Additionally, specifications which are not yet approved (so called "draft" specifications) are presented as TDocs at working group and at plenary meetings (as

soon as the working group decides to submit the specification to the plenary meeting for information or approval). In many cases, the TDocs are also distributed on the email exploder of the working group prior to the meeting, making the TDocs available to all those subscribed to the email distribution list.

57. The timestamp on 3GPP's FTP server shows the date when the document was uploaded the last time. Thus, the timestamp shows the latest possible date the document became publicly available and accessible on 3GPP's FTP server. The given document might have been available earlier and the original timestamp might have been overwritten because the document was uploaded again. According to my experience, this is something which happened occasionally. Thus, the FTP timestamp is reliable as the latest possible upload date but it may not always represent the first upload of a document to the FTP server.

58. An additional means of accessing 3GPP documents including TDocs and specifications is the 3GPP portal. *See* https://portal.3gpp.org/Specifications.aspx. 3GPP preserves the posted document indefinitely on its server for future reference. *Id.* As detailed below, the 3GPP website provides the date that a particular version of a technical specification was uploaded, using the date convention YYYY-MM-DD. The 3GPP portal also provides a login function to unlock full features, however, login is not required for searching and downloading technical specifications. Based on my personal

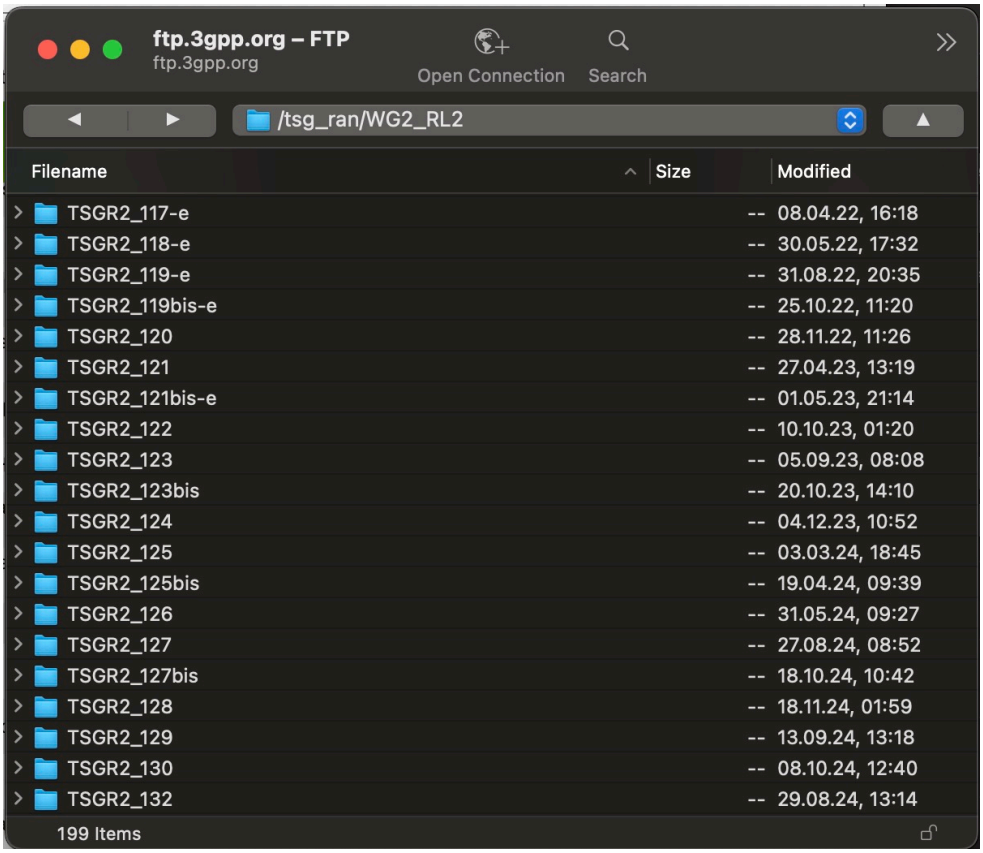
experience, throughout the 2018 timeframe, anyone interested in a particular 3GPP specification could search the 3GPP portal to find and download the latest version of a technical specification using the 3GPP portal in substantially the same manner as they would today:



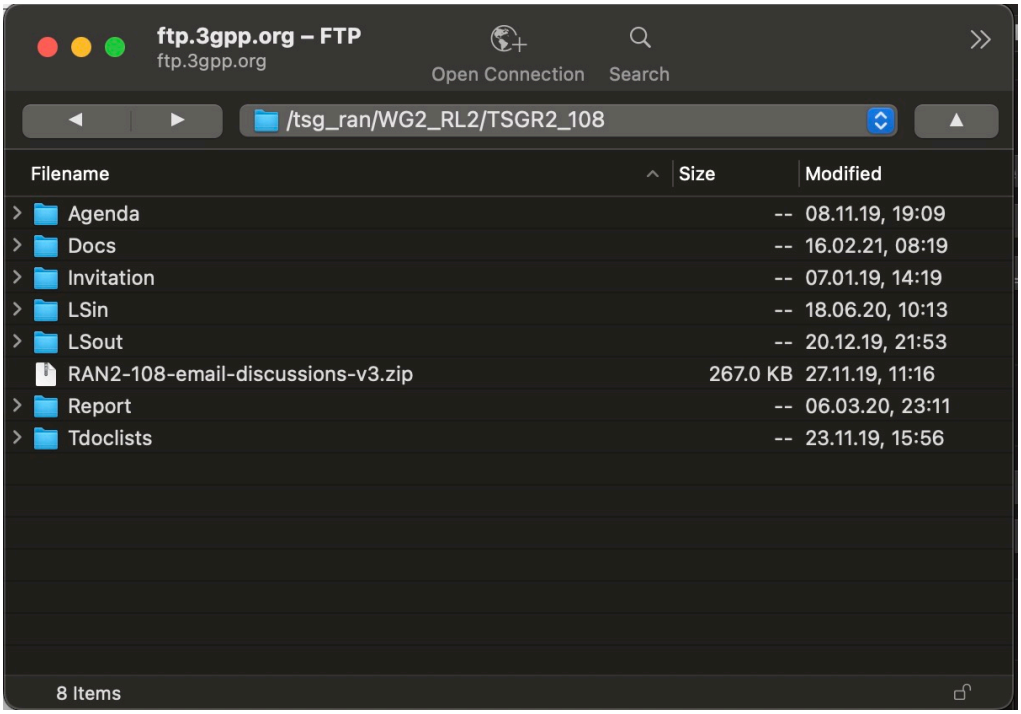
https://portal.3gpp.org/Specifications.aspx; *see, e.g.,* 2015 internet archive https://web.archive.org/web/20150924200802/https://portal.3gpp.org/.

59. 3GPP's working practice to store their documents on its FTP server, as described above, has not changed over time. Starting from the first 3GPP meetings in 1998 until present, all WGs and plenary meetings are represented by dedicated meeting folders on the FTP server. These meeting folders include the documents discussed at the meetings. Both the folders and the documents are accessible to the public. Almost every week, a new meeting folder with the respective documents is

added. As an example, the screenshot below shows an extract of the RAN WG2 folder named "WG2_RL2" showing that every meeting has a dedicated number:



60. As an example, the screenshot below shows the typical structure of a meeting folder including the most important folders "Agenda", "Docs" (includes all meeting contributions), and "Report" (includes the meeting report):



61. In addition to the plenary and WG meeting folders, and some other folders, there is also the "Specs" folder, which holds all 3GPP specifications including the aforementioned "snapshot" and archive folders. Since the early days of 3GPP a new folder is added inside the "Specs" folder after each TSG plenary meeting to hold the latest versions of specifications approved at those TSG plenary meetings. This is still 3GPP's working practice today; thus, this practice has not changed over time.

62. 3GPP maintains a set of publicly accessible documents[2] providing further details on its way of working:

[2] All available from https://www.3gpp.org/delegates-corner/3gpp-working-procedures

- 3GPP Working Procedures
- Vocabulary for 3GPP Specifications 3GPP TR 21.905
- Working Methods 3GPP TR 21.900
- Specification Drafting Rules 3GPP TR 21.801

B. Specific Documents

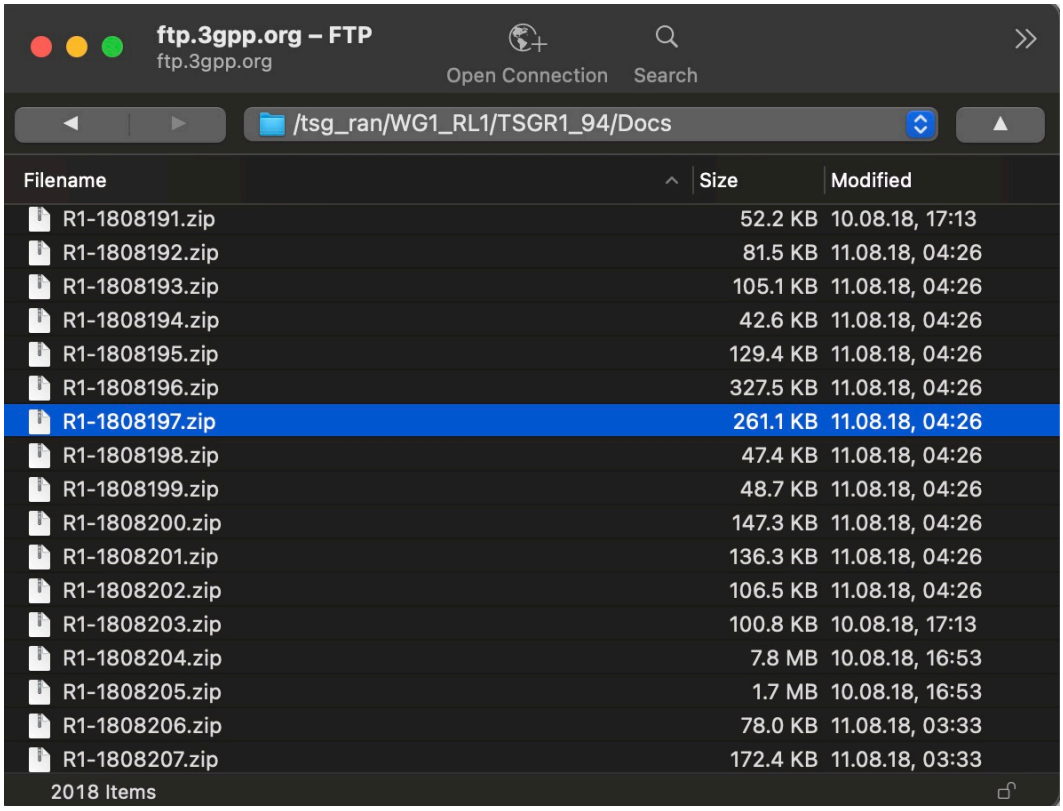
1. TDoc R1-1808197

63. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1011 as a true and correct copy of 3GPP TDoc R1-1808197, which represents a 3GPP document with the title "Maintenance for Reference signals and QCL." The document was authored by ZTE and included several text proposals for TS 38.211, TS 38.212, and TS 38.214 related to reference signals and QCL (quasi co-location).

64. On its face, R1-1808197 refers to the RAN WG1 meeting #94 held on August 20th-24th, 2018, in Gothenburg, Sweden. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1808197 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

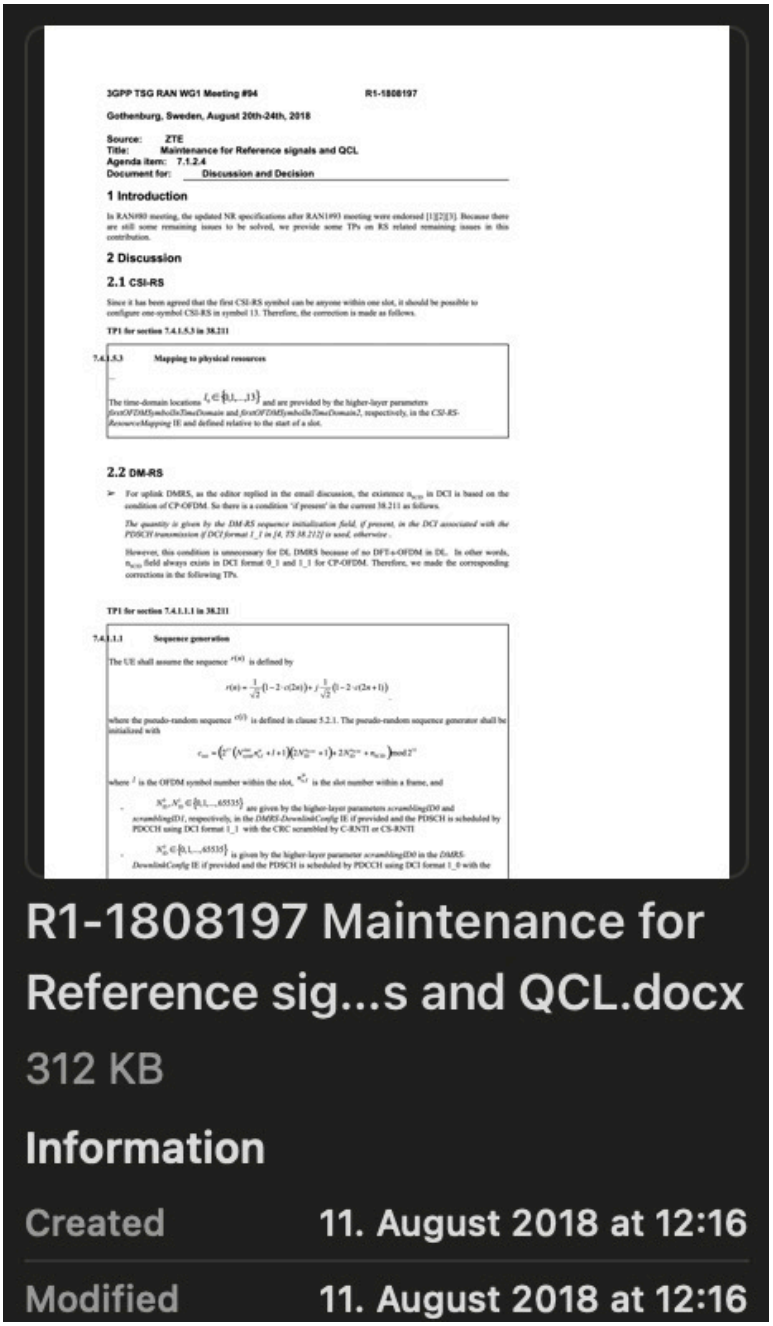
65. The public availability of the document is confirmed by the date stamp, August 11, 2018, shown on the historic 3GPP FTP server for the

corresponding downloadable file ("R1-1808197.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181020024053/http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94/Docs. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94/Docs as shown in the screenshot below:



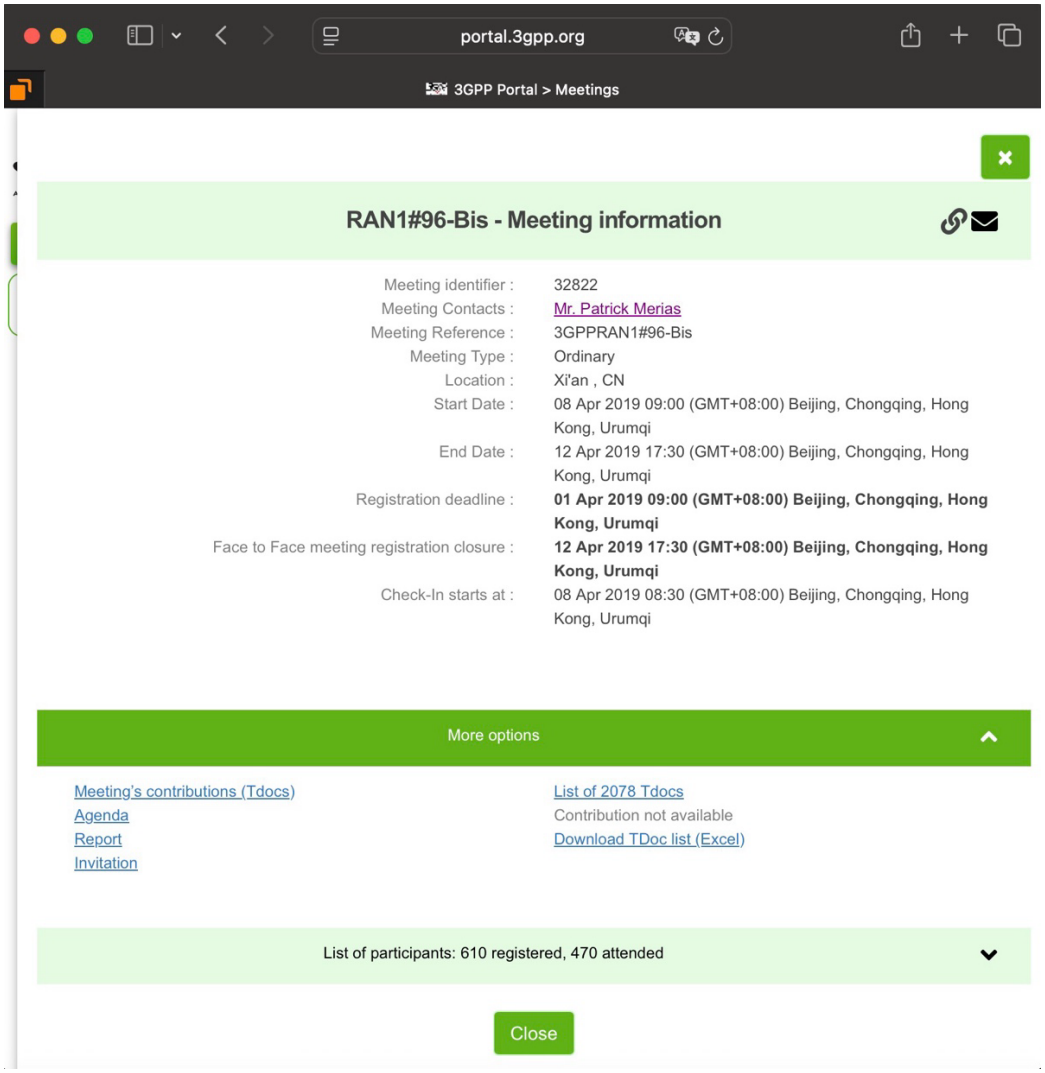
66. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

67. In addition, metadata information for the downloaded and extracted TDoc file states a last "Modified" date of "11. August 2018," as shown in the screenshot below.



68. This last modified date is consistent with the August 11, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

69. The final meeting report of the RAN WG1 meeting #94 held on August 20-24, 2018, in Gothenburg, Sweden, can be found in Appendix C. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 499 individuals (out of 622 registered participants):



70. The meeting report mentions R1-1808197 on page 93 which clearly indicates that the document was registered for this meeting. Furthermore, the

meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix D[3]. R1-1808197 is listed in row 199 and is tagged as "available". Furthermore, the "Uploaded" date is shown as "2018-08-11" indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
199	R1-1808197	Maintenance for Reference signals and QCL	ZTE	available	2018-07-26 01:52:19	2018-08-11 04:27:49

71. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1011 is an authentic copy of 3GPP TDoc R1-1808197 that was uploaded and made available via the 3GPP FTP server to the general public by August 11, 2018, at the latest.

2. TDoc R1-1809758

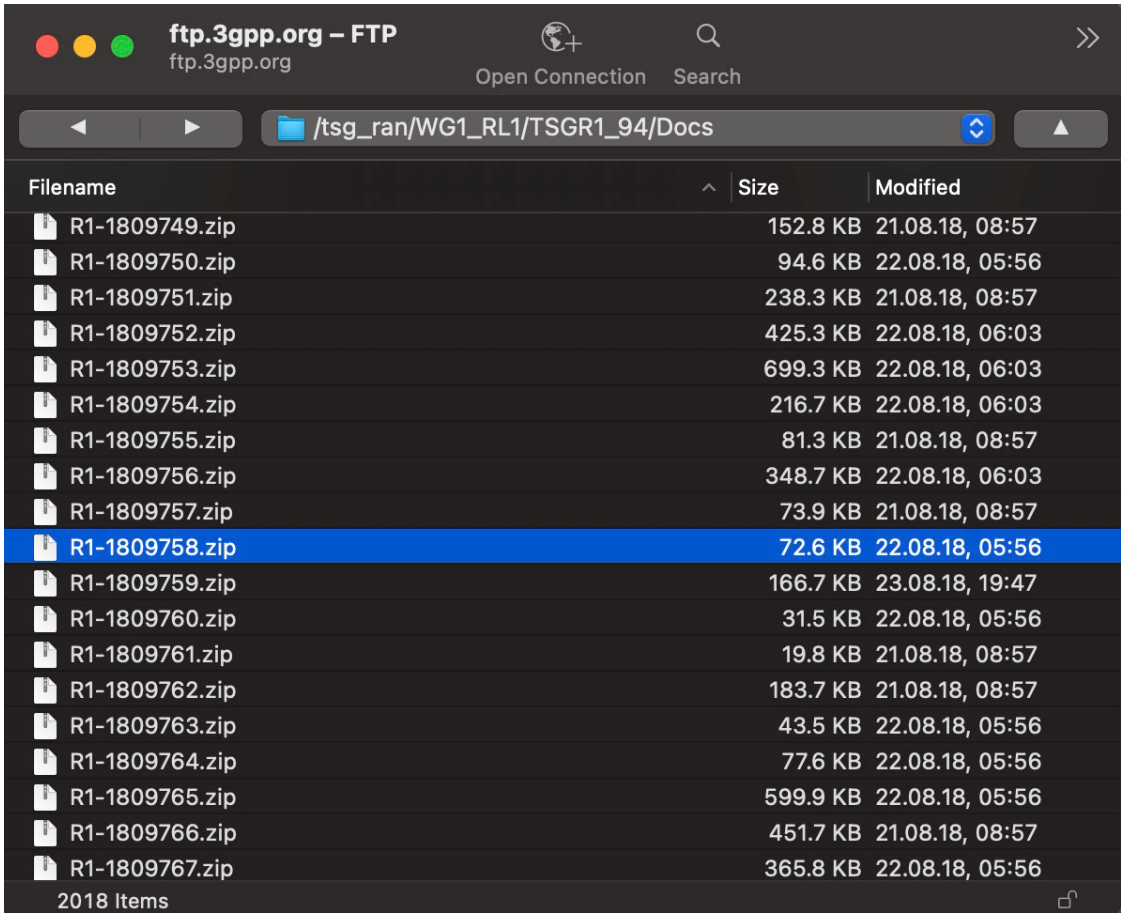
72. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1016 as a true and correct copy of 3GPP TDoc R1-1809758, which represents a 3GPP document with the title "Feature lead summary

[3] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

on QCL." The document was authored by Nokia and Nokia Shanghai Bell and summarized several proposals on QCL, and related company views.

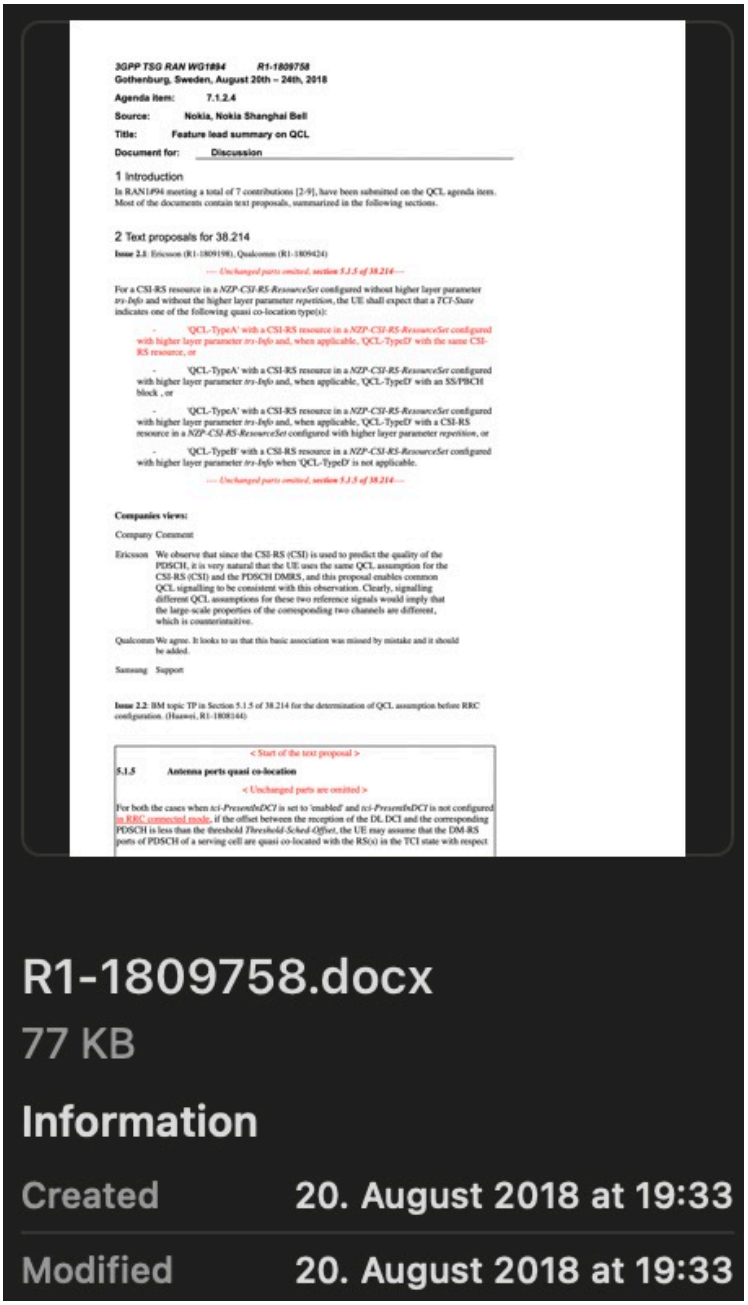
73. On its face, R1-1809758 refers to the RAN WG1 meeting #94 held on August 20th-24th, 2018, in Gothenburg, Sweden. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1809758 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

74. The public availability of the document is confirmed by the date stamp, August 22, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1809758.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181020024053/http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94/Docs. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94/Docs as shown in the screenshot below:



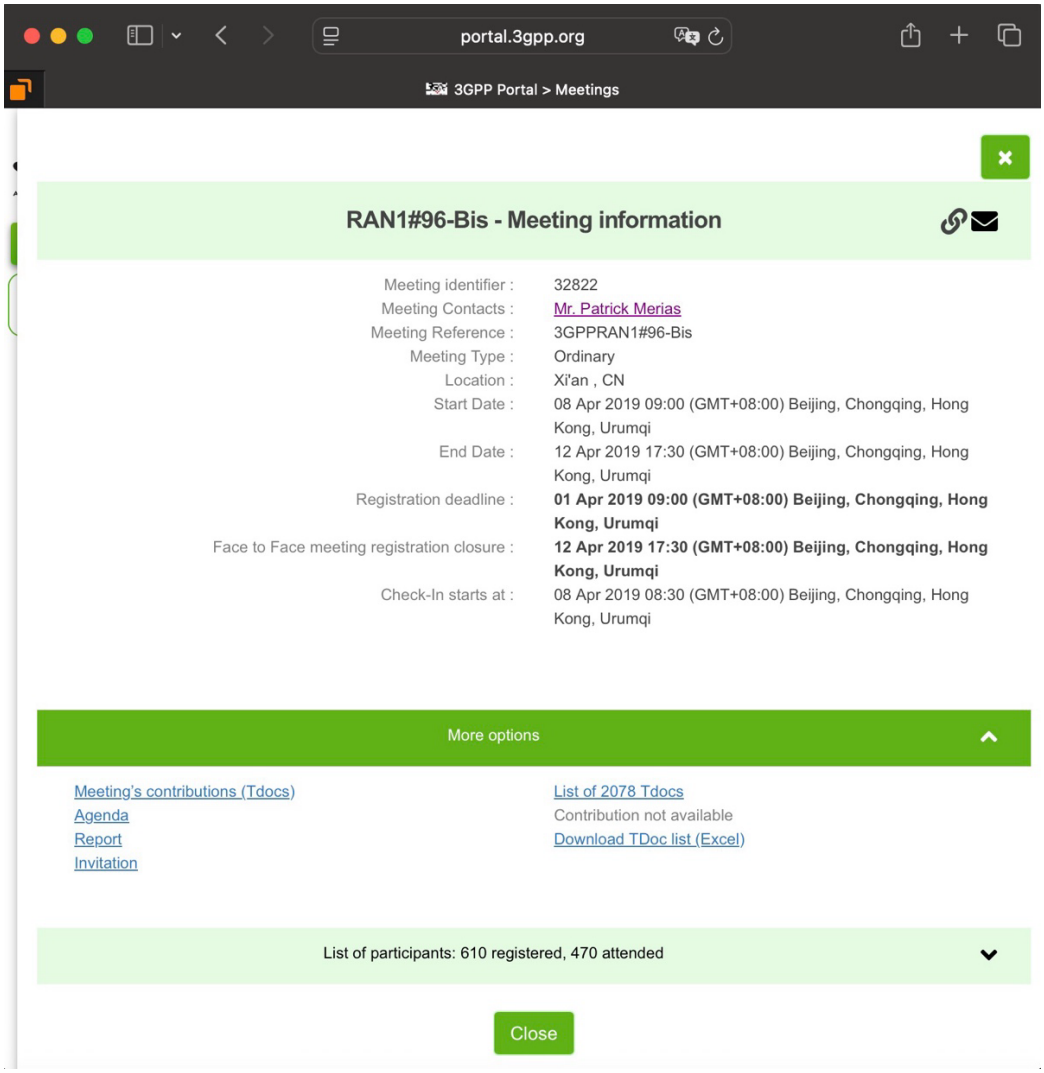
75. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

76. In addition, metadata information for the downloaded and extracted TDoc file states a last "Modified" date of "20. August 2018," as shown in the screenshot below.



77. This last modified date is consistent with the August 22, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

78. The final meeting report of the RAN WG1 meeting #94 held on August 20-24, 2018, in Gothenburg, Sweden, can be found in Appendix C. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 499 individuals (out of 622 registered participants):



79. The meeting report mentions R1-1809758 on page 89 which clearly indicates that the document was registered for this meeting. Additionally, the meeting report mentions the agreed text proposals, as can be seen below:

R1-1809758 **Feature lead summary on QCL Nokia**

Agreement
The following text proposal is agreed
----------Start of TP ----------
---- *Unchanged parts omitted,* ***section 5.1.5 of 38.214*** ----
For a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* and without the higher layer parameter *repetition*, the UE shall expect that a *TCI-State* indicates one of the following quasi co-location type(s):

- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with the same CSI-RS resource, or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with an SS/PBCH block, or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or

89

- 'QCL-TypeB' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* when 'QCL-TypeD' is not applicable.

---- *Unchanged parts omitted,* ***section 5.1.5 of 38.214*** ----
----------End of TP ----------

Agreement
TP in Section 5.1.5 of 38.214 for the determination of QCL assumption before RRC configuration
----------Start of TP ----------
5.1.5 Antenna ports quasi co-location
< Unchanged parts are omitted >
For both the cases when *tci-PresentInDCI* is set to 'enabled' and *tci-PresentInDCI* is not configured in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *Threshold-Sched-Offset*, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the lowest *CORESET-ID* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE. If none of configured TCI states contains 'QCL-TypeD', the UE shall obtain the other QCL assumptions from the indicated TCI states for its scheduled PDSCH irrespective of the time offset between the reception of the DL DCI and the corresponding PDSCH.
----------End of TP ----------

Agreement
Text proposal for TS38.214
----------Start of TP ----------
5.2.1.4.3 L1-RSRP Reporting
For L1-RSRP computation

- the UE may be configured with CSI-RS resources, SS/PBCH Block resources or both CSI-RS and SS/PBCH block resources, when resource-wise quasi co-located with 'QCL-Type ~~A~~ C' and 'QCL-TypeD' when applicable.

----------End of TP ----------

80. Furthermore, the meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix D[4]. R1-1809758 is listed in row 1760 and is tagged as "noted". Furthermore, the "Uploaded" date is shown as "2018-08-21" indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
1760	R1-1809758	Feature lead summary on QCL	Nokia, Nokia Shanghai Bell	noted	2018-08-21 08:56:59	2018-08-21 17:54:57

81. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1016 is an authentic copy of 3GPP TDoc R1-1809758 that was uploaded and made available via the 3GPP FTP server to the general public by August 22, 2018, at the latest.

3. TDoc R1-1808490

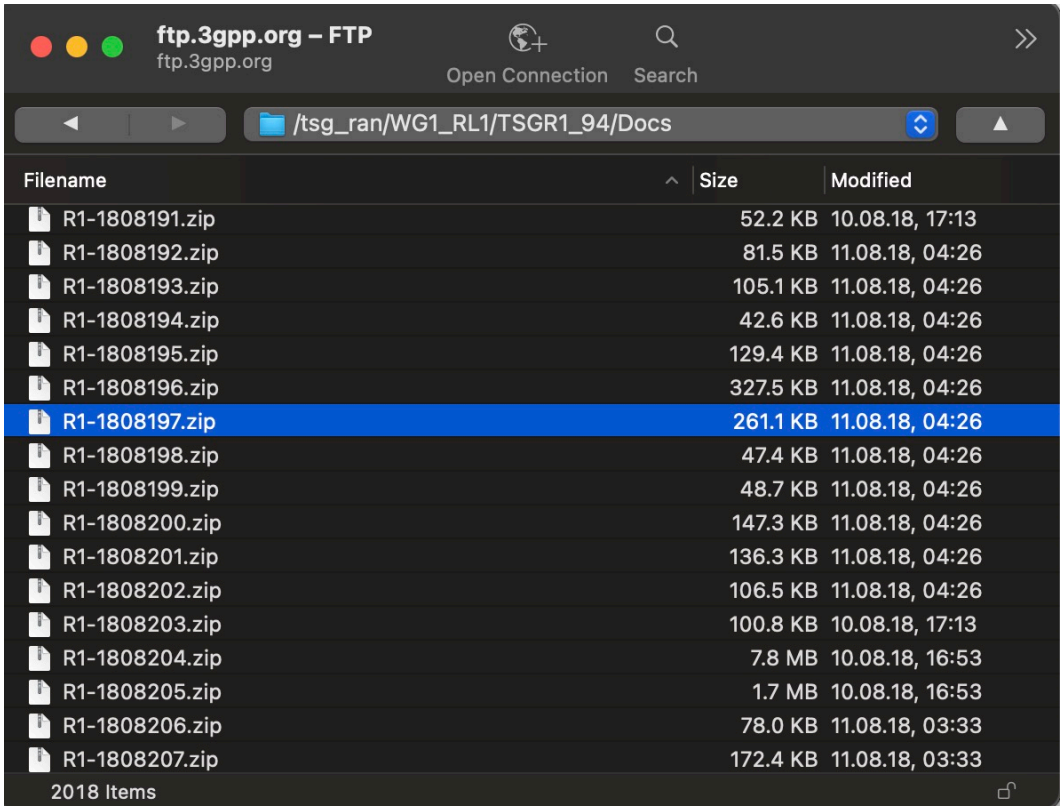
82. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1017 as a true and correct copy of 3GPP TDoc R1-

[4] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

1808490, which represents a 3GPP document with the title "Remaining issues on downlink control channel." The document was authored by LG Electronics and discussed issues related to PDCCH structure, search space, and GC-PDCCH.

83. On its face, R1-1808490 refers to the RAN WG1 meeting #94 held on August 20th-24th, 2018, in Gothenburg, Sweden. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1808490 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

84. The public availability of the document is confirmed by the date stamp, August 11, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1808490.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181020024053/http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94/Docs. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94/Docs as shown in the screenshot below:



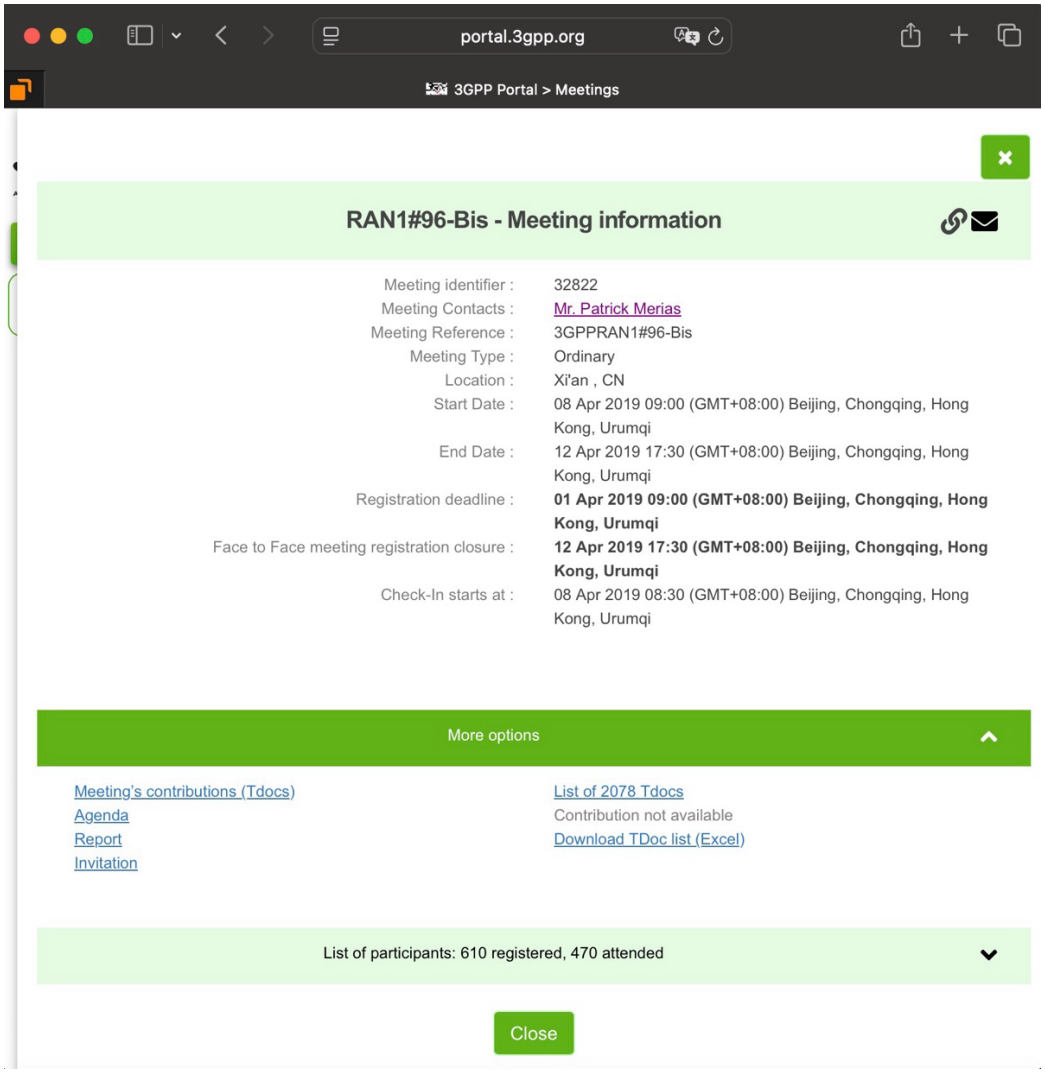
85. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

86. In addition, metadata information for the downloaded and extracted TDoc file states a last "Modified" date of "11. August 2018," as shown in the screenshot below.



87. This last modified date is consistent with the August 11, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

88. The final meeting report of the RAN WG1 meeting #94 held on August 20-24, 2018, in Gothenburg, Sweden, can be found in Appendix C. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 499 individuals (out of 622 registered participants):



89. The meeting report mentions R1-1808490 on page 101 which clearly indicates that the document was registered for this meeting. Furthermore, the

meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix D[5]. R1-1808490 is listed in row 199 and is tagged as "available". Furthermore, the "Uploaded" date is shown as "2018-08-11" indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
492	R1-1808490	Remaining issues on downlink control channel	LG Electronics	available	2018-08-08 09:37:51	2018-08-11 05:23:28

90. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1017 is an authentic copy of 3GPP TDoc R1-1808490 that was uploaded and made available via the 3GPP FTP server to the general public by August 11, 2018, at the latest.

4. TDoc R1-1808330

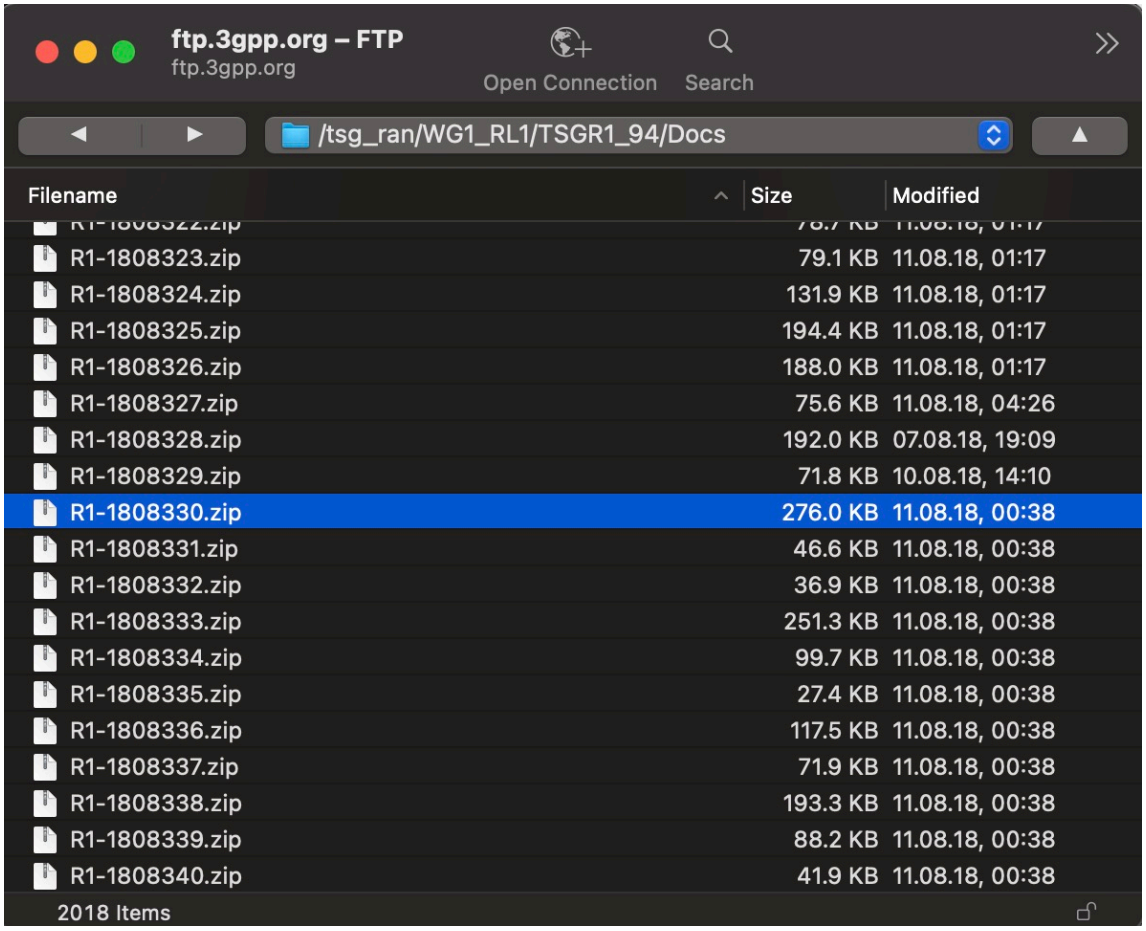
91. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1024 as a true and correct copy of 3GPP TDoc R1-1808330, which represents a 3GPP document with the title "Remaining issues on

[5] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

beam management and beam failure recovery." The document was authored by Sony and discussed remaining details of beam management including beam failure recovery.

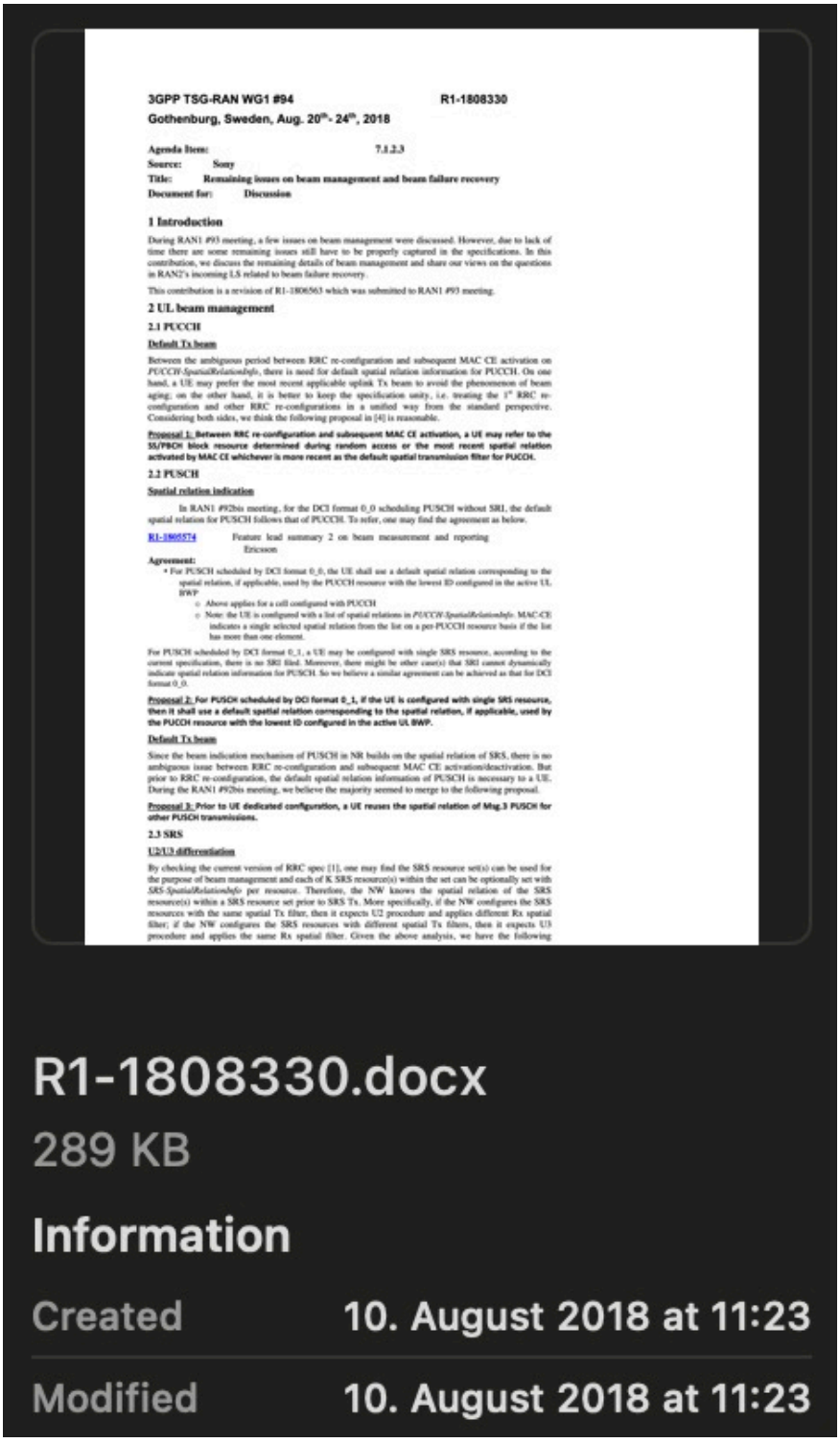
92. On its face, R1-1808330 refers to the RAN WG1 meeting #94 held on August 20th-24th, 2018, in Gothenburg, Sweden. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1808330 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

93. The public availability of the document is confirmed by the date stamp, August 11, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1808330.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20180918100702/http://www.3gpp.org:80/ftp/tsg_ran/WG1_RL1/TSGR1_94/Docs/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94/Docs as shown in the screenshot below:



94. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

95. In addition, metadata information for the downloaded and extracted TDoc file states a last "Modified" date of "10. August 2018," as shown in the screenshot below.



3GPP TSG-RAN WG1 #94 R1-1808330

Gothenburg, Sweden, Aug. 20th- 24th, 2018

Agenda Item: 7.1.2.3
Source: Sony
Title: Remaining issues on beam management and beam failure recovery
Document for: Discussion

1 Introduction

During RAN1 #93 meeting, a few issues on beam management were discussed. However, due to lack of time there are some remaining issues still have to be properly captured in the specifications. In this contribution, we discuss the remaining details of beam management and share our views on the questions in RAN2's incoming LS related to beam failure recovery.

This contribution is a revision of R1-1806563 which was submitted to RAN1 #93 meeting.

2 UL beam management

2.1 PUCCH

Default Tx beam

Between the ambiguous period between RRC re-configuration and subsequent MAC CE activation on *PUCCH-SpatialRelationInfo*, there is need for default spatial relation information for PUCCH. On one hand, a UE may prefer the most recent applicable uplink Tx beam to avoid the phenomenon of beam aging; on the other hand, it is better to keep the specification unity, i.e. treating the 1st RRC re-configuration and other RRC re-configurations in a unified way from the standard perspective. Considering both sides, we think the following proposal in [4] is reasonable.

Proposal 1: Between RRC re-configuration and subsequent MAC CE activation, a UE may refer to the SS/PBCH block resource determined during random access or the most recent spatial relation activated by MAC CE whichever is more recent as the default spatial transmission filter for PUCCH.

2.2 PUSCH

Spatial relation indication

In RAN1 #92bis meeting, for the DCI format 0_0 scheduling PUSCH without SRI, the default spatial relation for PUSCH follows that of PUCCH. To refer, one may find the agreement as below.

R1-1805574 Feature lead summary 2 on beam measurement and reporting
Ericsson

Agreement:

- For PUSCH scheduled by DCI format 0_0, the UE shall use a default spatial relation corresponding to the spatial relation, if applicable, used by the PUCCH resource with the lowest ID configured in the active UL BWP
  - Above applies for a cell configured with PUCCH
  - Note: the UE is configured with a list of spatial relations in *PUCCH-SpatialRelationInfo*. MAC-CE indicates a single selected spatial relation from the list on a per-PUCCH resource basis if the list has more than one element.

For PUSCH scheduled by DCI format 0_1, a UE may be configured with single SRS resource, according to the current specification, there is no SRI filed. Moreover, there might be other case(s) that SRI cannot dynamically indicate spatial relation information for PUSCH. So we believe a similar agreement can be achieved as that for DCI format 0_0.

Proposal 2: For PUSCH scheduled by DCI format 0_1, if the UE is configured with single SRS resource, then it shall use a default spatial relation corresponding to the spatial relation, if applicable, used by the PUCCH resource with the lowest ID configured in the active UL BWP.

Default Tx beam

Since the beam indication mechanism of PUSCH in NR builds on the spatial relation of SRS, there is no ambiguous issue between RRC re-configuration and subsequent MAC CE activation/deactivation. But prior to RRC re-configuration, the default spatial relation information of PUSCH is necessary to a UE. During the RAN1 #92bis meeting, we believe the majority seemed to merge to the following proposal.

Proposal 3: Prior to UE dedicated configuration, a UE reuses the spatial relation of Msg.3 PUSCH for other PUSCH transmissions.

2.3 SRS

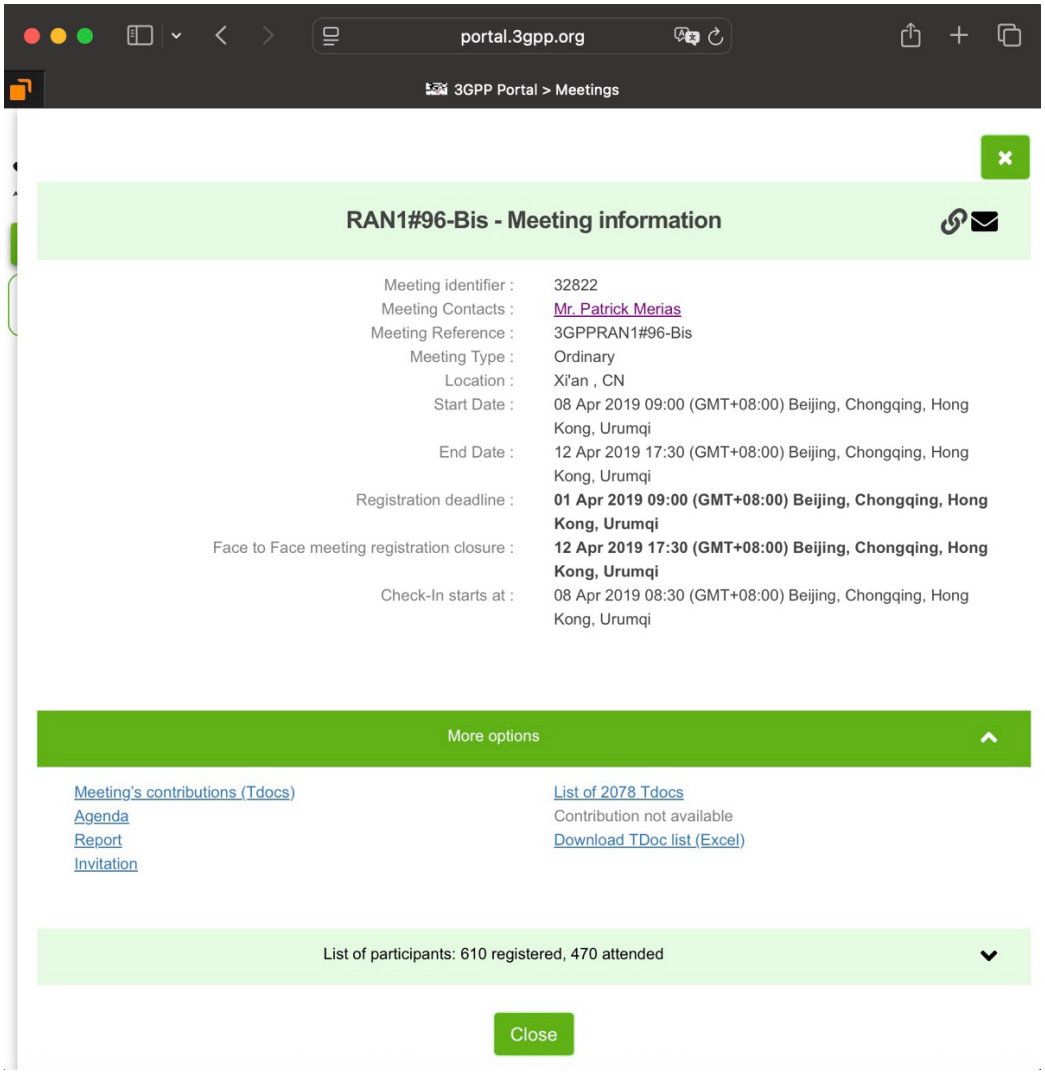
U2/U3 differentiation

By checking the current version of RRC spec [1], one may find the SRS resource set(s) can be used for the purpose of beam management and each of K SRS resource(s) within the set can be optionally set with *SRS-SpatialRelationInfo* per resource. Therefore, the NW knows the spatial relation of the SRS resource(s) within a SRS resource set prior to SRS Tx. More specifically, if the NW configures the SRS resources with the same spatial Tx filter, then it expects U2 procedure and applies different Rx spatial filter; if the NW configures the SRS resources with different spatial Tx filters, then it expects U3 procedure and applies the same Rx spatial filter. Given the above analysis, we have the following

R1-1808330.docx
289 KB
Information
Created 10. August 2018 at 11:23
Modified 10. August 2018 at 11:23

96. This last modified date is consistent with the August 11, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

97. The final meeting report of the RAN WG1 meeting #94 held on August 20-24, 2018, in Gothenburg, Sweden, can be found in Appendix C. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 499 individuals (out of 622 registered participants):



98. The meeting report mentions R1-1808330 on page 71 which clearly indicates that the document was registered for this meeting. Furthermore, the meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix D[6]. R1-1808330 is listed in row 332 and is tagged as "available". Furthermore, the "Uploaded" date is shown as "2018-08-11"

[6] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
332	R1-1808330	Remaining issues on beam management and beam failure recovery	Sony	available	2018-08-07 22:06:51	2018-08-11 00:40:14

99. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1024 is an authentic copy of 3GPP TDoc R1-1808330 that was uploaded and made available via the 3GPP FTP server to the general public by August 11, 2018, at the latest.

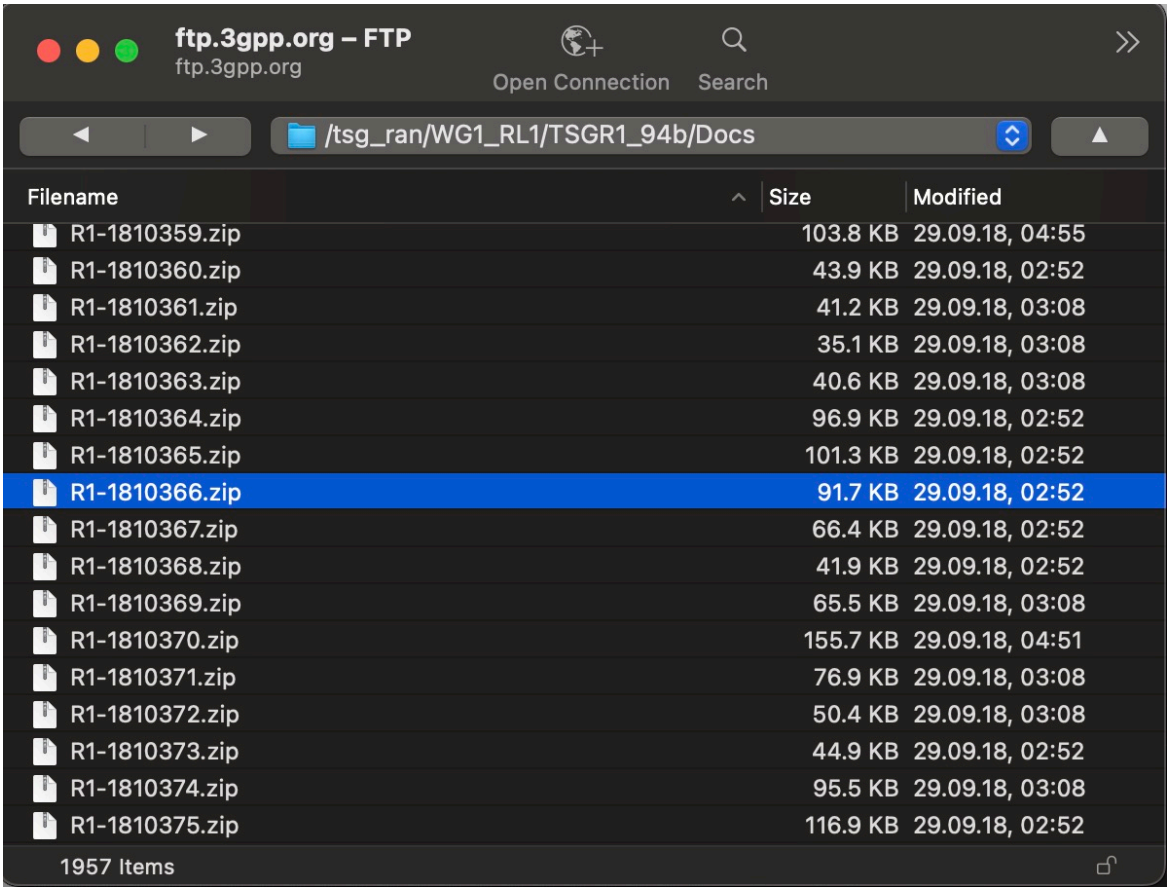
5. TDoc R1-1810366

100. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1015 as a true and correct copy of 3GPP TDoc R1-1810366, which represents a 3GPP document with the title "Maintenance for beam management." The document was authored by vivo and discussed several remaining issues on beam measurement, beam reporting and beam failure recovery.

101. On its face, R1-1810366 refers to the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this

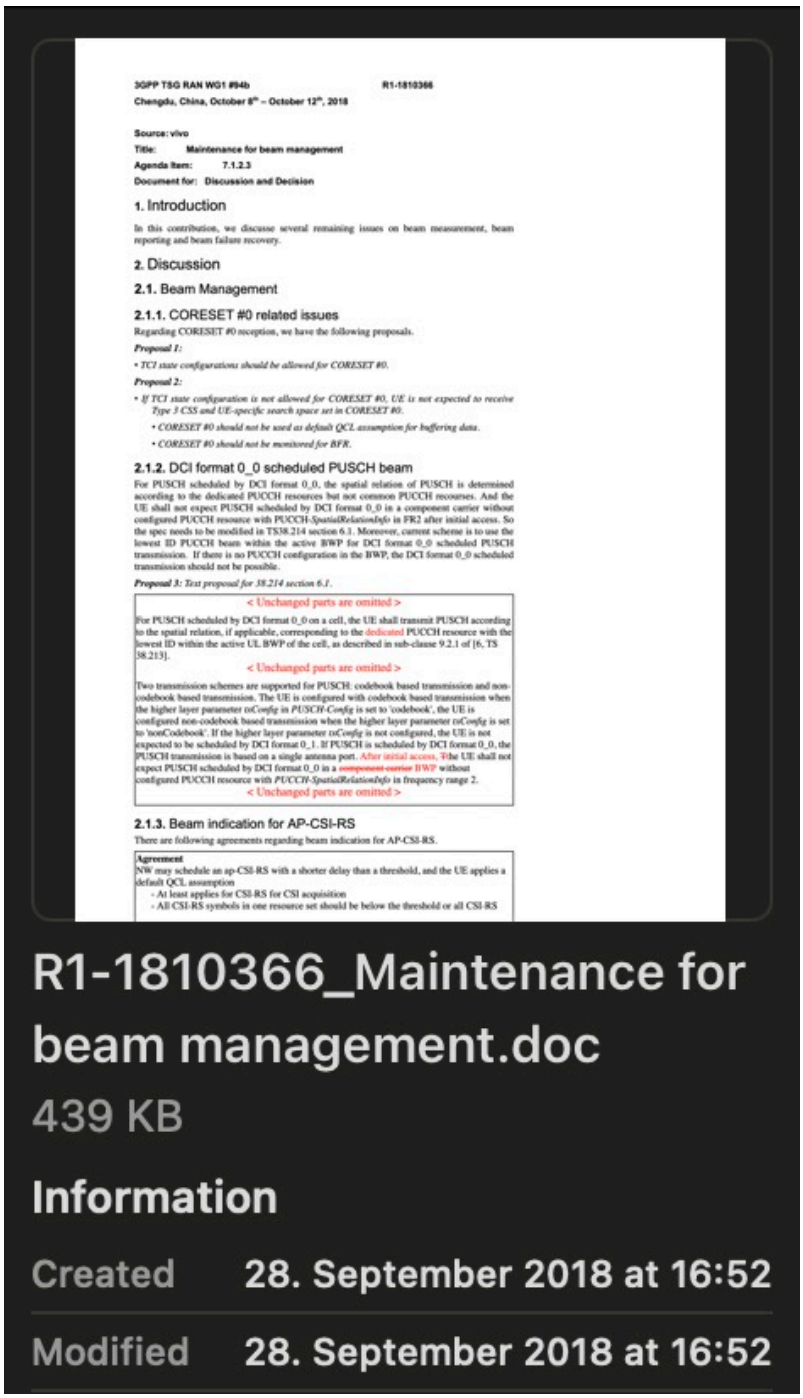
information tells me that R1-1810366 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

102. The public availability of the document is confirmed by the date stamp, September 29, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1810366.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181119002652/https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs as shown in the screenshot below:



103. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

104. In addition, metadata information for the downloaded and extracted TDoc file states a last Modified date of "28. September 2018," as shown in the screenshot below.



3GPP TSG RAN WG1 #94b R1-1810366

Chengdu, China, October 8th – October 12th, 2018

Source: vivo

Title: Maintenance for beam management

Agenda Item: 7.1.2.3

Document for: Discussion and Decision

1. Introduction

In this contribution, we discusse several remaining issues on beam measurement, beam reporting and beam failure recovery.

2. Discussion

2.1. Beam Management

2.1.1. CORESET #0 related issues

Regarding CORESET #0 reception, we have the following proposals.

Proposal 1:

- *TCI state configurations should be allowed for CORESET #0.*

Proposal 2:

- *If TCI state configuration is not allowed for CORESET #0, UE is not expected to receive Type 3 CSS and UE-specific search space set in CORESET #0.*
  - *CORESET #0 should not be used as default QCL assumption for buffering data.*
  - *CORESET #0 should not be monitored for BFR.*

2.1.2. DCI format 0_0 scheduled PUSCH beam

For PUSCH scheduled by DCI format 0_0, the spatial relation of PUSCH is determined according to the dedicated PUCCH resources but not common PUCCH recourses. And the UE shall not expect PUSCH scheduled by DCI format 0_0 in a component carrier without configured PUCCH resource with *PUCCH-SpatialRelationInfo* in FR2 after initial access. So the spec needs to be modified in TS38.214 section 6.1. Moreover, current scheme is to use the lowest ID PUCCH beam within the active BWP for DCI format 0_0 scheduled PUSCH transmission. If there is no PUCCH configuration in the BWP, the DCI format 0_0 scheduled transmission should not be possible.

Proposal 3: Text proposal for 38.214 section 6.1.

< Unchanged parts are omitted >

For PUSCH scheduled by DCI format 0_0 on a cell, the UE shall transmit PUSCH according to the spatial relation, if applicable, corresponding to the dedicated PUCCH resource with the lowest ID within the active UL BWP of the cell, as described in sub-clause 9.2.1 of [6, TS 38.213].

< Unchanged parts are omitted >

Two transmission schemes are supported for PUSCH: codebook based transmission and non-codebook based transmission. The UE is configured with codebook based transmission when the higher layer parameter *txConfig* in *PUSCH-Config* is set to 'codebook', the UE is configured non-codebook based transmission when the higher layer parameter *txConfig* is set to 'nonCodebook'. If the higher layer parameter *txConfig* is not configured, the UE is not expected to be scheduled by DCI format 0_1. If PUSCH is scheduled by DCI format 0_0, the PUSCH transmission is based on a single antenna port. After initial access, tThe UE shall not expect PUSCH scheduled by DCI format 0_0 in a ~~component carrier BWP~~ without configured PUCCH resource with *PUCCH-SpatialRelationInfo* in frequency range 2.

< Unchanged parts are omitted >

2.1.3. Beam indication for AP-CSI-RS

There are following agreements regarding beam indication for AP-CSI-RS.

Agreement

NW may schedule an ap-CSI-RS with a shorter delay than a threshold, and the UE applies a default QCL assumption

- At least applies for CSI-RS for CSI acquisition
- All CSI-RS symbols in one resource set should be below the threshold or all CSI-RS

R1-1810366_Maintenance for beam management.doc

439 KB

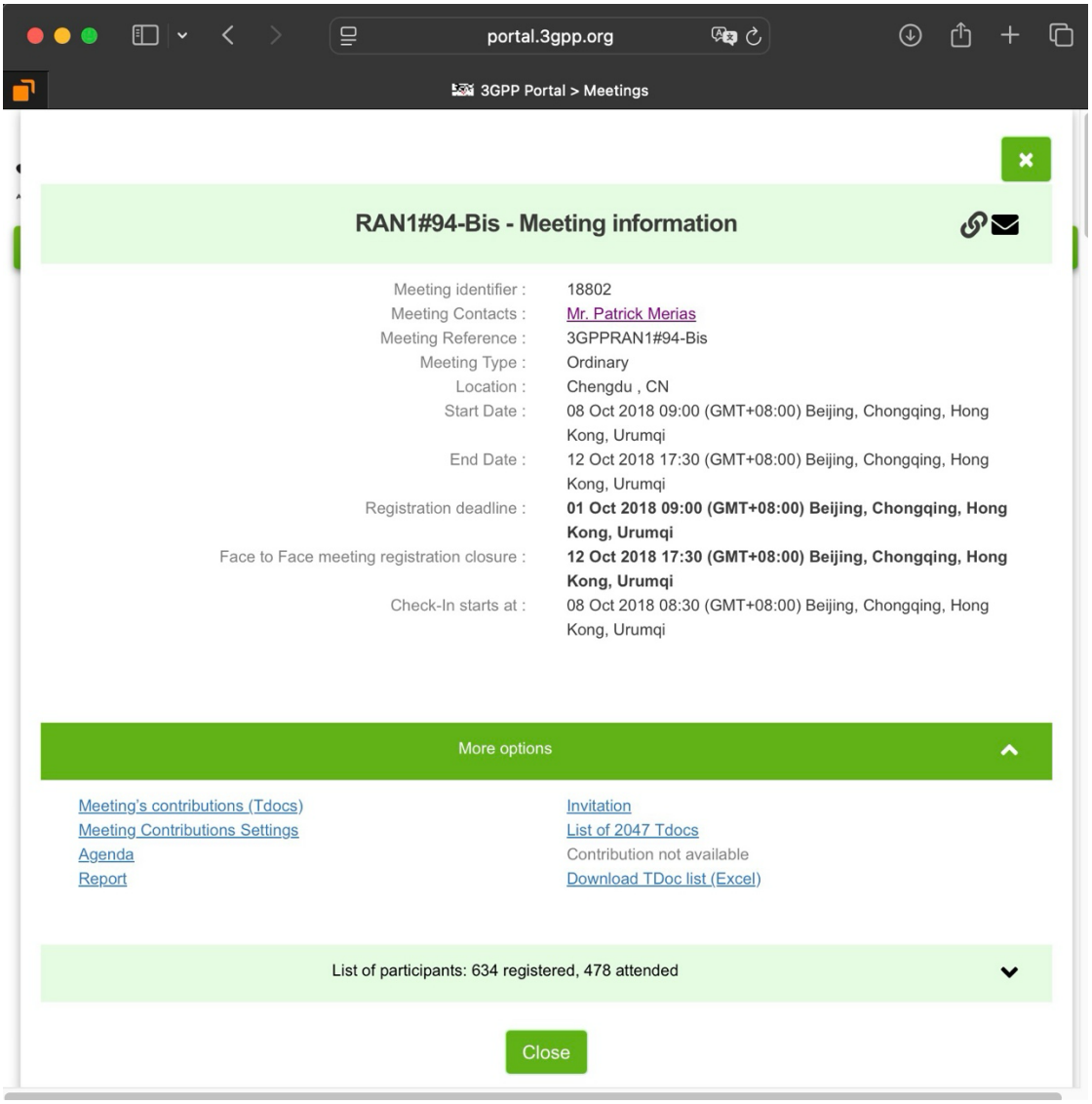
Information

Created 28. September 2018 at 16:52

Modified 28. September 2018 at 16:52

105. This last modified date is consistent with the September 29, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

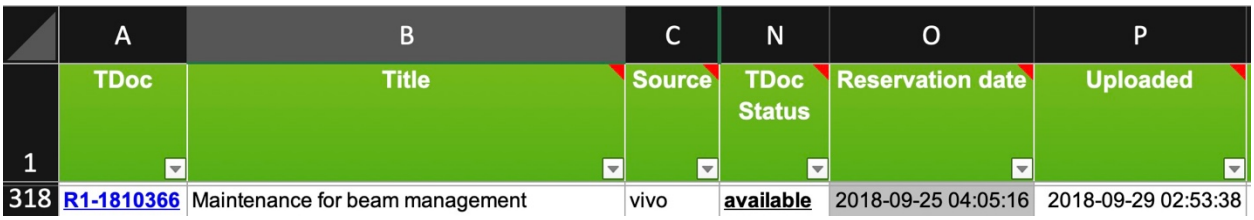
106. The final meeting report of the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China, can be found in Appendix E. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 478 individuals (out of 634 registered participants):



107. The meeting report mentions R1-1810366 on page 58 which clearly indicates that the document was registered for this meeting. Furthermore, the meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix F[7]. R1-1810366 is listed in row 318 and is tagged

[7] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

as "available". Furthermore, the "Uploaded" date is shown as "2018-09-29" indicating the document was available at the meeting, as can be seen by the screenshot below:



	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
318	R1-1810366	Maintenance for beam management	vivo	available	2018-09-25 04:05:16	2018-09-29 02:53:38

108. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, EXxxxx is an authentic copy of 3GPP TDoc R1-1810366 that was uploaded and made available via the 3GPP FTP server to the general public by September 29, 2018, at the latest.

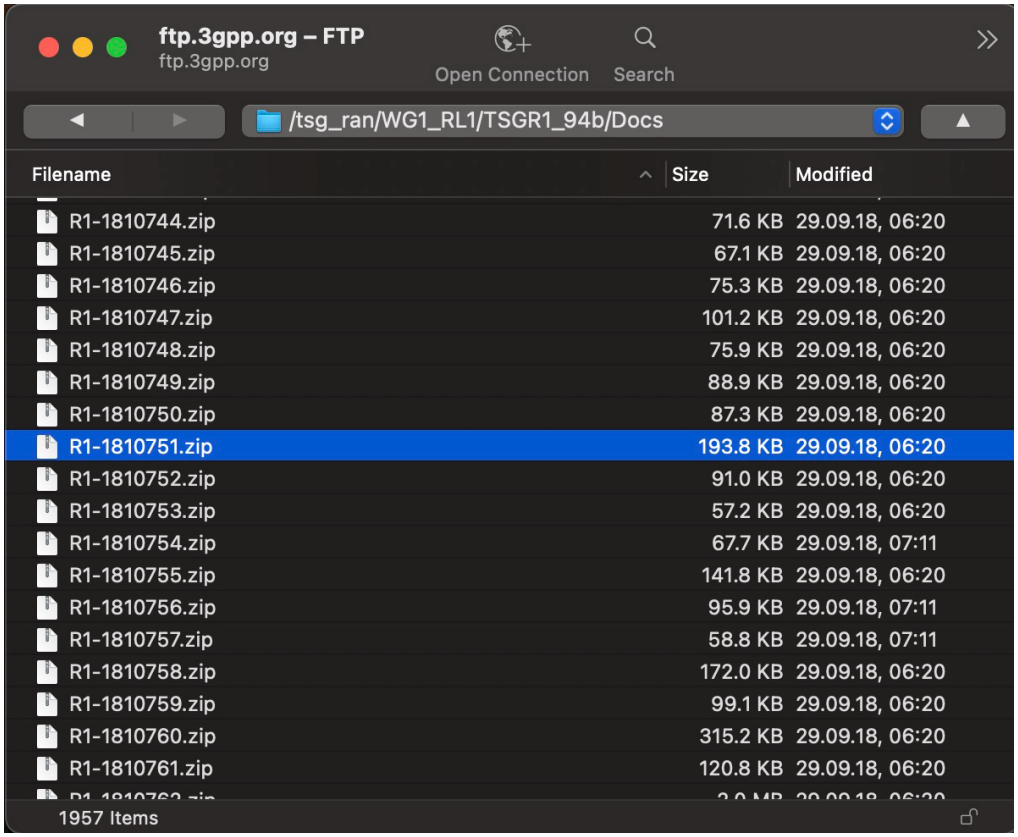
6. TDoc R1-1810751

109. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1006 as a true and correct copy of 3GPP TDoc R1-1810751, which represents a 3GPP document with the title "Remaining Issues on Beam Management." The document was authored by Intel Corporation and proposed corrections for beam management and beam failure recovery.

110. On its face, R1-1810751 refers to the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this

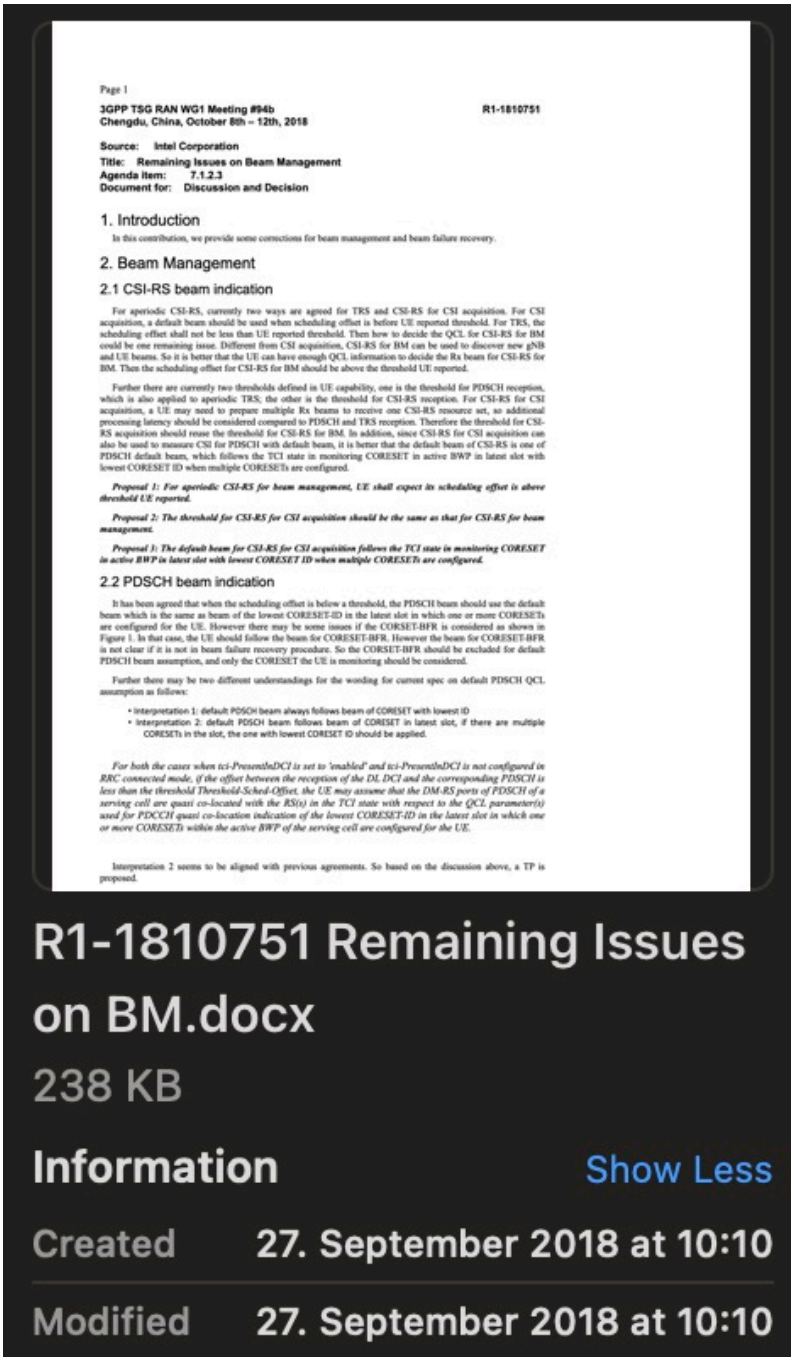
information tells me that R1-1810751 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

111. The public availability of the document is confirmed by the date stamp, September 29, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1810751.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181119002652/https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs as shown in the screenshot below:



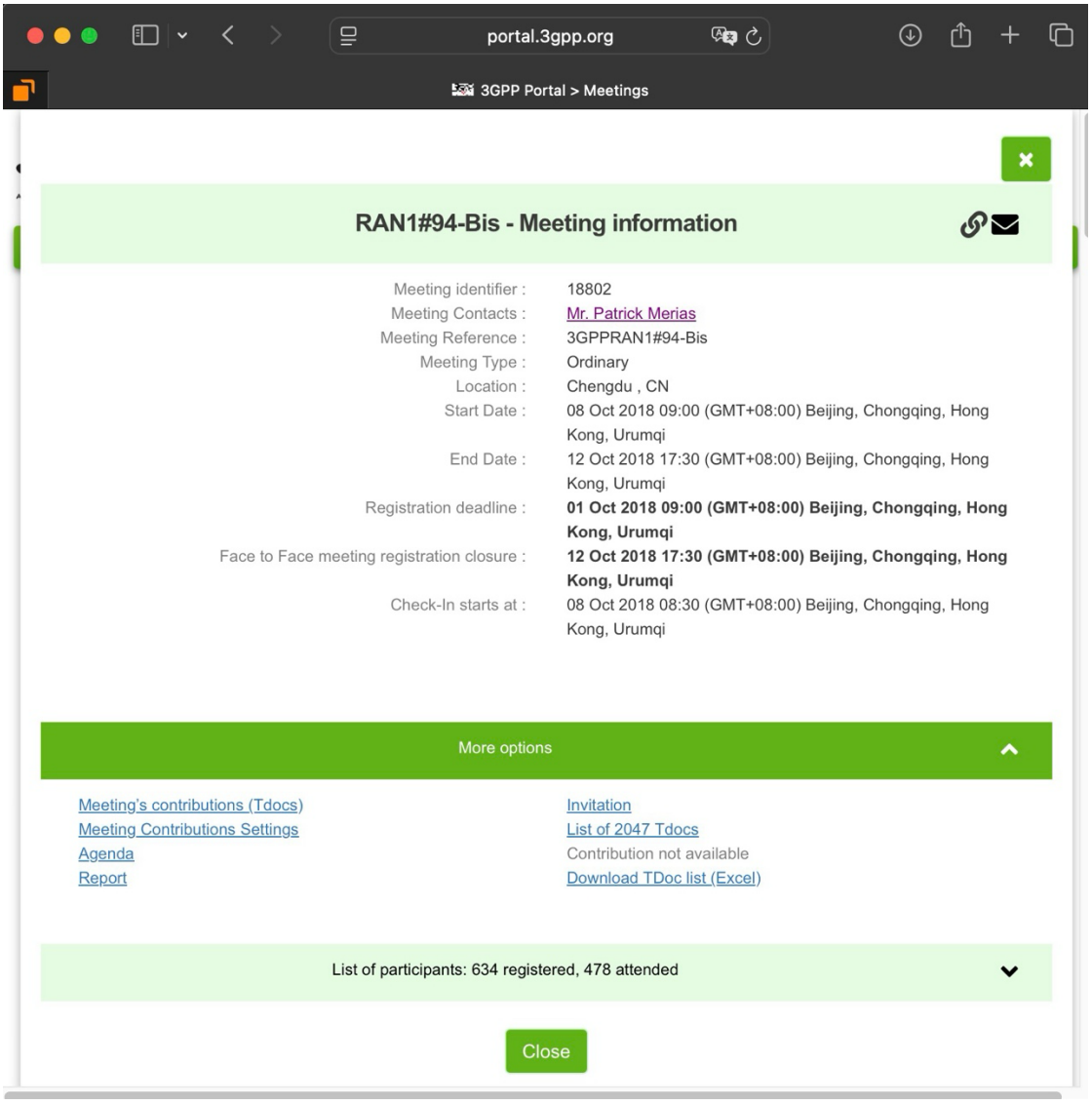
112. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

113. In addition, metadata information for the downloaded and extracted TDoc file states a last Modified date of "27. September 2018," as shown in the screenshot below.



114. This last modified date is consistent with the September 29, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

115. The final meeting report of the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China, can be found in Appendix E. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 478 individuals (out of 634 registered participants):



116. The meeting report mentions R1-1810751 on page 58 which clearly indicates that the document was registered for this meeting. Furthermore, the meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix F[8]. R1-1810751 is listed in row 703 and is tagged as "available". Furthermore, the "Uploaded" date is shown as "2018-09-29" indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
703	R1-1810751	Remaining issues for beam management	Intel Corporation	available	2018-09-27 02:01:51	2018-09-29 06:24:01

117. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1006 is an authentic copy of 3GPP TDoc R1-1810751 that was uploaded and made available via the 3GPP FTP server to the general public by September 29, 2018, at the latest.

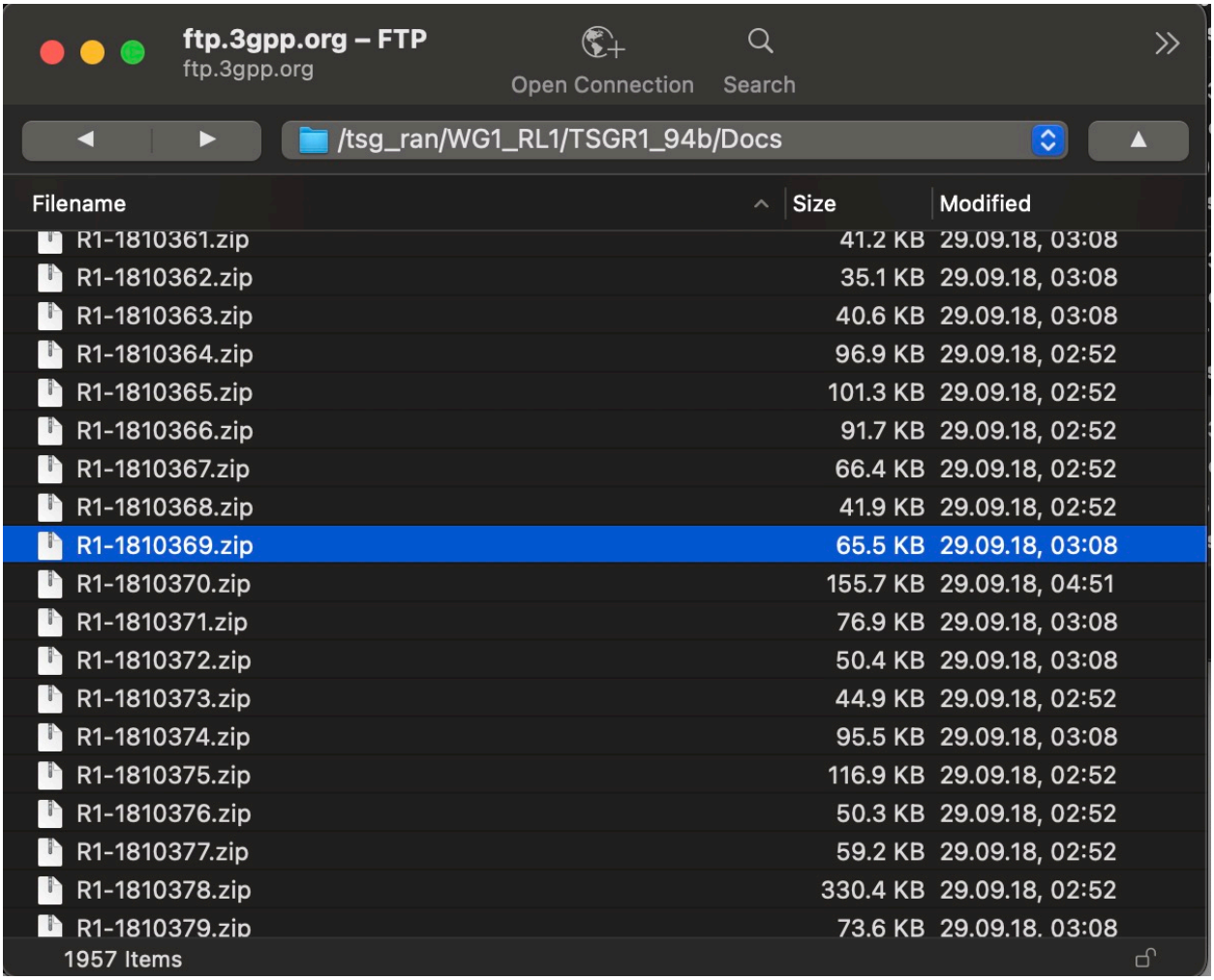
7. TDoc R1-1810369

[8] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

118. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1022 as a true and correct copy of 3GPP TDoc R1-1810369, which represents a 3GPP document with the title "Remaining issues on physical downlink control channel." The document was authored by vivo and discussed issues related to the physical downlink control channel (PDCCH) including beam failure recovery.

119. On its face, R1-1810369 refers to the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1810369 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

120. The public availability of the document is confirmed by the date stamp, September 29, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1810369.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181119002652/https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs as shown in the screenshot below:



121. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

122. In addition, metadata information for the downloaded and extracted TDoc file states a last Modified date of "28. September 2018," as shown in the screenshot below.



3GPP TSG RAN WG1 Meeting #94bis R1-1810369
Chengdu, China, October 8th – 12th, 2018

Source: vivo
Title: Remaining issues on physical downlink control channel
Agenda Item: 7.1.3.1
Document for: Discussion and Decision

1. Introduction

In this contribution, we discuss some remaining issues on physical downlink control channel (PDCCH).

2. PDCCH monitoring for beam failure recovery

The BFR search space set and the associated CORESET are configured and only activated for beam failure recovery procedure. A UE is not expected to monitor the BSR-SS before BFR procedure (e.g., PRACH transmission). After the UE sending PRACH for contention-free BFR, it has been agreed in the previous meeting [1] that all configured search spaces before dedicated BFR PRACH transmission for BFR are monitored.

Agreement
Concerning the questions in RAN2 LS (R1-1808166) on BFR
Question 1: After UE sending PRACH for contention-free BFR, does the UE continue monitoring PDCCH candidates in configured search spaces monitored before PRACH, in addition to the search space indicated by recoverySearchSpaceId?
- RAN1 response: Yes, all configured search spaces before dedicated BFR PRACH transmission for BFR are monitored

With this agreement, the number of monitored PDCCH search space sets may dynamically vary during BFR procedure. Consequently, the PDCCH BD/CCE counting and search space set mapping should be properly handled considering the activation and deactivation of BFR-SS.

The most simple and straightforward solution is that, the PDCCH BD/CCE counting and search space set mapping rule always check the BFR-SS, no matter whether it is activated or not. This is also aligned with another agreement that the PDCCH BD/CCE counting is only based on the configured PDCCH decoding candidates.

Agreements:
- PDCCH BD/CCE counting is only based on the configured PDCCH decoding candidates (i.e., irrespective of whether or not a PDCCH decoding candidate is dropped, e.g., due to collision with other channels/signals)
  - Check further offline on potential spec impact

However, BFR should be considered as an exception case rather than a regular operation, which means that the BFR-SS is usually not monitored. Always counting the candidates of BFR-SS that may never be monitored seems overkill, thus overbooking can be applied once the BFR-SS is activated.

Observation 1: BFR should be considered as an exception case rather than a regular operation, thus always counting the candidates of BFR-SS that may never be monitored seems overkill.

If overbooking is applied, it is obviously that the BFR-SS should have a higher priority than other UE-specific search space sets, and even higher than common search space sets. One straightforward solution is to map the BFR-SS before any other SS sets (i.e. assigning it a highest priority). But such a solution imposes undesirable specification impacts at this late stage.

On the other hand, implementation-based solutions can be considered. Firstly, the BFR-SS can be configured with a lowest SS ID, so that it is always mapped before any other USS. Alternatively, according to the current specification [2], it is allowed to configure the BFR-SS as a CSS that is always mapped during overbooking, though only fallback DCI can be monitored. Both solutions have some restrictions; nevertheless, they can resolve this issue without specification impact.

Proposal 1: The BFR-SS can be prioritized in search space mapping by network configuration, e.g. by assigning a lowest USS ID or configuring as a CSS.

3. BD/CCE limit for CA case

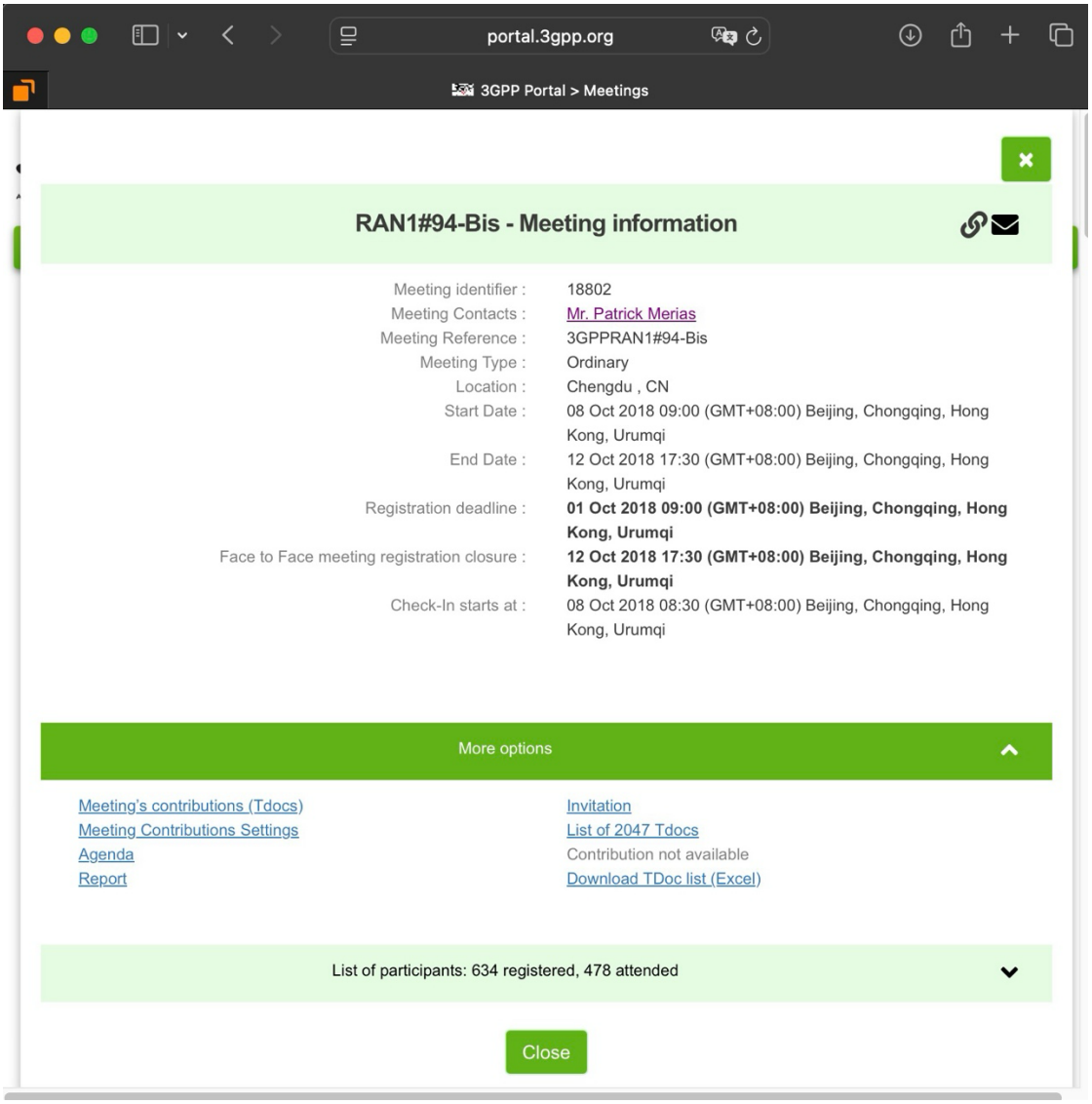
The BD/CCE limit for CA case has been discussed in the RAN1#93 meeting and the following agreements have been achieved [3].

Agreements:
- For following, regardless of whether one or more numerologies, the limit of BDs/CCEs per CC per slot is equal to the limit of BDs/CCEs for non-CA case.
  - Self-scheduling with up to 4 DL-CCs
  - Self-scheduling with up to T DL-CCs where the UE reports BD capability of y >= T
    - y is integer from {4, ..., 16}
    - T is integer from {1, .., 16}

R1-1810369 Remaining issues on physical do...l channel.docx
75 KB
Information
Created 28. September 2018 at 23:06
Modified 28. September 2018 at 23:06

123. This last modified date is consistent with the September 29, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

124. The final meeting report of the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China, can be found in Appendix E. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 478 individuals (out of 634 registered participants):



125. The meeting report mentions R1-1810369 on page 76 which clearly indicates that the document was registered for this meeting. Furthermore, the meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix F[9]. R1-1810369 is listed in row 321 and is tagged

[9] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

as "available". Furthermore, the "Uploaded" date is shown as "2018-09-29" indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
321	R1-1810369	Remaining issues on physical downlink control channel	vivo	available	2018-09-25 04:05:17	2018-09-29 03:10:32

126. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1022 is an authentic copy of 3GPP TDoc R1-1810369 that was uploaded and made available via the 3GPP FTP server to the general public by September 29, 2018, at the latest.

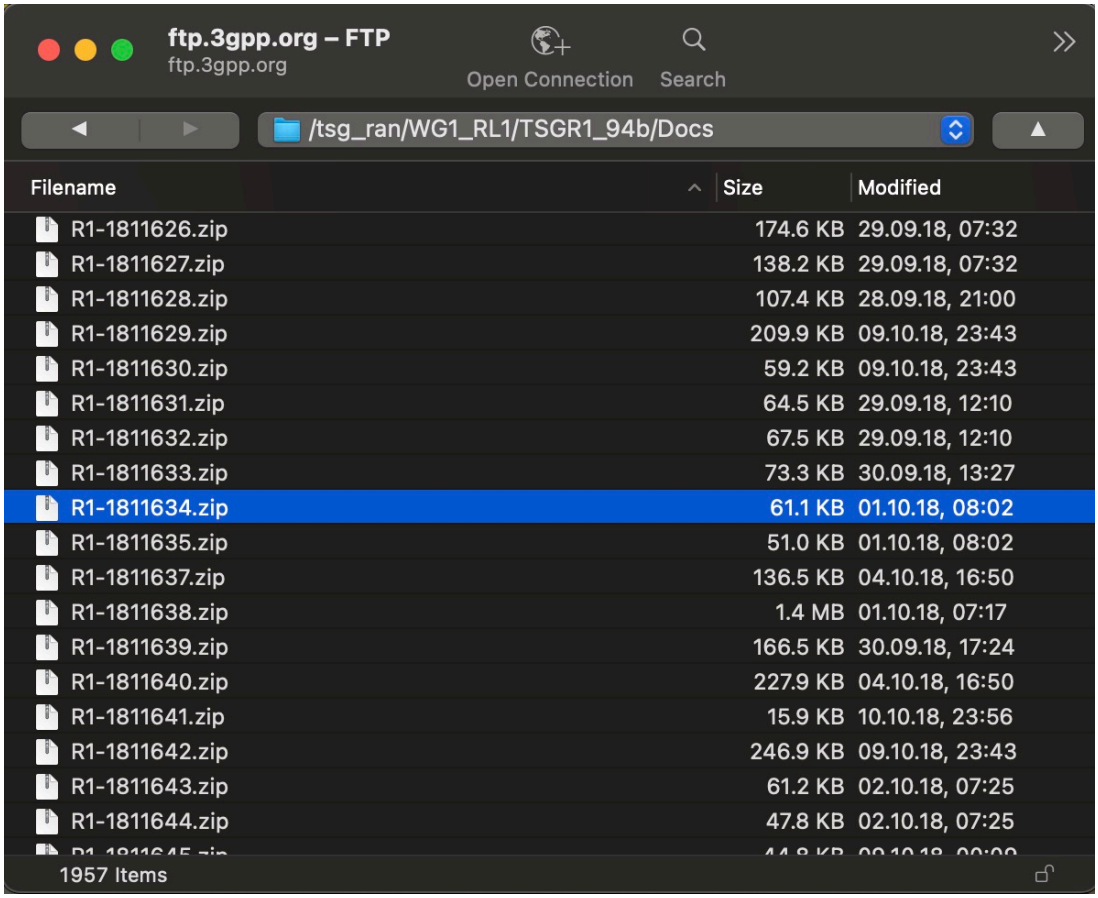
8. TDoc R1-1811634

127. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1023 as a true and correct copy of 3GPP TDoc R1-1811634, which represents a 3GPP document with the title "Text proposals for Beam management." The document was authored by OPPO and discussed issues related to beam management, including beam failure recovery and beam indication, including related text proposals.

128. On its face, R1-1811634 refers to the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China. Thus, based on my personal knowledge

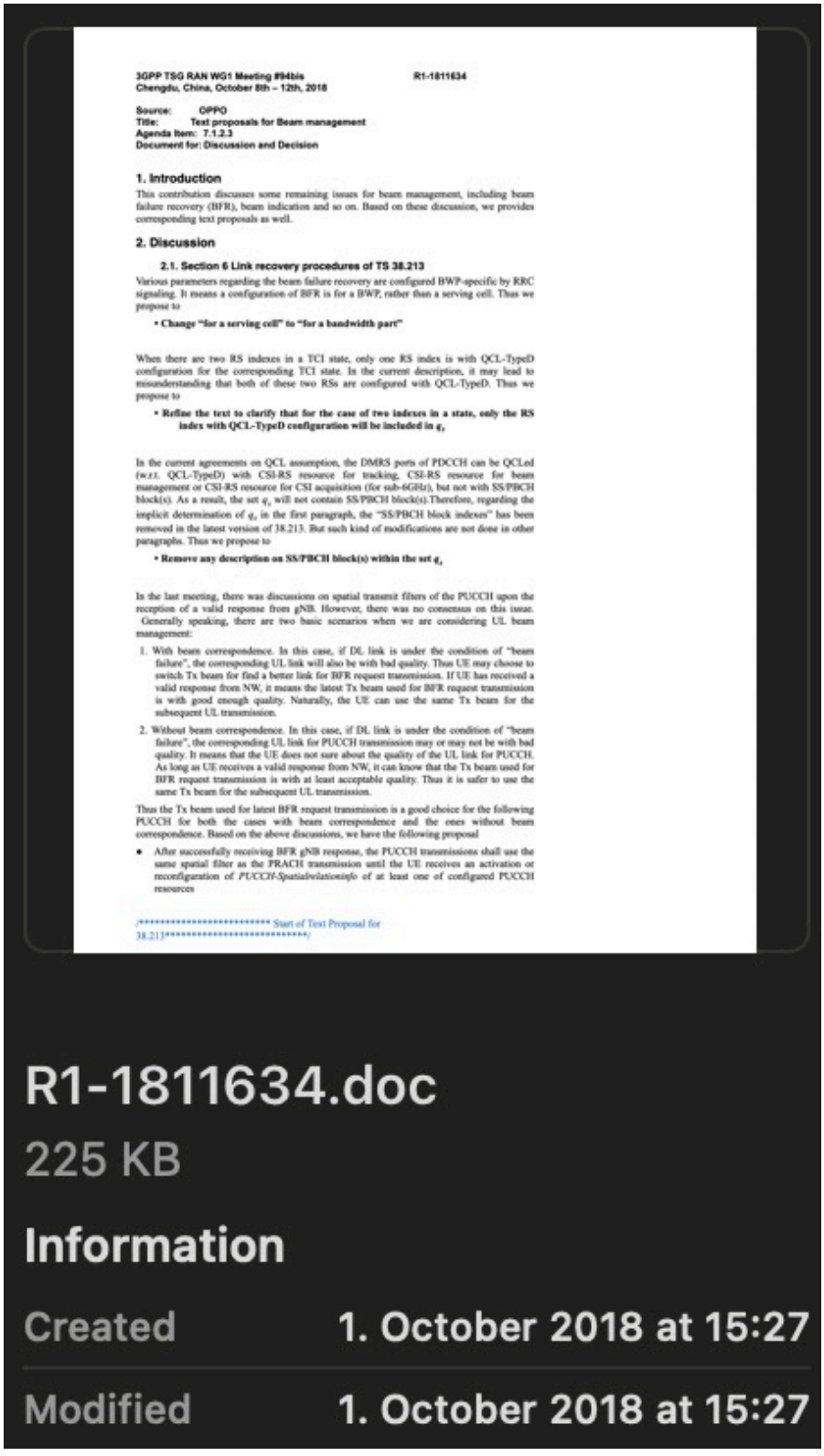
and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1811634 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

129. The public availability of the document is confirmed by the date stamp, October 1, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1811634.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181119002652/https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs as shown in the screenshot below:



130. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

131. In addition, metadata information for the downloaded and extracted TDoc file states a last Modified date of "1. October 2018," as shown in the screenshot below.



3GPP TSG RAN WG1 Meeting #94bis R1-1811634
Chengdu, China, October 8th – 12th, 2018

Source: OPPO
Title: Text proposals for Beam management
Agenda Item: 7.1.2.3
Document for: Discussion and Decision

1. Introduction

This contribution discusses some remaining issues for beam management, including beam failure recovery (BFR), beam indication and so on. Based on these discussion, we provides corresponding text proposals as well.

2. Discussion

2.1. Section 6 Link recovery procedures of TS 38.213

Various parameters regarding the beam failure recovery are configured BWP-specific by RRC signaling. It means a configuration of BFR is for a BWP, rather than a serving cell. Thus we propose to

- **Change "for a serving cell" to "for a bandwidth part"**

When there are two RS indexes in a TCI state, only one RS index is with QCL-TypeD configuration for the corresponding TCI state. In the current description, it may lead to misunderstanding that both of these two RSs are configured with QCL-TypeD. Thus we propose to

- **Refine the text to clarify that for the case of two indexes in a state, only the RS index with QCL-TypeD configuration will be included in q_1**

In the current agreements on QCL assumption, the DMRS ports of PDCCH can be QCLed (*w.r.t.* QCL-TypeD) with CSI-RS resource for tracking, CSI-RS resource for beam management or CSI-RS resource for CSI acquisition (for sub-6GHz), but not with SS/PBCH block(s). As a result, the set q_1 will not contain SS/PBCH block(s).Therefore, regarding the implicit determination of q_1 in the first paragraph, the "SS/PBCH block indexes" has been removed in the latest version of 38.213. But such kind of modifications are not done in other paragraphs. Thus we propose to

- **Remove any description on SS/PBCH block(s) within the set q_1**

In the last meeting, there was discussions on spatial transmit filters of the PUCCH upon the reception of a valid response from gNB. However, there was no consensus on this issue. Generally speaking, there are two basic scenarios when we are considering UL beam management:

1. With beam correspondence. In this case, if DL link is under the condition of "beam failure", the corresponding UL link will also be with bad quality. Thus UE may choose to switch Tx beam for find a better link for BFR request transmission. If UE has received a valid response from NW, it means the latest Tx beam used for BFR request transmission is with good enough quality. Naturally, the UE can use the same Tx beam for the subsequent UL transmission.
2. Without beam correspondence. In this case, if DL link is under the condition of "beam failure", the corresponding UL link for PUCCH transmission may or may not be with bad quality. It means that the UE does not sure about the quality of the UL link for PUCCH. As long as UE receives a valid response from NW, it can know that the Tx beam used for BFR request transmission is with at least acceptable quality. Thus it is safer to use the same Tx beam for the subsequent UL transmission.

Thus the Tx beam used for latest BFR request transmission is a good choice for the following PUCCH for both the cases with beam correspondence and the ones without beam correspondence. Based on the above discussions, we have the following proposal

- After successfully receiving BFR gNB response, the PUCCH transmissions shall use the same spatial filter as the PRACH transmission until the UE receives an activation or reconfiguration of *PUCCH-SpatialRelationInfo* of at least one of configured PUCCH resources

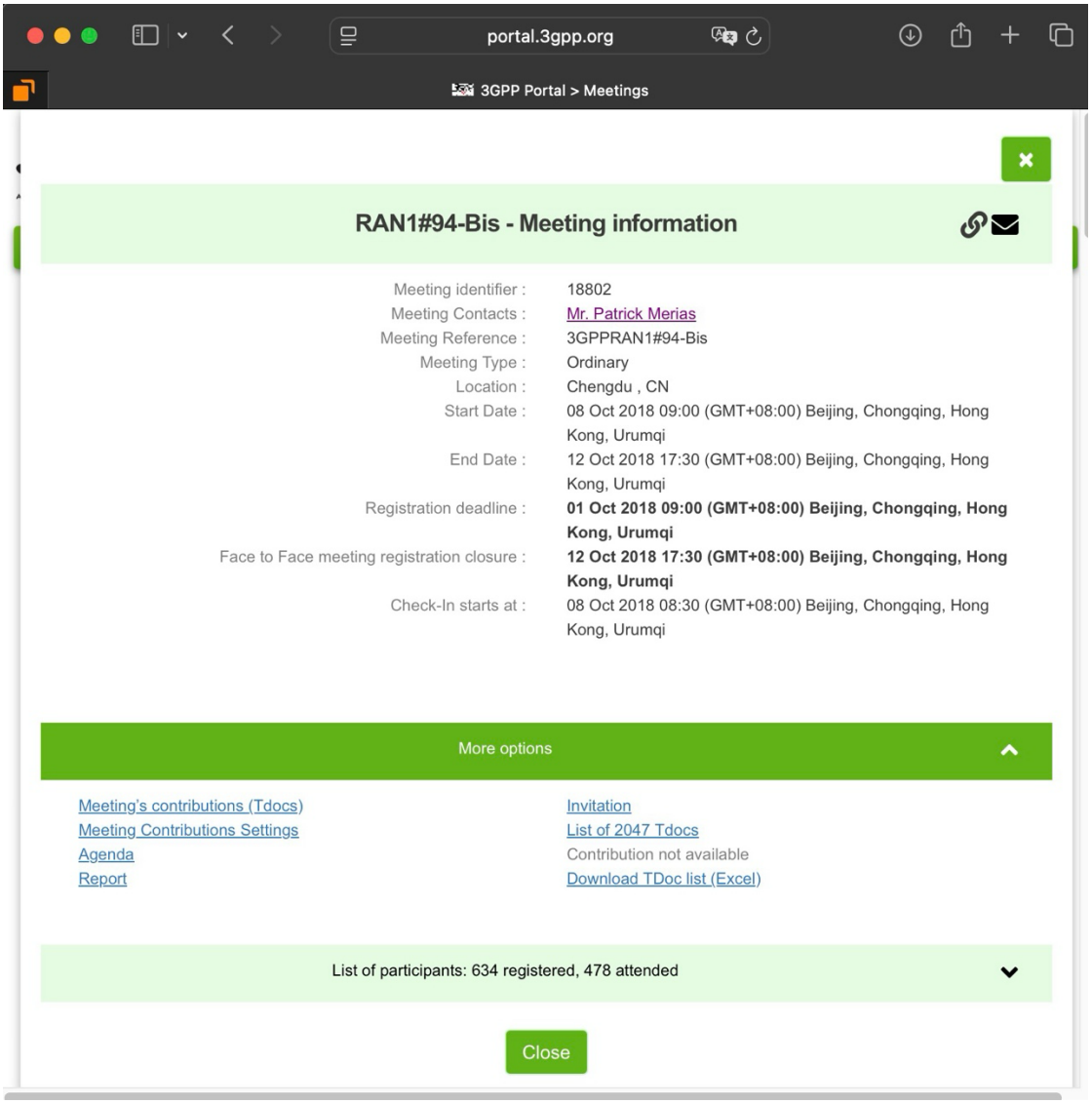
/********** Start of Text Proposal for 38.213**********/

R1-1811634.doc
225 KB
Information
Created 1. October 2018 at 15:27
Modified 1. October 2018 at 15:27

132. This last modified date is consistent with the October 1, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

133. Furthermore, the document was shared via the public 3GPP_TSG_RAN_WG1 email exploder on October 1, 2018, as shown in Appendix G. As of today, the 3GPP_TSG_RAN_WG1 email exploder has nearly 1500 subscribers as can be seen at https://list.etsi.org/scripts/wa.exe?INDEX. According to my experience I would expect a similar or only slightly smaller number of subscribers around 2018.

134. The final meeting report of the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China, can be found in Appendix E. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 478 individuals (out of 634 registered participants):



135. The meeting report mentions R1-1811634 on page 58 which clearly indicates that the document was registered for this meeting. Furthermore, the meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix F[10]. R1-1811634 is listed in row 1586 and is

[10] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

tagged as "available". Furthermore, the "Uploaded" date is shown as "2018-10-01" indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
1586	R1-1811634	Text proposals for Beam management	Guangdong OPPO Mobile Telecom.	available	2018-09-30 13:39:38	2018-10-01 08:02:29

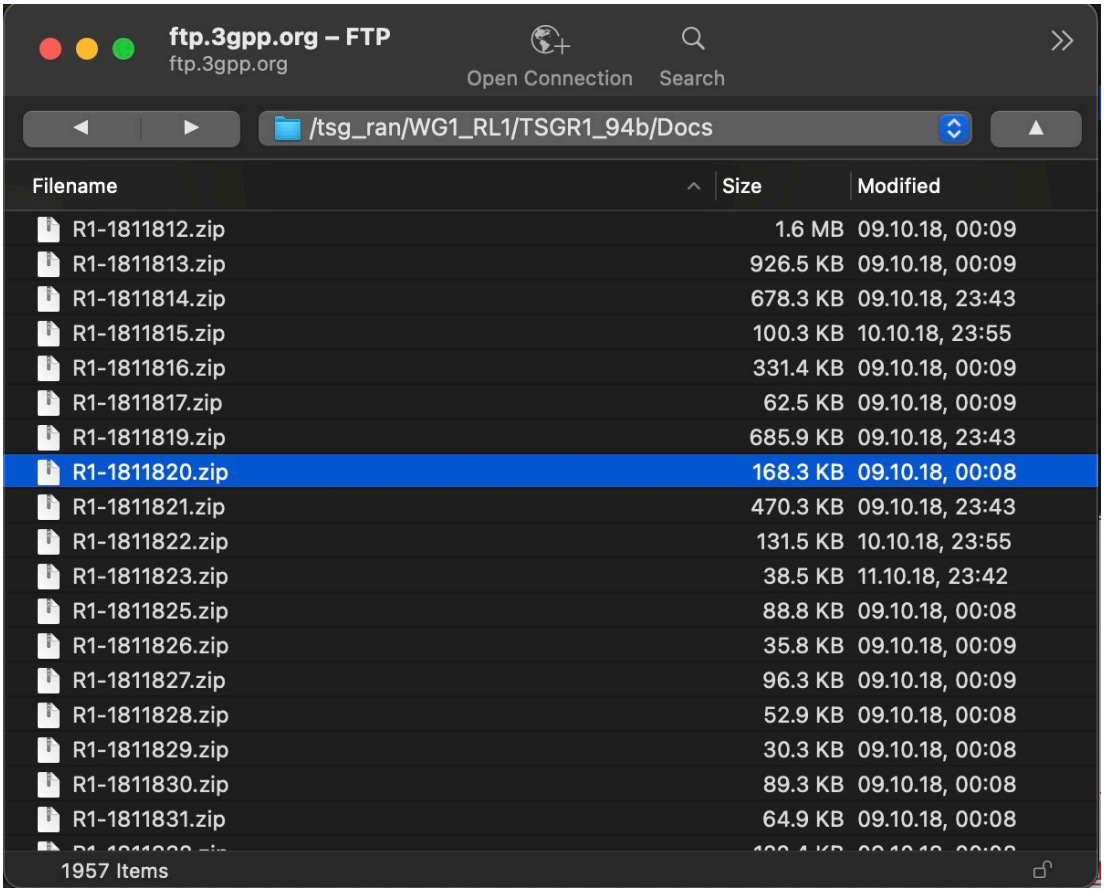
136. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1023 is an authentic copy of 3GPP TDoc R1-1811634 that was uploaded and made available via the 3GPP FTP server to the general public by October 1, 2018, at the latest.

9. TDoc R1-1811820

137. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1025 as a true and correct copy of 3GPP TDoc R1-1811820, which represents a 3GPP document with the title "Offline summary for PDCCH structure and search space." The document was authored by NTT DOCOMO, INC. and summarized a discussion on PDCCH structure and search space.

138. On its face, R1-1811820 refers to the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1811820 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

139. The public availability of the document is confirmed by the date stamp, October 9, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1811820.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181119002652/https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs as shown in the screenshot below:



140. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

141. In addition, metadata information for the downloaded and extracted TDoc file states a last Modified date of "8. October 2018," as shown in the screenshot below.



3GPP TSG RAN WG1 Meeting #94bis R1-1811820
Chengdu, China, October 8th – 12th, 2018

Source: NTT DOCOMO, INC.
Title: Offline summary for PDCCH structure and search space
Agenda Item: 7.1.3.1
Document for: Discussion and Decision

1. Introduction

This document summarizes the discussion points for PDCCH structure and search space. The topics to be discussed are described in Section 2 and Section 3. Companies are encouraged to check them and provide comment if any.

Note that following issues are somehow related to the search space aspects, but are assumed to be handled by other feature leads:

- **RA procedure**
  - QCL-source selection for CORESETs in case RA procedure (DOCOMO 11373)
- **DCI formats/contents:**
  - Identification between fallback DCI and non-fallback DCI (Huawei 10111)
  - Clarification on DCI size alignment (ZTE 10339)
  - Number of DCI format sizes for CA (ZTE 10339)
  - DCI format 1_0 sizing and RB indexing when no CORESET#0 is present (Intel 10754, Samsung 10842, DCM 11373, Ericsson 11488)
  - Padding bits handling (Panasonic 11397)
  - Where to map the TCI field for the DCI format 1_1 in a CORESET enabling tci-PresentInDCI (ASUSTEK 11423)
- **MIMO BM/BFR:**
  - Whether to support SSB/CORESET#0-based BFR (Huawei 10111, CATT 10520,)
  - TCI assumption for PDSCH (LGE 10256)
  - TCI-PresentInDCI for cross-carrier scheduling (MediaTek, 10421)
- **BWP:**
  - Condition on PDCCH monitoring for search spaces associated with the CORESET#0 if the DL BWP does not contain the initial DL BWP or uses different numerology (Intel 10754, Qualcomm 11234)
  - TCI field interpretation and TCI-state configuration for BWP-switching (DOCOMO 11373)
  - Default CSS configurations (DOCOMO 11373)
- **DL/UL scheduling procedure (or DCI formats/contents):**
  - Clarifications on the number of DCIs stored by a UE (DOCOMO 11373)
  - Clarification on 'Processing no more than one DCI with each RNTI in each of Type 0 CSS, Type 0A CSS, Type 1 CSS, Type 2 CSS, Type 3 CSS excluding unicast DCI per slot' (Panasonic 11397)

Following issue requires RAN2 feedback before RAN1 discussion:

- Search space and CORESET association for cross-carrier scheduling (ZTE 10339)

2. Remaining issues that need discussions

2.1 Simultaneous monitoring of PDCCHs with different QCL assumptions

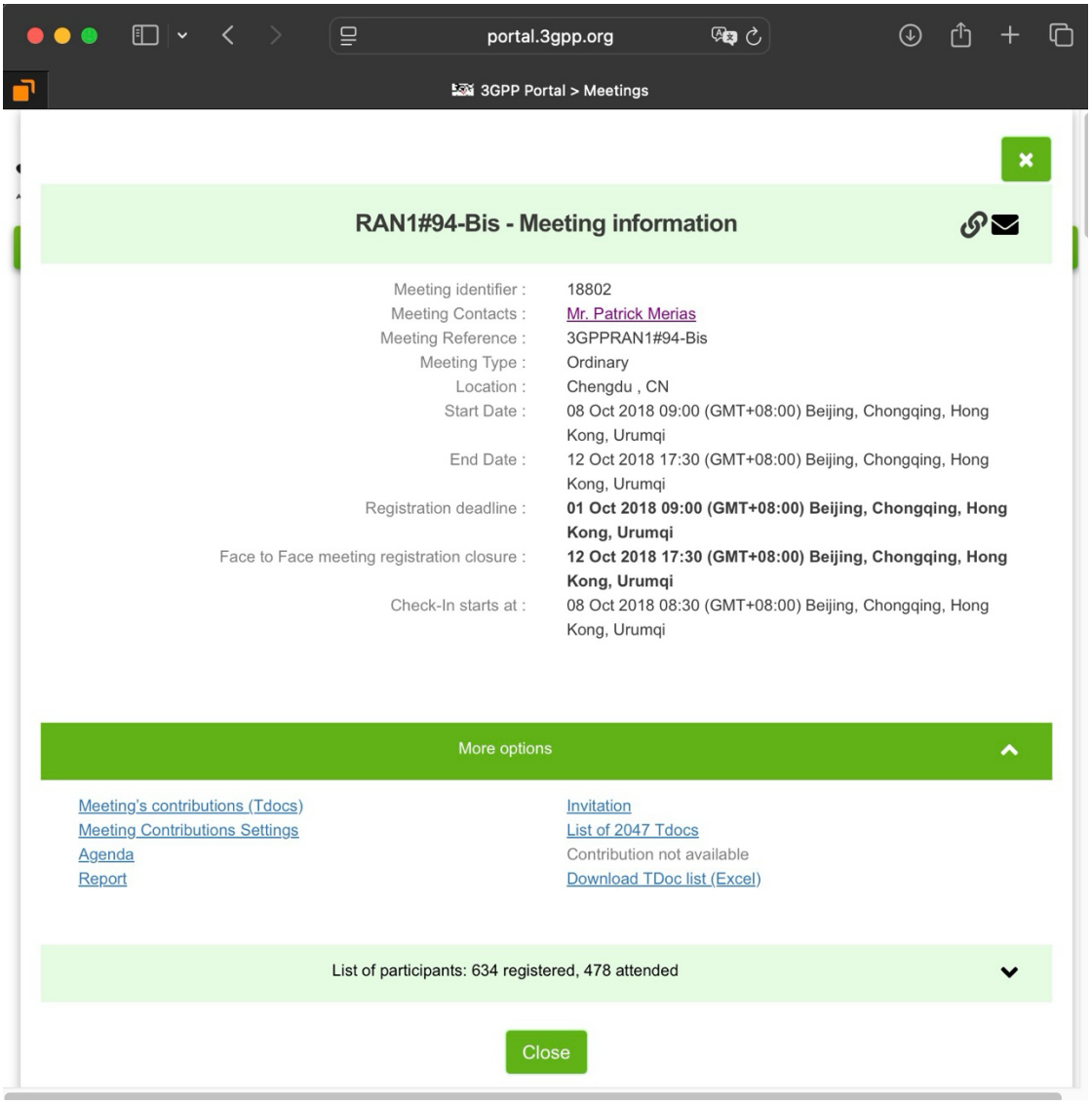
This UE behavior is not yet clear. Following offline proposal has been made but not yet clarified.

Offline proposal:

R1-1811820.docx
218 KB
Information
Created 8. October 2018 at 18:14
Modified 8. October 2018 at 18:14

142. This last modified date is consistent with the October 9, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

143. The final meeting report of the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China, can be found in Appendix E. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 478 individuals (out of 634 registered participants):



144. The meeting report mentions R1-1811820 on page 61 which clearly indicates that the document was registered for this meeting. Additionally, the meting report provides a summary of the discussion of the document:

R1-1811820 **Offline summary for PDCCH structure and search space NTT DOCOMO**
Discussion: Mr Chair recalled that his priority is to get stable NR specs by Dec18 - 17 remaining issues i s definitley out of the scope - requested focusing on non-controversial and essential enhancements
Decision: The document is noted.

Agreements:

- For cross-carrier scheduling with the same numerology between scheduling cell and scheduled cell(s) but different numerologies between scheduling cell(s), and the number of DL-CCs is up to 4 or with up to T DL-CCs where the UE reports BD capability of y >= T, the limit of BDs/CCEs per scheduling CC per slot is (the number of CCs schedulable by the scheduling CC) x (the limit of BDs/CCEs for non-CA case)
- For cross-carrier scheduling with the same numerology between scheduling cell and scheduled cell(s) but different numerologies between scheduling cell(s), and the number of DL-CCs is more than 4 and with up to T DL-CCs where the UE reports BD capability of y < T, the limit of BDs/CCEs per numerology per slot is Floor{Xi / (X0 + X1 + X2 + X3) * (Mi or Ni) * y)}, where;
  - Xi (i=0, 1, 2, 3) denotes the number of DL-CCs per numerology i
  - Mi and Ni denote the number of BDs and CCEs per slot specified for non-CA case for numerology i, respectively
- Discuss further offline per CC limit for the above two cases

Friday

- per CC limit for the above two cases should be revisited in RAN1#95
  - Take into account the number of search spaces (i.e., up to 10 per BWP in RAN1 spec)
    - Especially for cross-carrier scheduling.

Check further offline regarding TP of 3.4 of R1-1811820

145. Furthermore, the meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix F[11]. R1-1811820 is listed in row 1772 and is tagged as "noted". Furthermore, the "Uploaded" date is shown as "2018-10-08" indicating the document was available at the meeting, as can be seen by the screenshot below:

[11] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
1772	R1-1811820	Offline summary for PDCCH structure and search space	NTT DOCOMO	noted	2018-10-08 14:50:38	2018-10-08 14:50:38

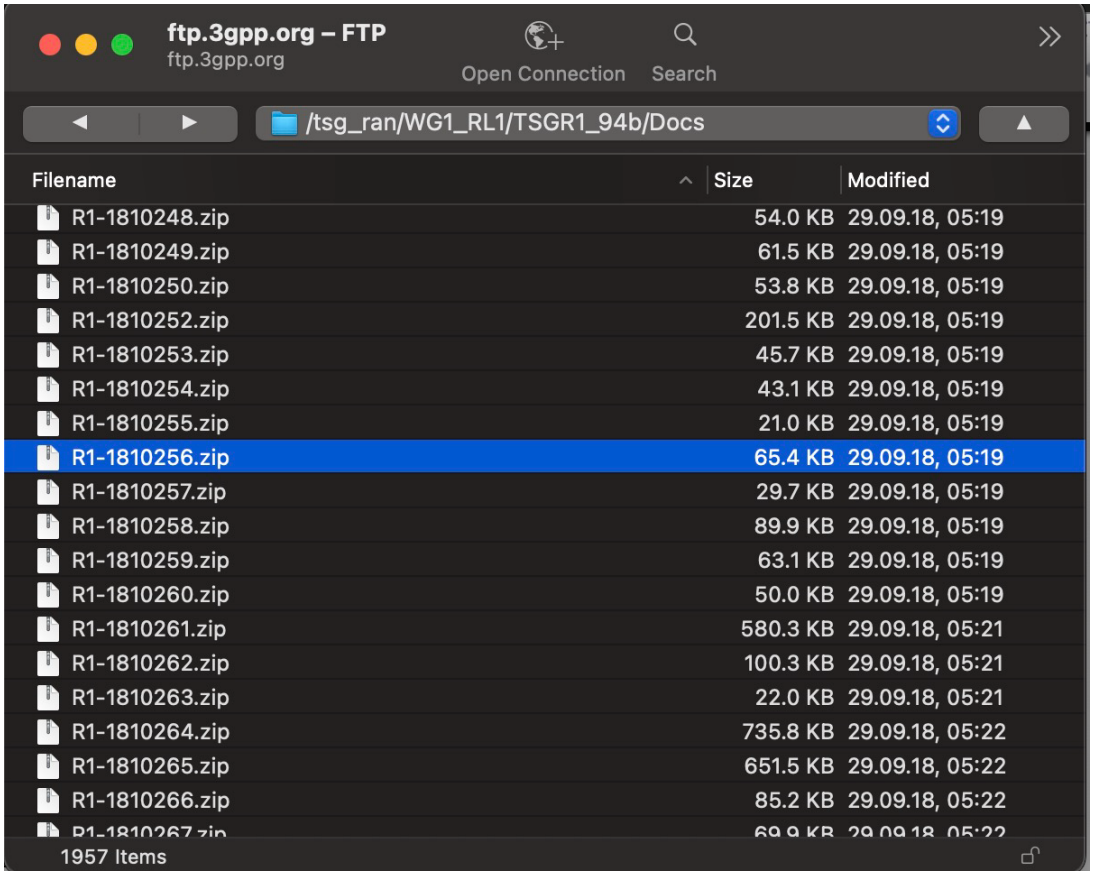
146. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1025 is an authentic copy of 3GPP TDoc R1-1811820 that was uploaded and made available via the 3GPP FTP server to the general public by October 9, 2018, at the latest.

10. TDoc R1-1810256

147. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1026 as a true and correct copy of 3GPP TDoc R1-1810256, which represents a 3GPP document with the title "Remaining issues on downlink control channel." The document was authored by LG Electronics and discussed issues related to PDCCH structure, search space, and GC-PDCCH.

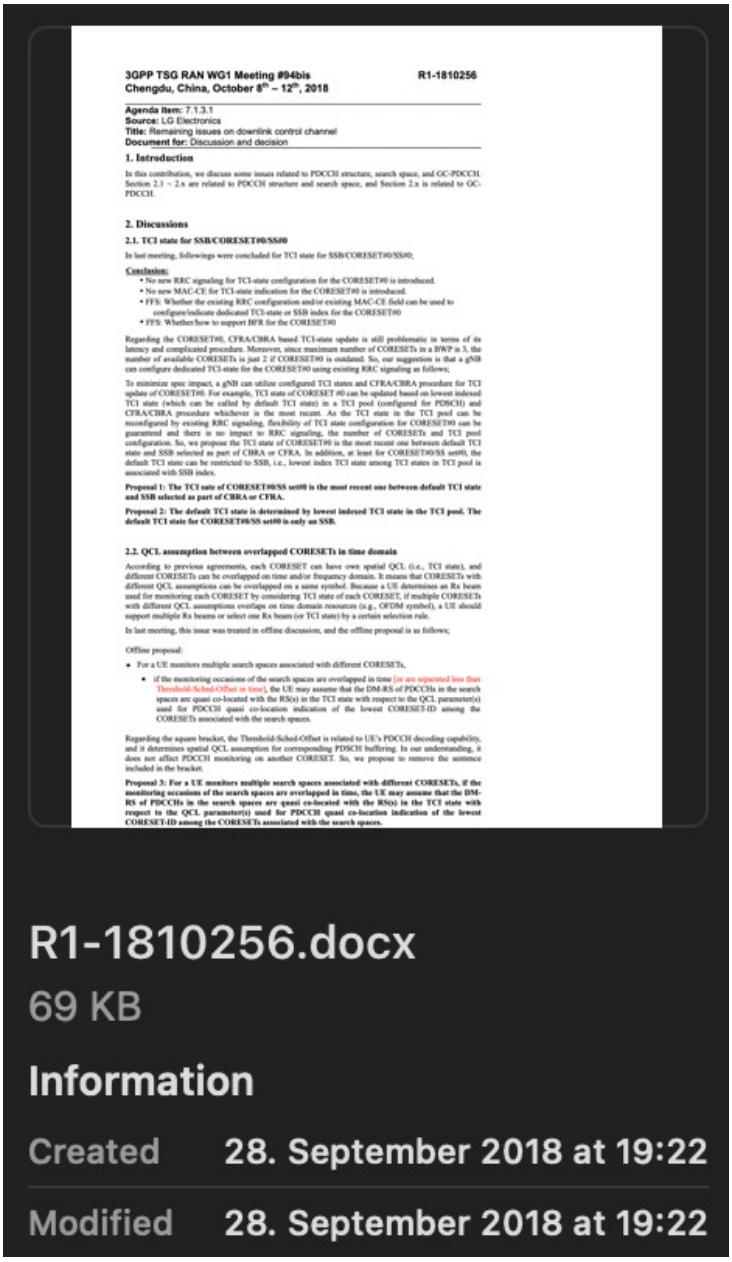
148. On its face, R1-1810256 refers to the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1810256 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

149. The public availability of the document is confirmed by the date stamp, September 29, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1810256.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181119002652/https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs as shown in the screenshot below:



150. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

151. In addition, metadata information for the downloaded and extracted TDoc file states a last Modified date of "28. September 2018," as shown in the screenshot below.



3GPP TSG RAN WG1 Meeting #94bis R1-1810256
Chengdu, China, October 8th – 12th, 2018

Agenda item: 7.1.3.1
Source: LG Electronics
Title: Remaining issues on downlink control channel
Document for: Discussion and decision

1. Introduction

In this contribution, we discuss some issues related to PDCCH structure, search space, and GC-PDCCH. Section 2.1 ~ 2.x are related to PDCCH structure and search space, and Section 2.x is related to GC-PDCCH.

2. Discussions

2.1. TCI state for SSB/CORESET#0/SS#0

In last meeting, followings were concluded for TCI state for SSB/CORESET#0/SS#0;

Conclusion:
- No new RRC signaling for TCI-state configuration for the CORESET#0 is introduced.
- No new MAC-CE for TCI-state indication for the CORESET#0 is introduced.
- FFS: Whether the existing RRC configuration and/or existing MAC-CE field can be used to configure/indicate dedicated TCI-state or SSB index for the CORESET#0
- FFS: Whether/how to support BFR for the CORESET#0

Regarding the CORESET#0, CFRA/CBRA based TCI-state update is still problematic in terms of its latency and complicated procedure. Moreover, since maximum number of CORESETs in a BWP is 3, the number of available CORESETs is just 2 if CORESET#0 is outdated. So, our suggestion is that a gNB can configure dedicated TCI-state for the CORESET#0 using existing RRC signaling as follows;

To minimize spec impact, a gNB can utilize configured TCI states and CFRA/CBRA procedure for TCI update of CORESET#0. For example, TCI state of CORESET #0 can be updated based on lowest indexed TCI state (which can be called by default TCI state) in a TCI pool (configured for PDSCH) and CFRA/CBRA procedure whichever is the most recent. As the TCI state in the TCI pool can be reconfigured by existing RRC signaling, flexibility of TCI state configuration for CORESET#0 can be guaranteed and there is no impact to RRC signaling, the number of CORESETs and TCI pool configuration. So, we propose the TCI state of CORESET#0 is the most recent one between default TCI state and SSB selected as part of CBRA or CFRA. In addition, at least for CORESET#0/SS set#0, the default TCI state can be restricted to SSB, i.e., lowest index TCI state among TCI states in TCI pool is associated with SSB index.

Proposal 1: The TCI sate of CORESET#0/SS set#0 is the most recent one between default TCI state and SSB selected as part of CBRA or CFRA.

Proposal 2: The default TCI state is determined by lowest indexed TCI state in the TCI pool. The default TCI state for CORESET#0/SS set#0 is only an SSB.

2.2. QCL assumption between overlapped CORESETs in time domain

According to previous agreements, each CORESET can have own spatial QCL (i.e., TCI state), and different CORESETs can be overlapped on time and/or frequency domain. It means that CORESETs with different QCL assumptions can be overlapped on a same symbol. Because a UE determines an Rx beam used for monitoring each CORESET by considering TCI state of each CORESET, if multiple CORESETs with different QCL assumptions overlaps on time domain resources (e.g., OFDM symbol), a UE should support multiple Rx beams or select one Rx beam (or TCI state) by a certain selection rule.

In last meeting, this issue was treated in offline discussion, and the offline proposal is as follows;

Offline proposal:
- For a UE monitors multiple search spaces associated with different CORESETs,
  - if the monitoring occasions of the search spaces are overlapped in time [or are separated less than Threshold-Sched-Offset in time], the UE may assume that the DM-RS of PDCCHs in the search spaces are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the lowest CORESET-ID among the CORESETs associated with the search spaces.

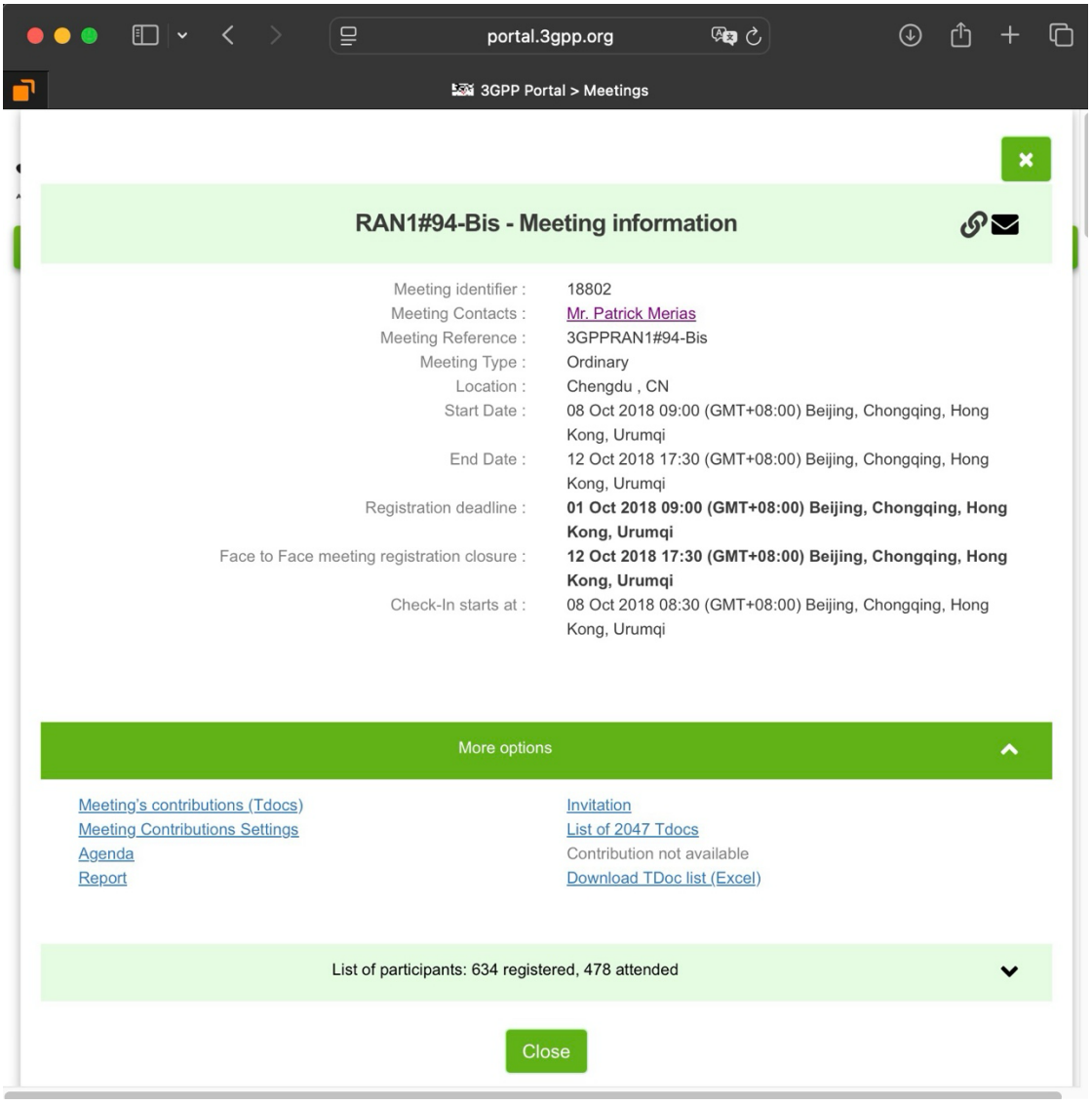
Regarding the square bracket, the Threshold-Sched-Offset is related to UE's PDCCH decoding capability, and it determines spatial QCL assumption for corresponding PDSCH buffering. In our understanding, it does not affect PDCCH monitoring on another CORESET. So, we propose to remove the sentence included in the bracket.

Proposal 3: For a UE monitors multiple search spaces associated with different CORESETs, if the monitoring occasions of the search spaces are overlapped in time, the UE may assume that the DM-RS of PDCCHs in the search spaces are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the lowest CORESET-ID among the CORESETs associated with the search spaces.

R1-1810256.docx
69 KB
Information
Created 28. September 2018 at 19:22
Modified 28. September 2018 at 19:22

152. This last modified date is consistent with the September 29, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

153. The final meeting report of the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China, can be found in Appendix E. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 478 individuals (out of 634 registered participants):



154. The meeting report mentions R1-1810256 on page 76 which clearly indicates that the document was registered for this meeting. Furthermore, the meeting report includes in the zip file the meeting's document list of which an excerpt can be found in Appendix F[12]. R1-1810256 is listed in row 208 and is tagged as "available". Furthermore, the "Uploaded" date is shown as "2018-09-29" indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
208	R1-1810256	Remaining issues on downlink control channel	LG Electronics	available	2018-09-21 10:23:42	2018-09-29 05:21:07

155. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1026 is an authentic copy of 3GPP TDoc R1-1810256 that was uploaded and made available via the 3GPP FTP server to the general public by September 29, 2018, at the latest.

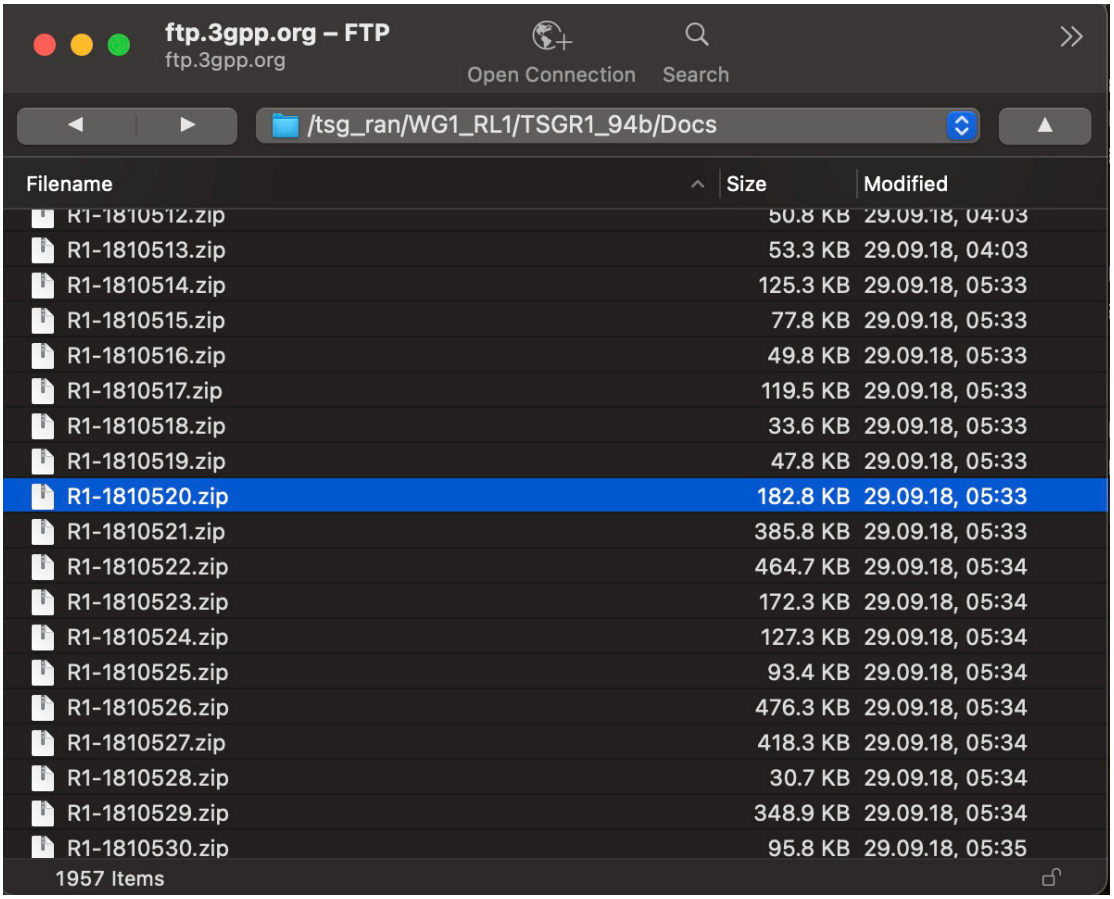
11. TDoc R1-1810520

[12] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

156. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1027 as a true and correct copy of 3GPP TDoc R1-1810520, which represents a 3GPP document with the title "Open issues and corrections for NR PDCCH." The document was authored by CATT and addressed issues on DL control signaling including PDCCH structure and search space.

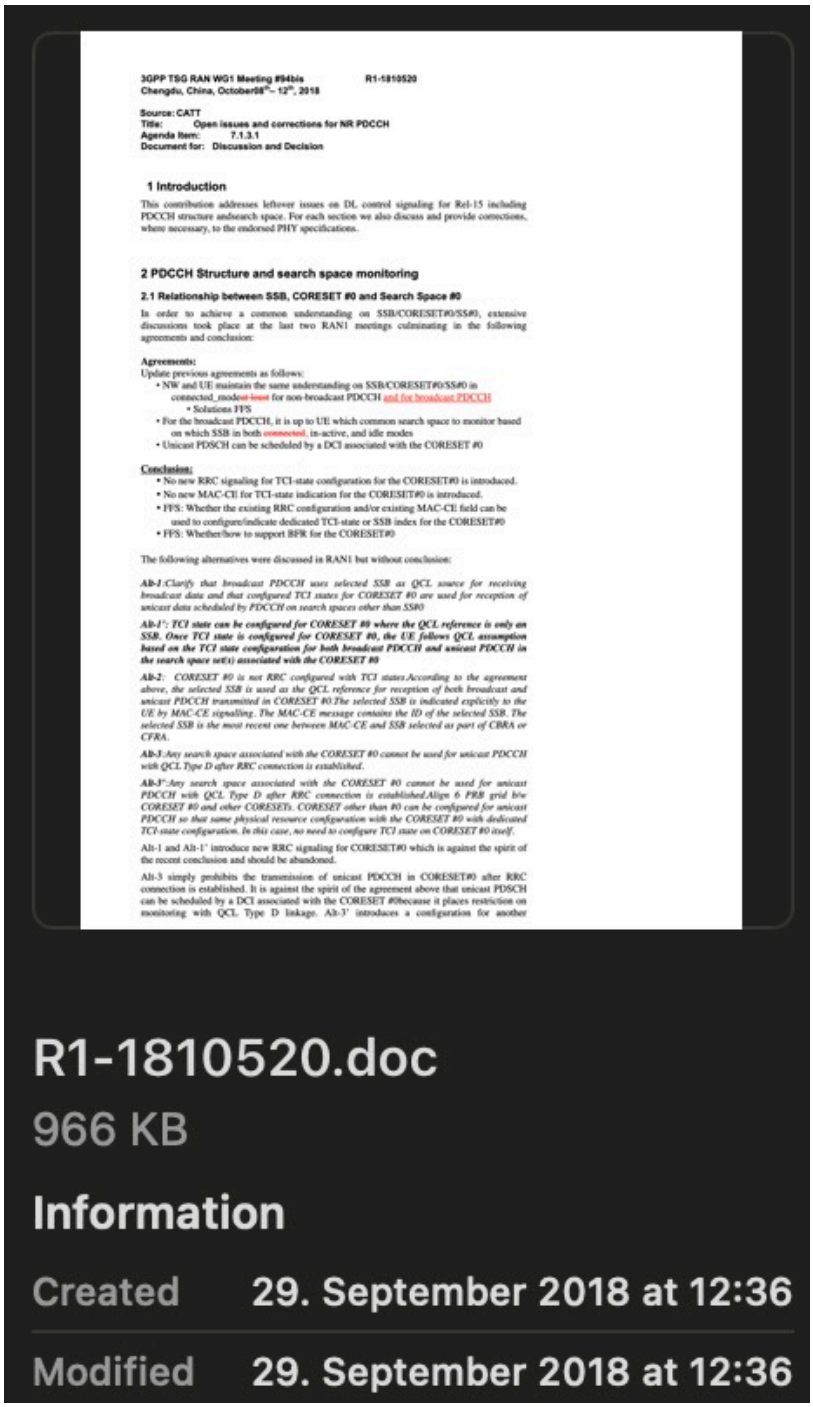
157. On its face, R1-1810520 refers to the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that R1-1810520 was available either prior to or during or shortly after that meeting to at least all attending 3GPP members.

158. The public availability of the document is confirmed by the date stamp, September 29, 2018, shown on the historic 3GPP FTP server for the corresponding downloadable file ("R1-1810520.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181119002652/https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_94b/Docs as shown in the screenshot below:



159. Experts in the field of determining the public availability of 3GPP documents would reasonably rely upon the FTP server upload date on the 3GPP FTP server as the date the document became available to the public.

160. In addition, metadata information for the downloaded and extracted TDoc file states a last Modified date of "29. September 2018," as shown in the screenshot below.



3GPP TSG RAN WG1 Meeting #94bis R1-1810520
Chengdu, China, October8th – 12th, 2018

Source: CATT
Title: Open issues and corrections for NR PDCCH
Agenda Item: 7.1.3.1
Document for: Discussion and Decision

1 Introduction

This contribution addresses leftover issues on DL control signaling for Rel-15 including PDCCH structure andsearch space. For each section we also discuss and provide corrections, where necessary, to the endorsed PHY specifications.

2 PDCCH Structure and search space monitoring

2.1 Relationship between SSB, CORESET #0 and Search Space #0

In order to achieve a common understanding on SSB/CORESET#0/SS#0, extensive discussions took place at the last two RAN1 meetings culminating in the following agreements and conclusion:

Agreements:
Update previous agreements as follows:
- NW and UE maintain the same understanding on SSB/CORESET#0/SS#0 in connected_mode~~or less~~ for non-broadcast PDCCH and for broadcast PDCCH
  - Solutions FFS
- For the broadcast PDCCH, it is up to UE which common search space to monitor based on which SSB in both connected, in-active, and idle modes
- Unicast PDSCH can be scheduled by a DCI associated with the CORESET #0

Conclusion:
- No new RRC signaling for TCI-state configuration for the CORESET#0 is introduced.
- No new MAC-CE for TCI-state indication for the CORESET#0 is introduced.
- FFS: Whether the existing RRC configuration and/or existing MAC-CE field can be used to configure/indicate dedicated TCI-state or SSB index for the CORESET#0
- FFS: Whether/how to support BFR for the CORESET#0

The following alternatives were discussed in RAN1 but without conclusion:

Alt-1*:Clarify that broadcast PDCCH uses selected SSB as QCL source for receiving broadcast data and that configured TCI states for CORESET #0 are used for reception of unicast data scheduled by PDCCH on search spaces other than SS#0*

Alt-1': TCI state can be configured for CORESET #0 where the QCL reference is only an SSB. Once TCI state is configured for CORESET #0, the UE follows QCL assumption based on the TCI state configuration for both broadcast PDCCH and unicast PDCCH in the search space set(s) associated with the CORESET #0

Alt-2*: CORESET #0 is not RRC configured with TCI states.According to the agreement above, the selected SSB is used as the QCL reference for reception of both broadcast and unicast PDCCH transmitted in CORESET #0.The selected SSB is indicated explicitly to the UE by MAC-CE signalling. The MAC-CE message contains the ID of the selected SSB. The selected SSB is the most recent one between MAC-CE and SSB selected as part of CBRA or CFRA.*

Alt-3*:Any search space associated with the CORESET #0 cannot be used for unicast PDCCH with QCL Type D after RRC connection is established.*

Alt-3'*:Any search space associated with the CORESET #0 cannot be used for unicast PDCCH with QCL Type D after RRC connection is established.Align 6 PRB grid b/w CORESET #0 and other CORESETs. CORESET other than #0 can be configured for unicast PDCCH so that same physical resource configuration with the CORESET #0 with dedicated TCI-state configuration. In this case, no need to configure TCI state on CORESET #0 itself.*

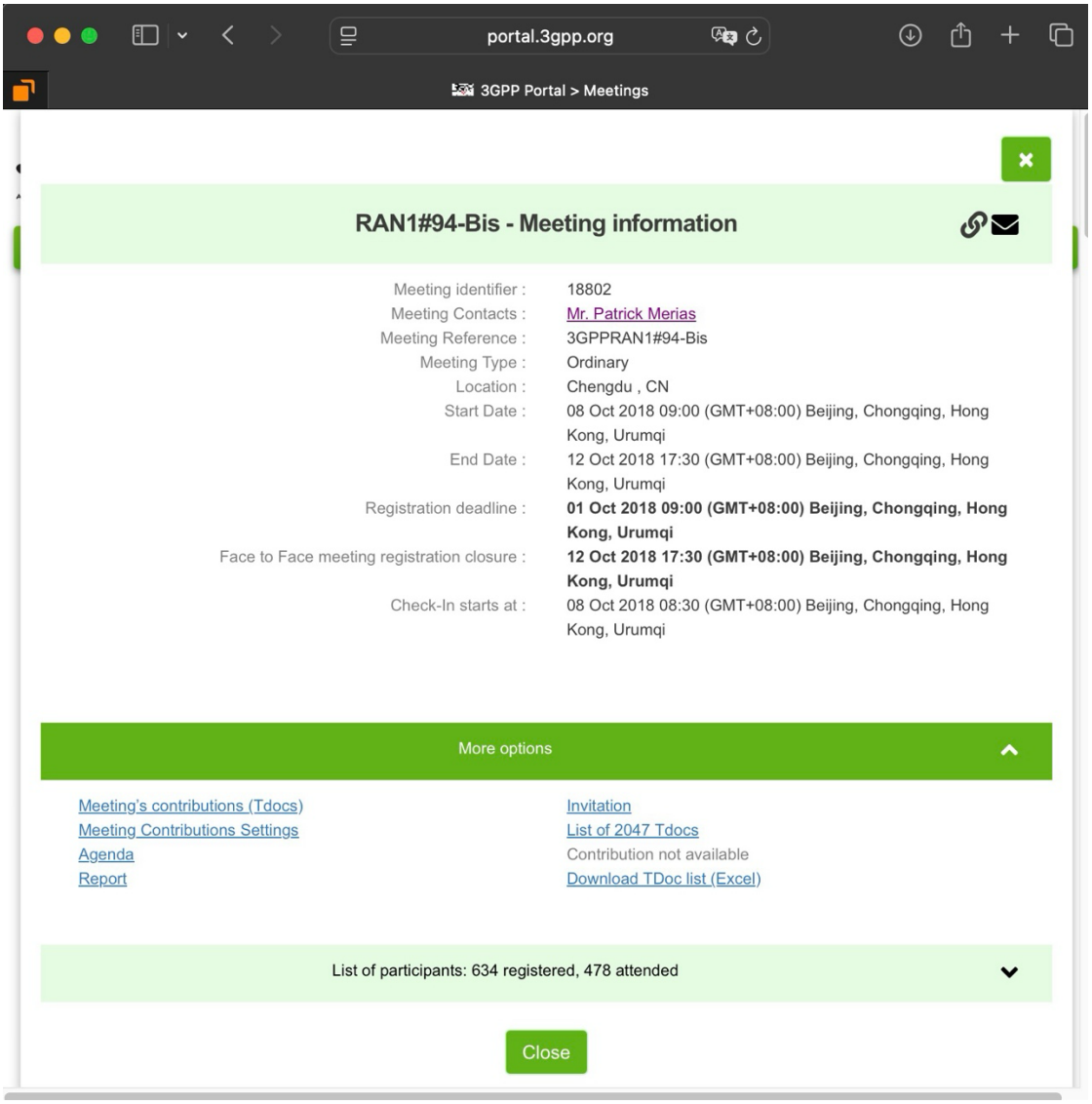
Alt-1 and Alt-1' introduce new RRC signaling for CORESET#0 which is against the spirit of the recent conclusion and should be abandoned.

Alt-3 simply prohibits the transmission of unicast PDCCH in CORESET#0 after RRC connection is established. It is against the spirit of the agreement above that unicast PDSCH can be scheduled by a DCI associated with the CORESET #0because it places restriction on monitoring with QCL Type D linkage. Alt-3' introduces a configuration for another

R1-1810520.doc
966 KB
Information
Created 29. September 2018 at 12:36
Modified 29. September 2018 at 12:36

161. This last modified date is consistent with the September 29, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

162. The final meeting report of the RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China, can be found in Appendix E. According to the 3GPP website at https://portal.3gpp.org/Meetings.aspx#/ which is shown by the screenshot below, that meeting was attended by 478 individuals (out of 634 registered participants):



163. The meeting report mentions R1-1810520 on page 76 which clearly indicates that the document was registered for this meeting. Furthermore, the meeting report includes in the zip file the meeting's document list of which an

excerpt can be found in Appendix F[13]. R1-1810520 is listed in row 472 and is tagged as "available". Furthermore, the "Uploaded" date is shown as "2018-09-29" indicating the document was available at the meeting, as can be seen by the screenshot below:

	A	B	C	N	O	P
1	TDoc	Title	Source	TDoc Status	Reservation date	Uploaded
472	R1-1810520	Open issues and corrections for NR PDCCH	CATT	available	2018-09-26 01:43:00	2018-09-29 05:39:47

164. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, Ex. 1027 is an authentic copy of 3GPP TDoc R1-1810520 that was uploaded and made available via the 3GPP FTP server to the general public by September 29, 2018, at the latest.

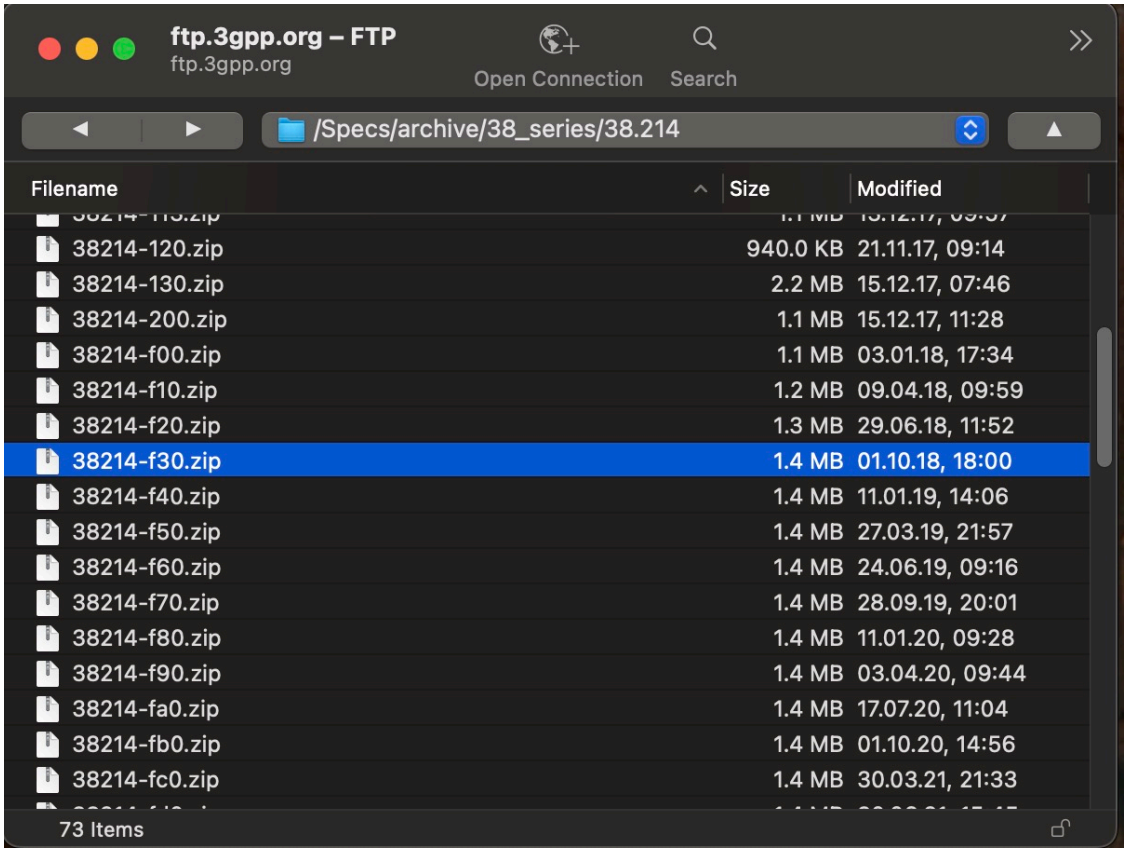
12. TS 38.214 V15.3.0

165. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1012 as a true and correct copy of version 15.3.0 of technical specification 3GPP TS 38.214 ("3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical layer procedures for data

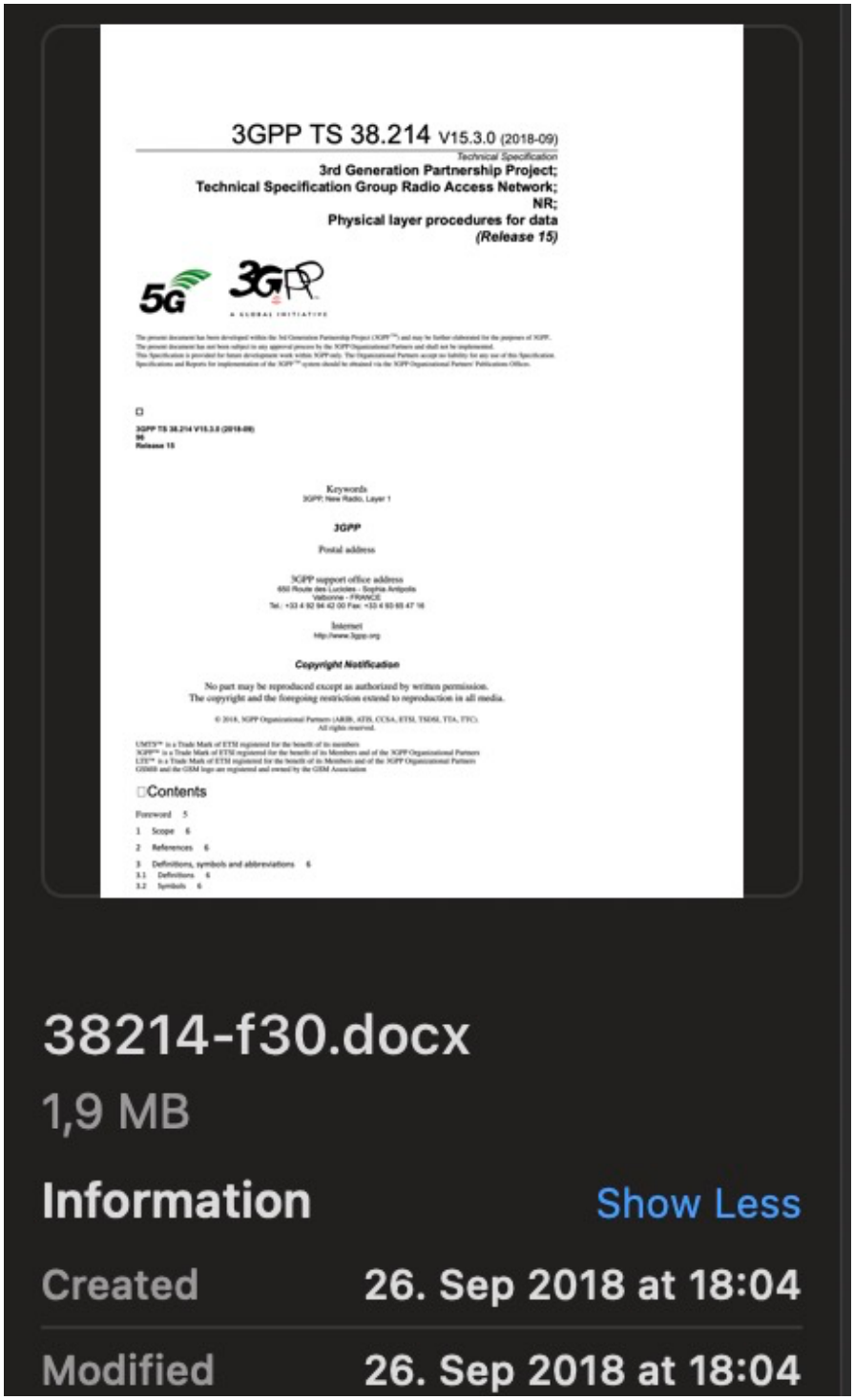
[13] Given the size of the document list with over 2000 rows (documents) and over 20 columns the Appendix only includes the columns relevant for this declaration: TDoc, Title, Source, TDoc Status, Reservation date, Uploaded.

(Release 15)"), which shows on its cover page "2018-09" as the year (2018) and month (March) during which this document was released by 3GPP.

166. The document was published and freely available on 3GPP's FTP server by October 1, 2018. This is confirmed by the date stamp shown on the historic 3GPP FTP server for the corresponding downloadable file ("38214-f30.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181017164334/http://www.3gpp.org/ftp/Specs/archive/38_series/38.214/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/Specs/archive/38_series/38.214, as shown by the screen shot below:

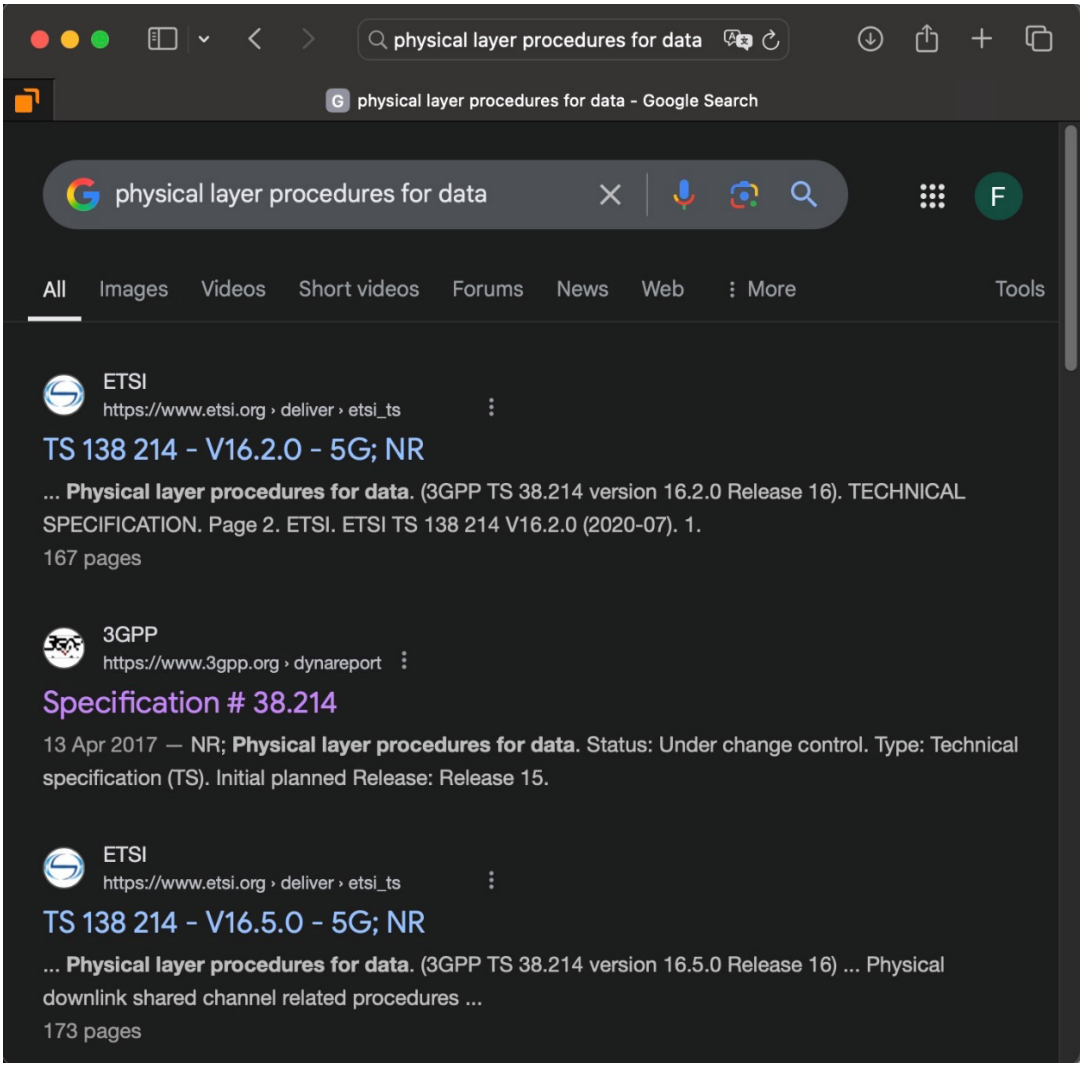


167. In addition, metadata information for the downloaded and extracted specification file states a last "Modified" date of "26. Sep 2018", as shown in the screenshot below:

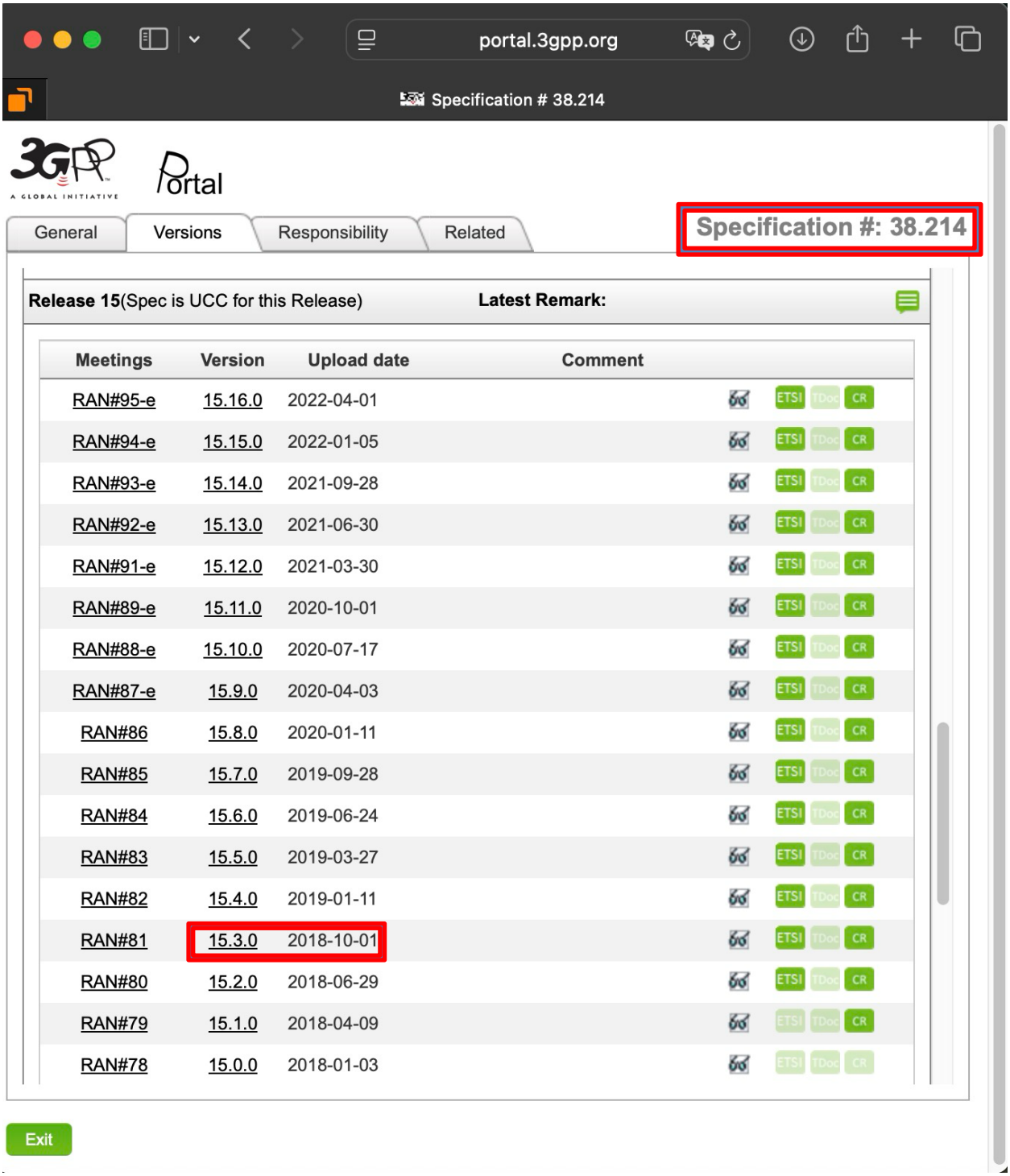

3GPP TS 38.214 V15.3.0 (2018-09)
Technical Specification
3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NR;
Physical layer procedures for data
(Release 15)
38214-f30.docx
1,9 MB
Information
Show Less
Created
26. Sep 2018 at 18:04
Modified
26. Sep 2018 at 18:04

168. This last modified date is well aligned with the October 1, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload documents shortly after completing them.

169. I believe that a person without prior knowledge of 3GPP and/or the technical specification (TS) number would have been able to easily find the TS for download via internet search. For instance, a Google search for "physical layer procedures for data" provides the TS number "38.214" as one of the top results as can be seen in the screenshot below:



170. Following the provided search result link "Specification # 38.214" leads to a 3GPP web page offering under the tab "Versions" download links to all versions of TS 38.214 including version 15.3.0, as shown by the screenshot below:


portal.3gpp.org
Specification # 38.214
3GPP
A GLOBAL INITIATIVE
Portal
General
Versions
Responsibility
Related
Specification #: 38.214
Release 15(Spec is UCC for this Release)
Latest Remark:
Meetings
Version
Upload date
Comment
RAN#95-e 15.16.0 2022-04-01
RAN#94-e 15.15.0 2022-01-05
RAN#93-e 15.14.0 2021-09-28
RAN#92-e 15.13.0 2021-06-30
RAN#91-e 15.12.0 2021-03-30
RAN#89-e 15.11.0 2020-10-01
RAN#88-e 15.10.0 2020-07-17
RAN#87-e 15.9.0 2020-04-03
RAN#86 15.8.0 2020-01-11
RAN#85 15.7.0 2019-09-28
RAN#84 15.6.0 2019-06-24
RAN#83 15.5.0 2019-03-27
RAN#82 15.4.0 2019-01-11
RAN#81 15.3.0 2018-10-01
RAN#80 15.2.0 2018-06-29
RAN#79 15.1.0 2018-04-09
RAN#78 15.0.0 2018-01-03
ETSI
TDoc
CR
Exit

171. The above example search illustrates that it is very easy for an interested member of the public without prior knowledge of the TS number and even without prior knowledge of 3GPP to locate any version of TS 38.214, including version 15.3.0, for download.

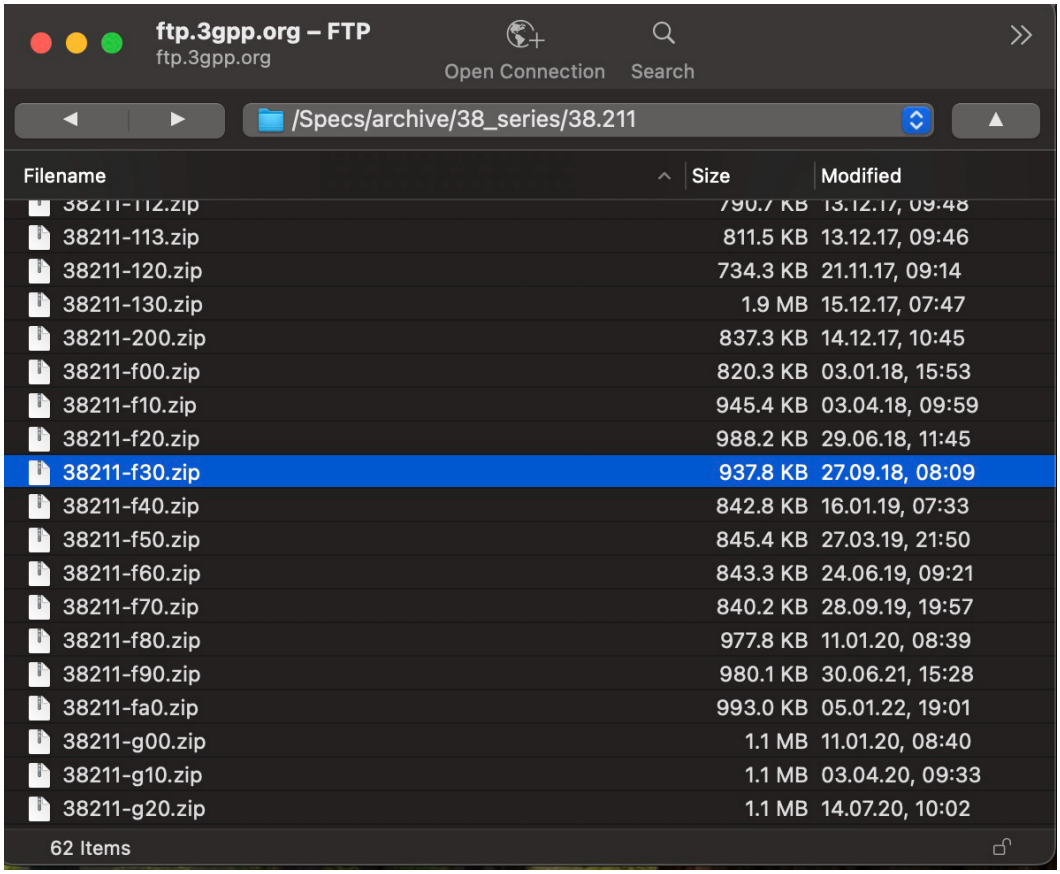
172. The above search was performed at the time of writing this report. According to my personal experience, in October 2018 or around that timeframe it would have been similarly straightforward to locate a path to download version 15.3.0 of TS 38.214.

173. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that this document was available to all 3GPP members and the general public by October 1, 2018, at the latest.

13. TS 38.211 V15.3.0

174. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1018 as a true and correct copy of version 15.3.0 of technical specification 3GPP TS 38.211 ("3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical channels and modulation (Release 15)"), which shows on its cover page "2018-09" as the year (2018) and month (December) during which this document was released by 3GPP.

175. The document was published and freely available on 3GPP's FTP server by September 27, 2018. This is confirmed by the date stamp shown on the historic 3GPP FTP server for the corresponding downloadable file ("38211-f30.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20200315162707/https://www.3gpp.org/ftp/Specs/archive/38_series/38.211/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/Specs/archive/38_series/38.211, as shown by the screenshot below:



176. In addition, metadata information for the downloaded and extracted specification files states a last Modified dates of "27. September 2018", as shown in the screenshot below:

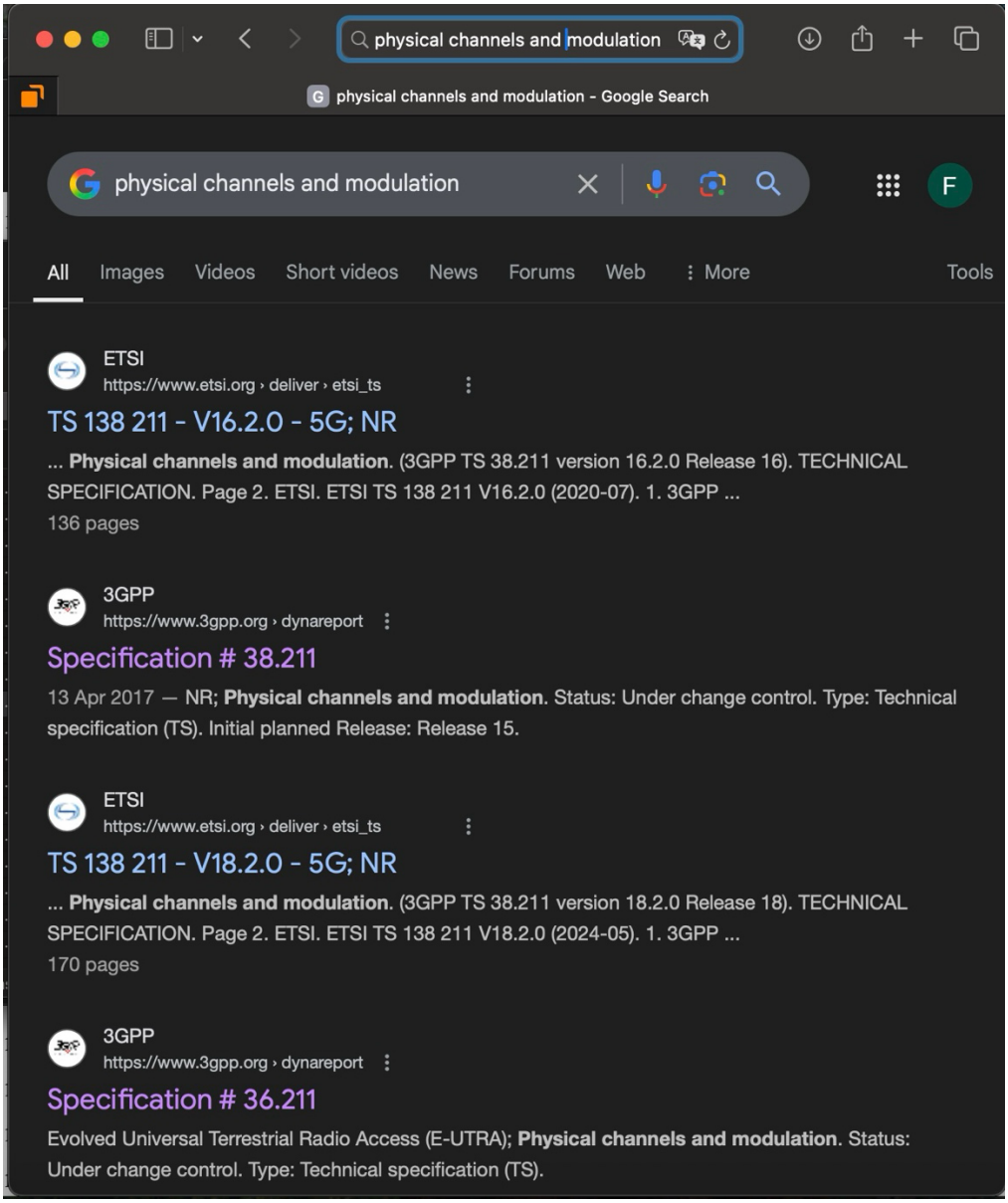


177. This last modified date is well aligned with the September 27, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload documents shortly after completing them.

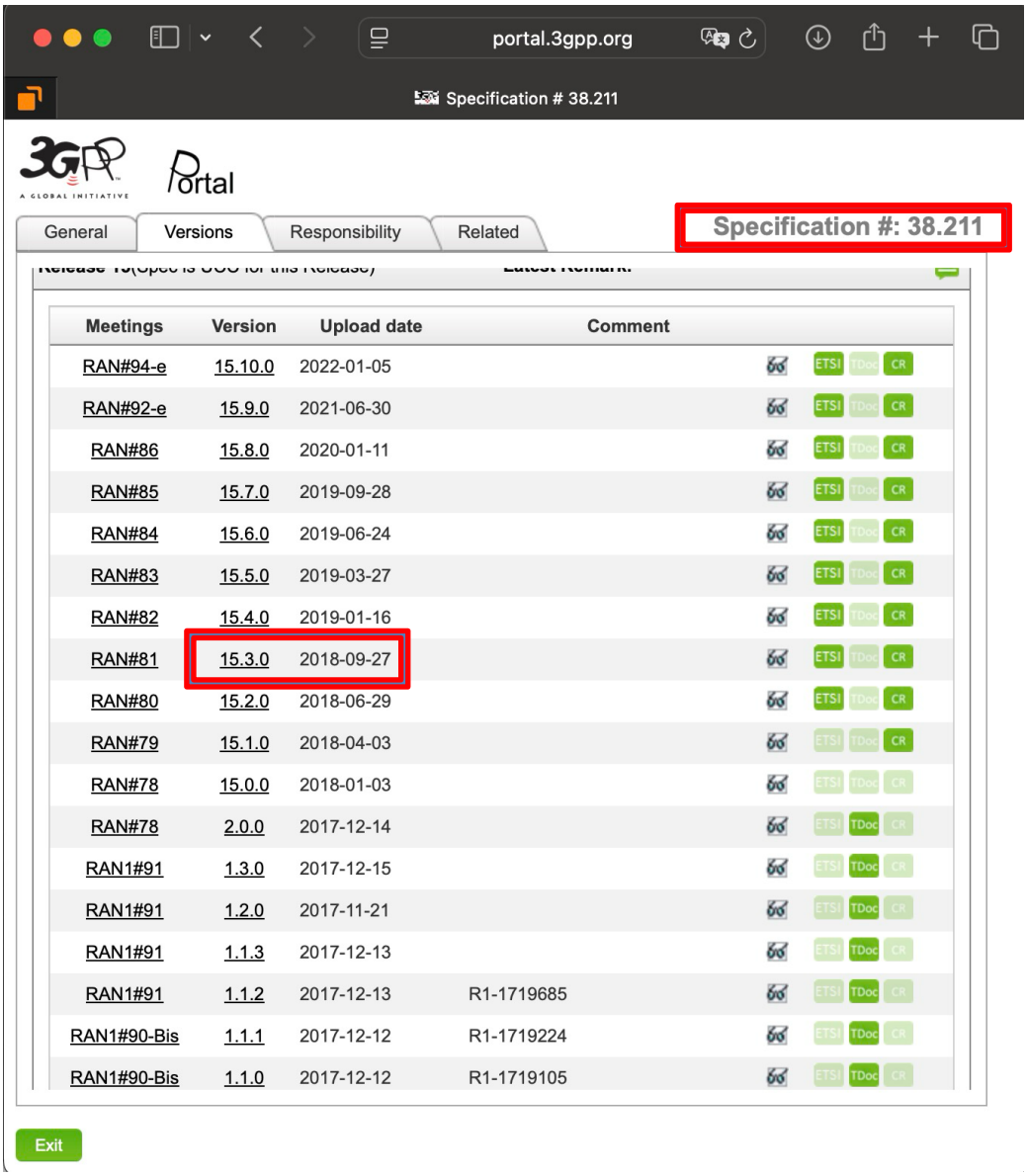
178. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that this document

was available to all 3GPP members and the general public by September 27, 2018, at the latest.

179. I believe that a person without prior knowledge of 3GPP and/or the technical specification (TS) number would have been able to easily find the TS for download via internet search. For instance, a Google search for "physical channels and modulation" provides the TS number "38.211" as one of the top results as can be seen in the screenshot below:



180. Following the provided search result link "Specification # 38.211" leads to a 3GPP web page offering under the tab "Versions" download links to all versions of TS 38.211 including version 15.3.0, as shown by the screenshot below:



181. The above example search illustrates that it is very easy for an interested member of the public without prior knowledge of the TS number and even without prior knowledge of 3GPP to locate any version of TS 38.211, including version 15.3.0, for download.

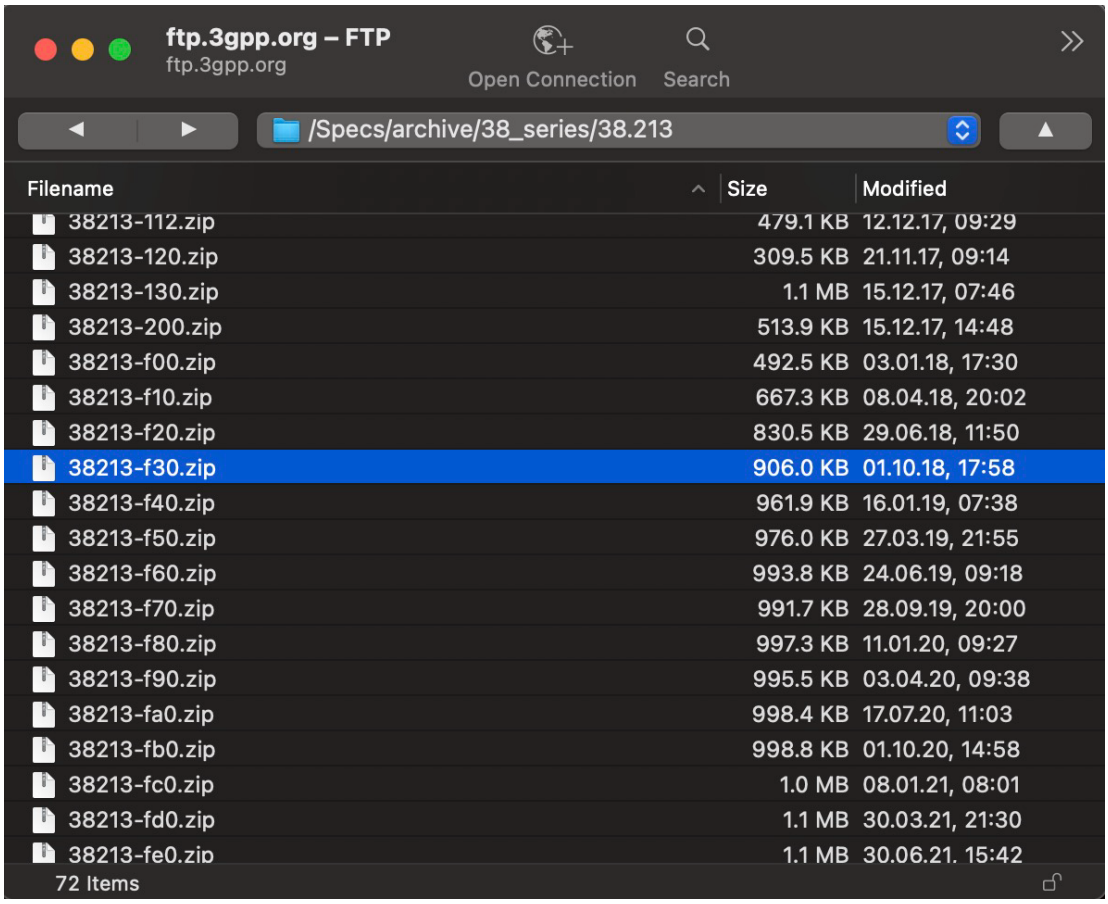
182. The above search was performed near the time of writing this report. According to my personal experience, similar searches done in September 2018 or around that timeframe would have similarly provided the path to download version 15.3.0 of TS 38.211.

14. TS 38.213 V15.3.0

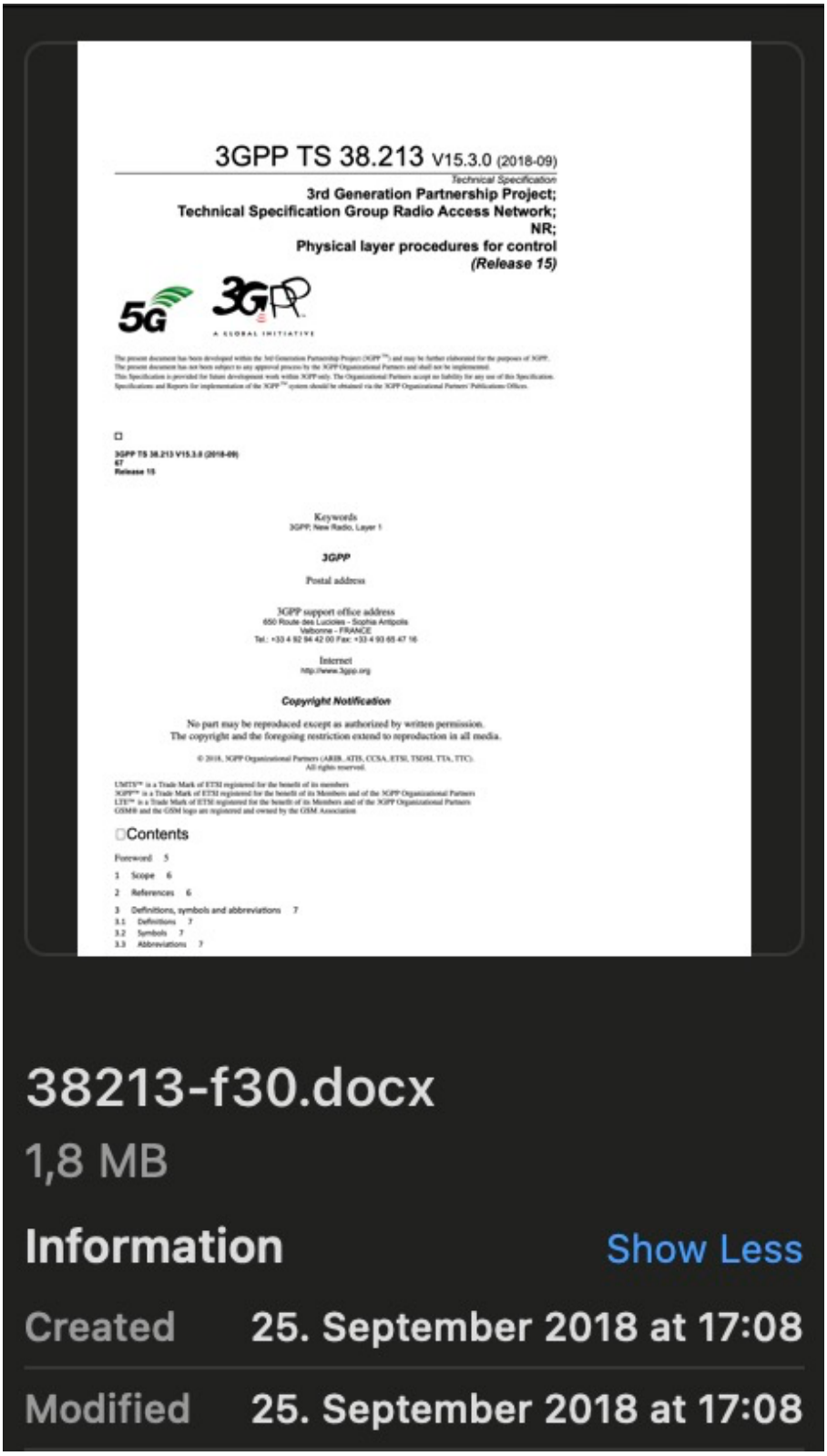
183. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1019 as a true and correct copy of version 15.3.0 of technical specification 3GPP TS 38.213 ("Technical Specification Group Radio Access Network; NR; Physical layer procedures for control (Release 15)"), which shows on its cover page "2018-09" as the year (2018) and month (September) during which this document was released by 3GPP.

184. The document was published and freely available on 3GPP's FTP server by October 1, 2018. This is confirmed by the date stamp shown on the historic 3GPP FTP server for the corresponding downloadable file ("38213-f30.zip"), as maintained by the Internet Archive at http://web.archive.org/web/20181017154048/http://www.3gpp.org:80/ftp/Specs/archive/38_series/38.213/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at

https://www.3gpp.org/ftp/Specs/archive/38_series/38.213, as shown by the screen shot below:



185. In addition, metadata information for the downloaded and extracted specification file states a last Modified date of "25. September 2018", as shown in the screenshot below:



3GPP TS 38.213 V15.3.0 (2018-09)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NR;
Physical layer procedures for control
(Release 15)

5G 3GPP A GLOBAL INITIATIVE

The present document has been developed within the 3rd Generation Partnership Project (3GPP™) and may be further elaborated for the purposes of 3GPP.
The present document has not been subject to any approval process by the 3GPP Organizational Partners and shall not be implemented.
This Specification is provided for future development work within 3GPP only. The Organizational Partners accept no liability for any use of this Specification.
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3GPP TS 38.213 V15.3.0 (2018-09)
67
Release 15

Keywords
3GPP, New Radio, Layer 1

3GPP

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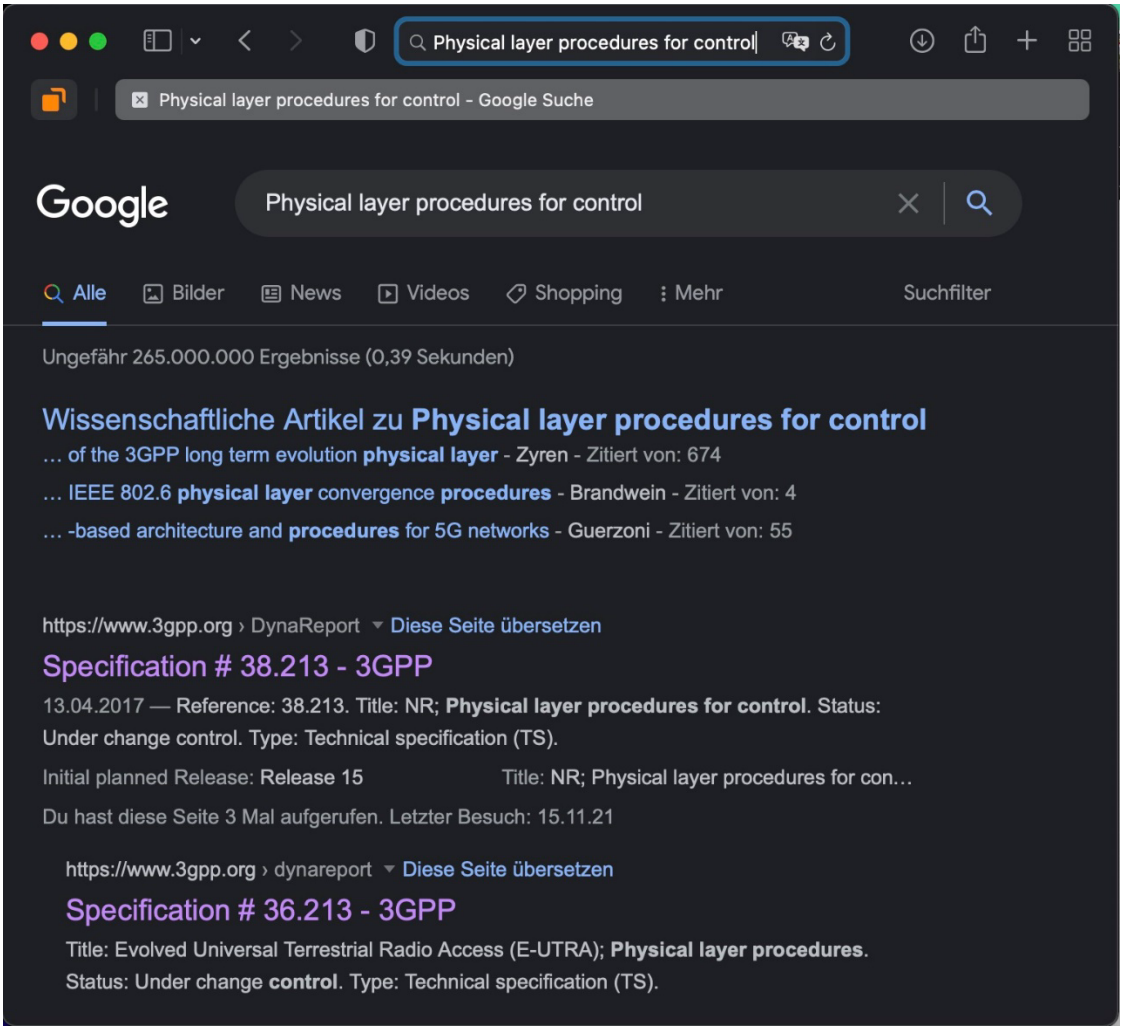
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3.2 Symbols 7
3.3 Abbreviations 7

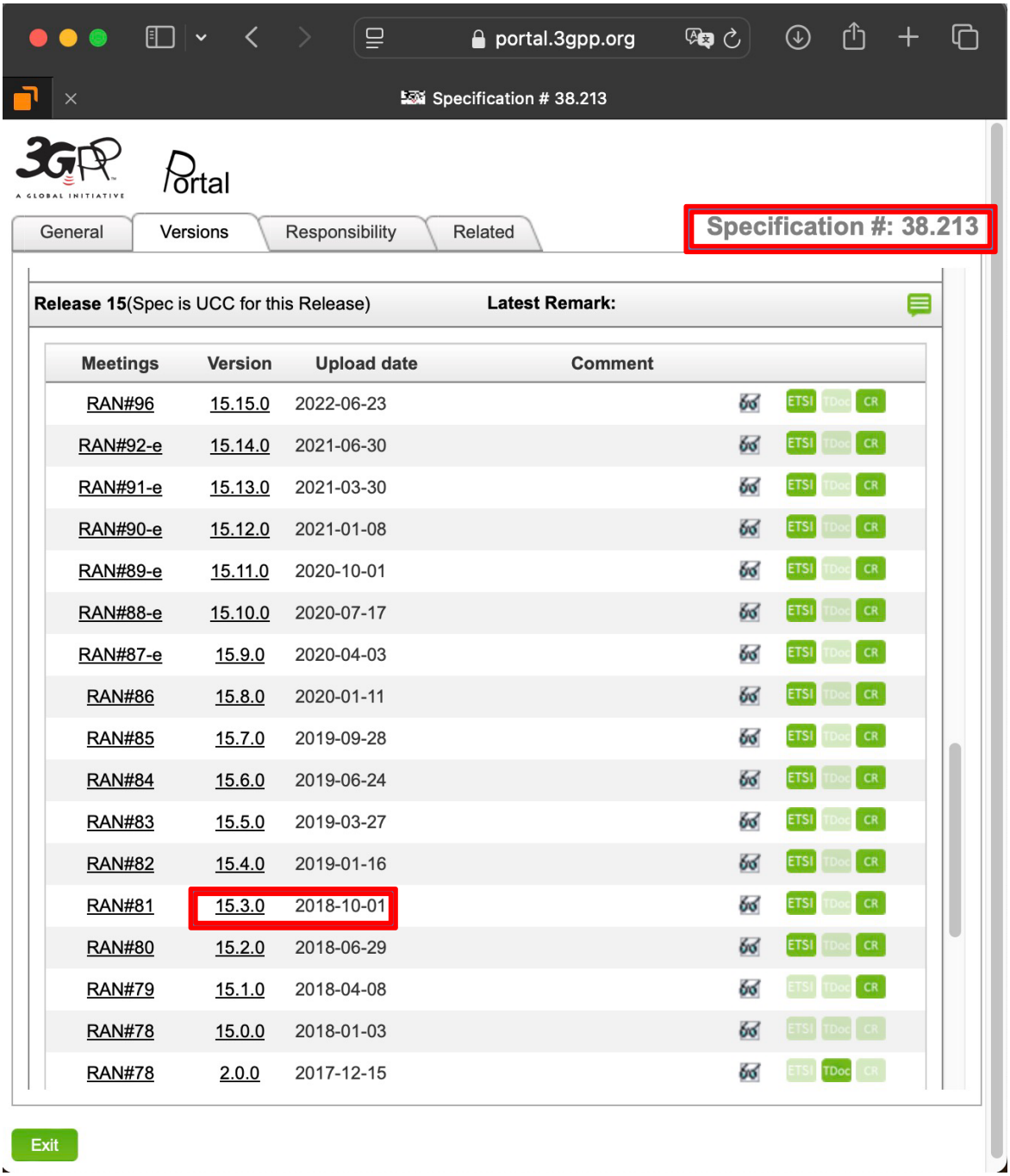
38213-f30.docx
1,8 MB
Information Show Less
Created 25. September 2018 at 17:08
Modified 25. September 2018 at 17:08

186. This last modified date well aligned with the October 1, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload submissions shortly after completing them.

187. I believe that a person without prior knowledge of 3GPP and/or the technical specification (TS) number would have been able to easily find the TS for download via internet search. For instance, a Google search for "Physical layer procedures for control" provides the TS number "38.213" as one of the top results as can be seen in the screenshot below:



188. Following the provided search result link "Specification # 38.213" leads to a 3GPP web page offering under the tab "Versions" download links to all versions of TS 38.213 including version 15.3.0, as shown by the screenshot below:



189. The above example search illustrates that it is very easy for an interested member of the public without prior knowledge of the TS number and even without prior knowledge of 3GPP to locate any version of TS 38.213, including version 15.3.0, for download.

190. The above search was performed at the time of writing this report. According to my personal experience, in October 2018 or around that timeframe it would have been similarly straightforward to locate a path to download version 15.3.0 of TS 38.213.

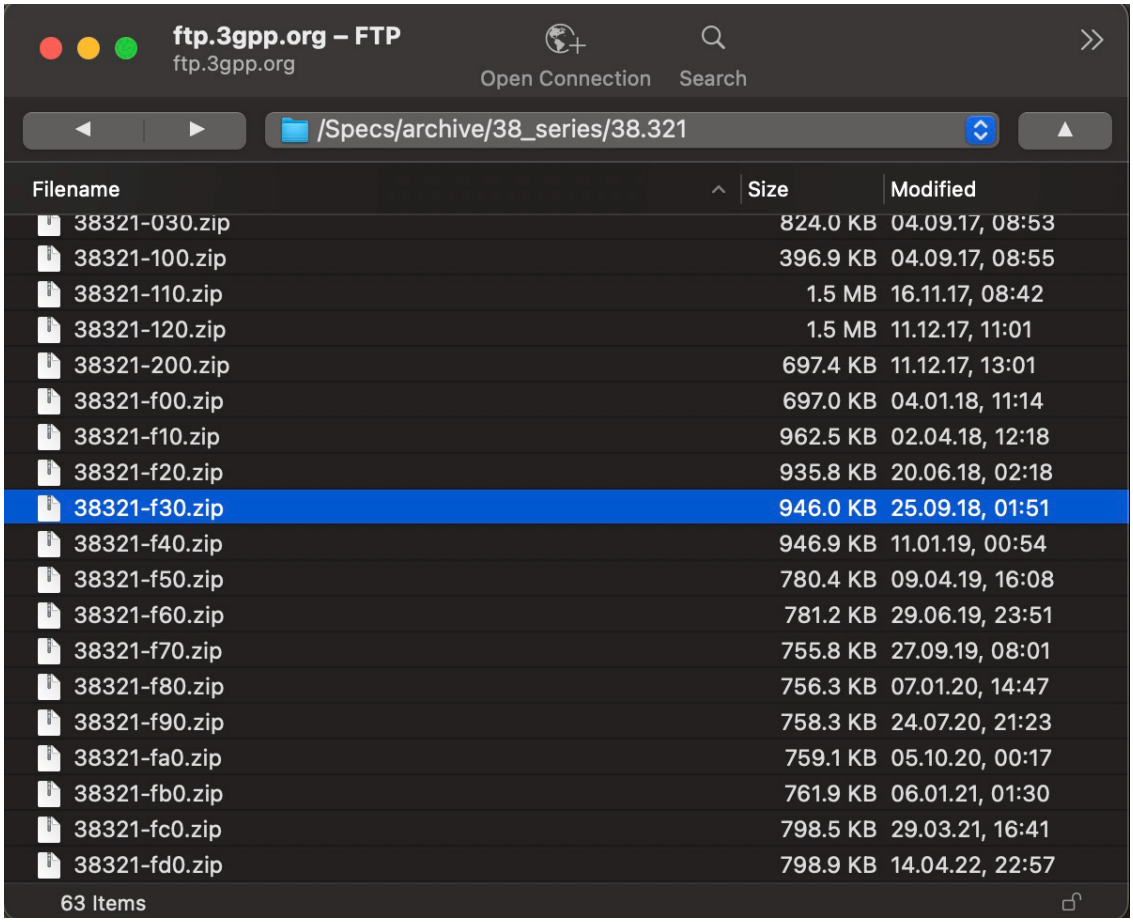
191. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that this document was available to all 3GPP members and the general public by October 1, 2018, at the latest.

15. TS 38.321 V15.3.0

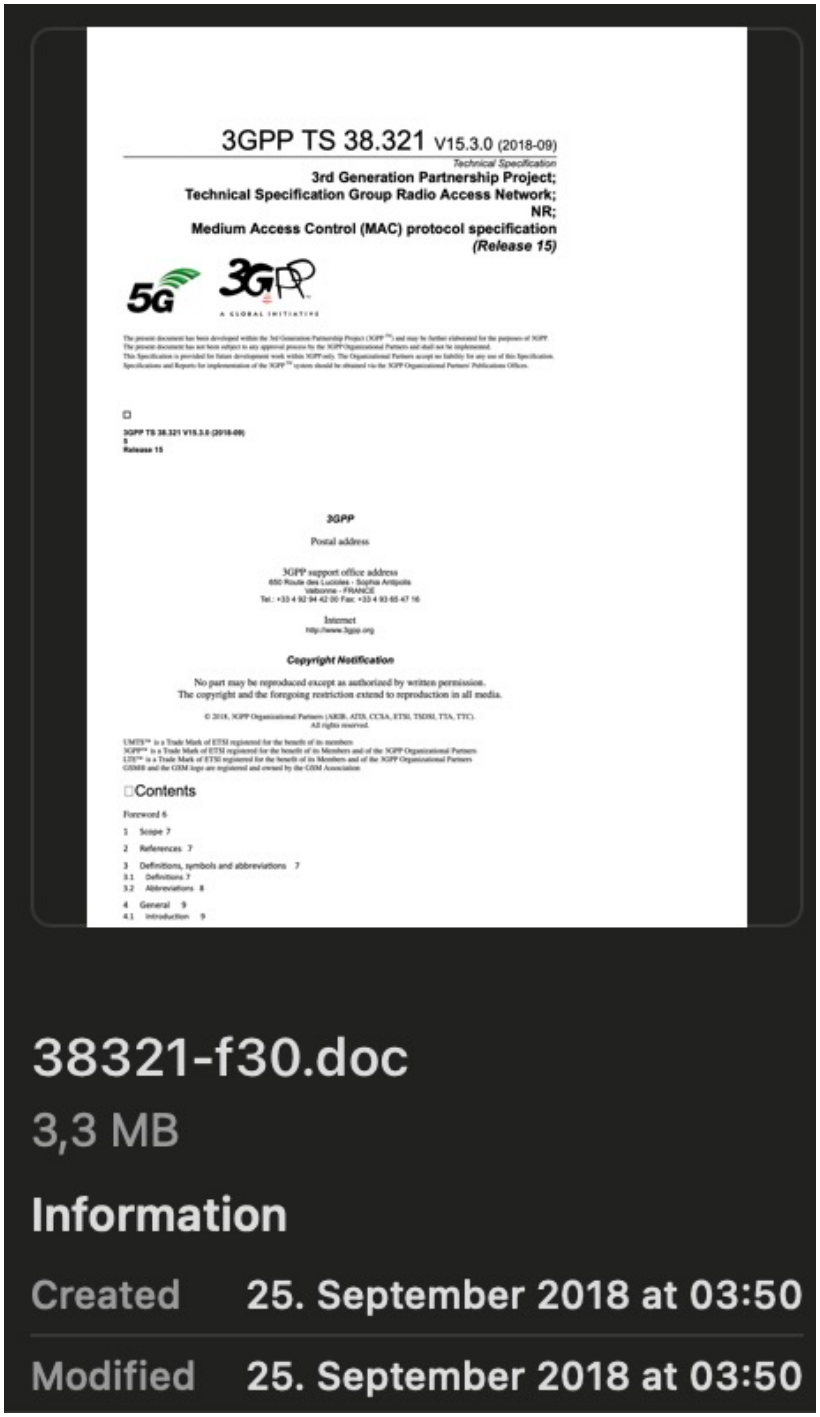
192. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1020 as a true and correct copy of version 15.3.0 of technical specification 3GPP TS 38.321 ("3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Medium Access Control (MAC) protocol specification (Release 15)"), which shows on its cover page "2018-09" as the year (2018) and month (September) during which this document was released by 3GPP.

193. The document was published and freely available on 3GPP's FTP server by September 25, 2018. This is confirmed by the date stamp shown on the historic 3GPP FTP server for the corresponding downloadable file ("38321-f30.zip"), as maintained by the Internet Archive at

https://web.archive.org/web/20181003072802/http://www.3gpp.org/ftp/Specs/archive/38_series/38.321/. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/Specs/archive/38_series/38.321, as shown by the screenshot below:



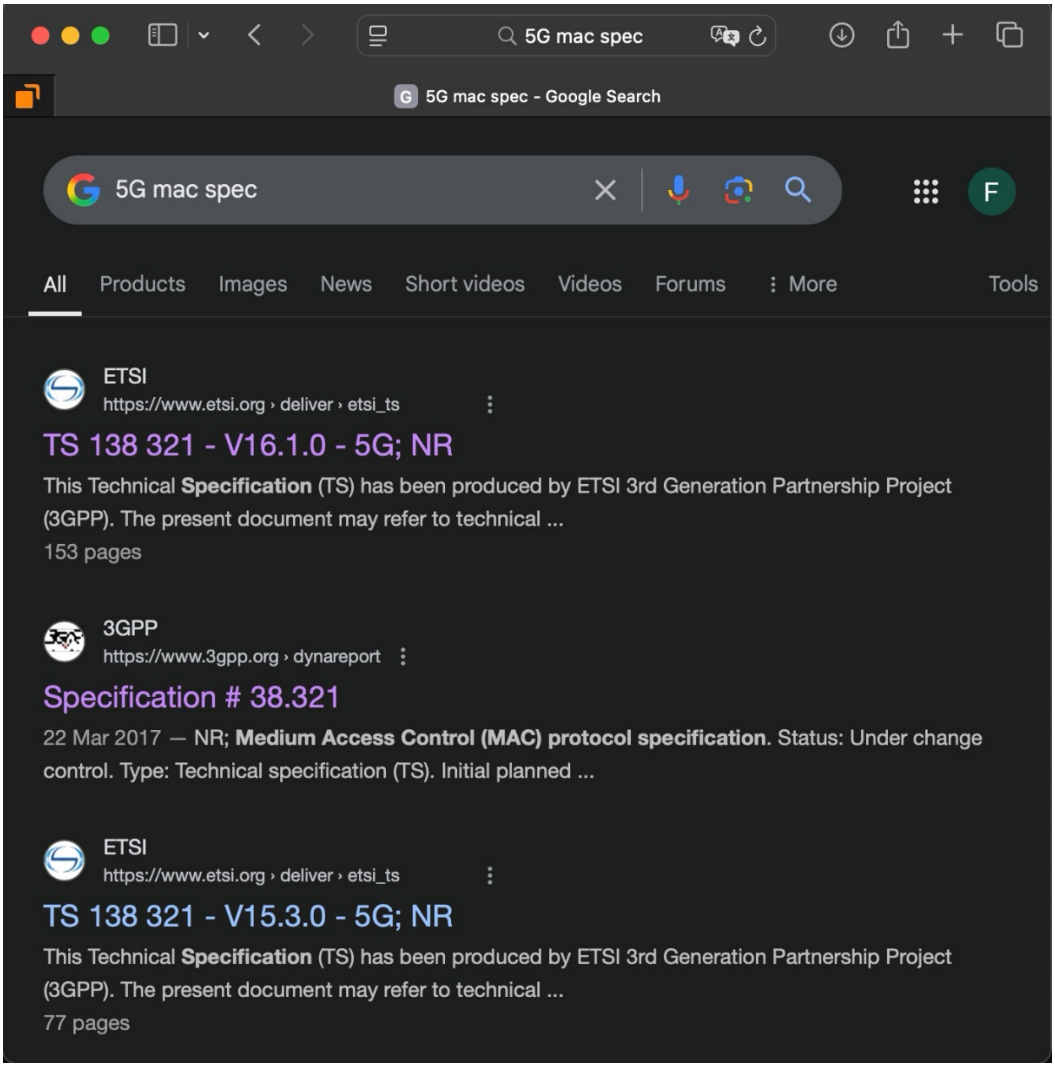
194. In addition, metadata information for the downloaded and extracted specification file states a last "Modified" date of "25. September 2018", as shown in the screenshot below:



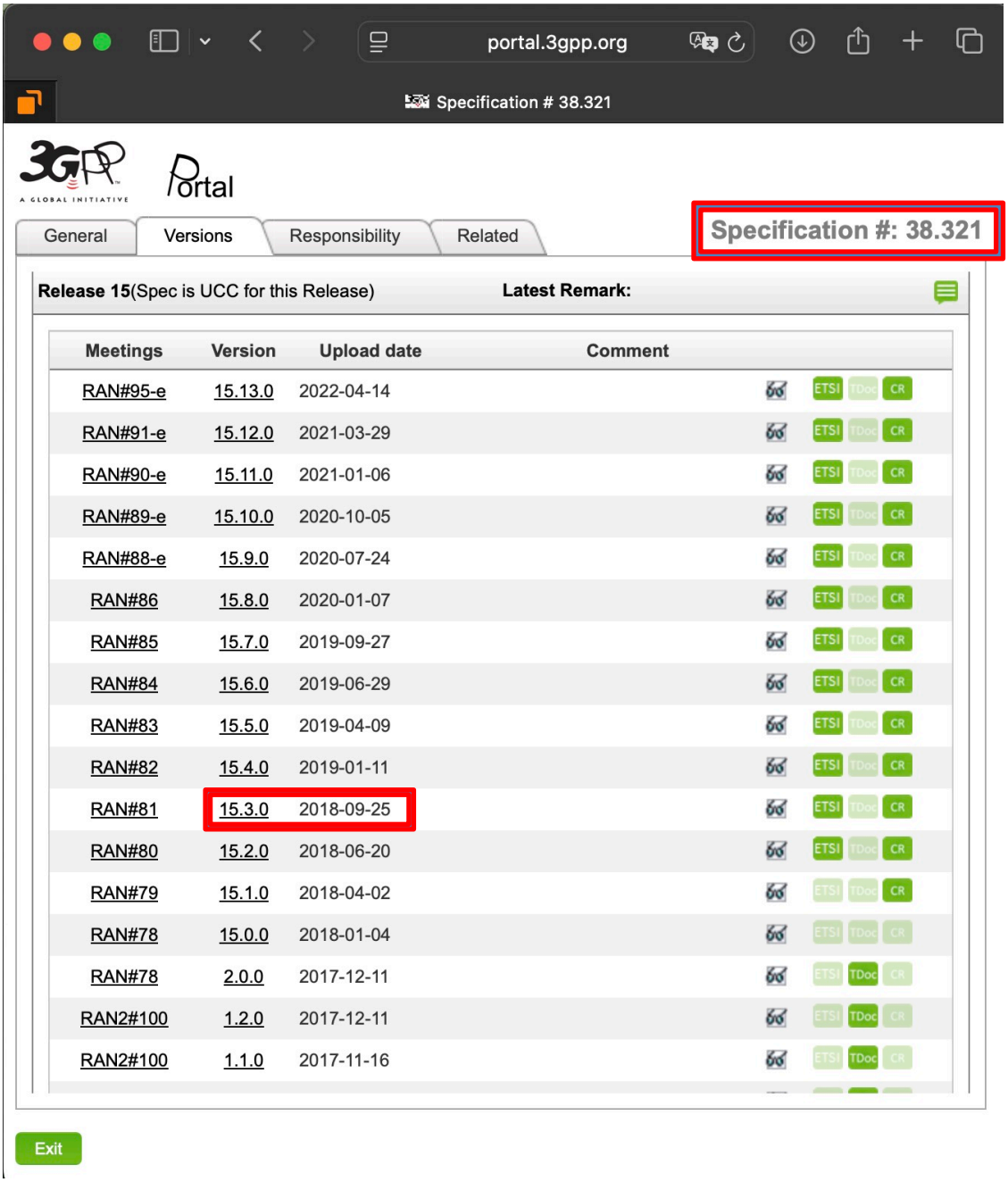
195. This last modified date is well aligned with the September 25, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload documents shortly after completing them.

196. Furthermore, the availability of several new RAN2 specification versions including TS 38.321 V15.3.0 (filename 38321-f30) was announced by the RAN WG2 secretary via the public 3GPP_TSG_RAN_WG2 email exploder on September 25, 2018, as shown in Appendix H. As of today, the 3GPP_TSG_RAN_WG2 email exploder has around 1100 subscribers at https://list.etsi.org/scripts/wa.exe?INDEX. According to my experience I would expect a similar or only slightly smaller number of subscribers around 2018.

197. I believe that a person without prior knowledge of 3GPP and/or the technical specification (TS) number would have been able to easily find the TS for download via internet search. For instance, a Google search for "5G mac spec" provides the TS number "38.321" as one of the top results as can be seen in the screenshot below:



198. Following the provided search result link "Specification # 38.321" leads to a 3GPP web page offering under the tab "Versions" download links to all versions of TS 38.321 including version 15.3.0, as shown by the screenshot below:



199. The above example search illustrates that it is very easy for an interested member of the public without prior knowledge of the TS number and even

without prior knowledge of 3GPP to locate any version of TS 38.321, including version 15.3.0, for download.

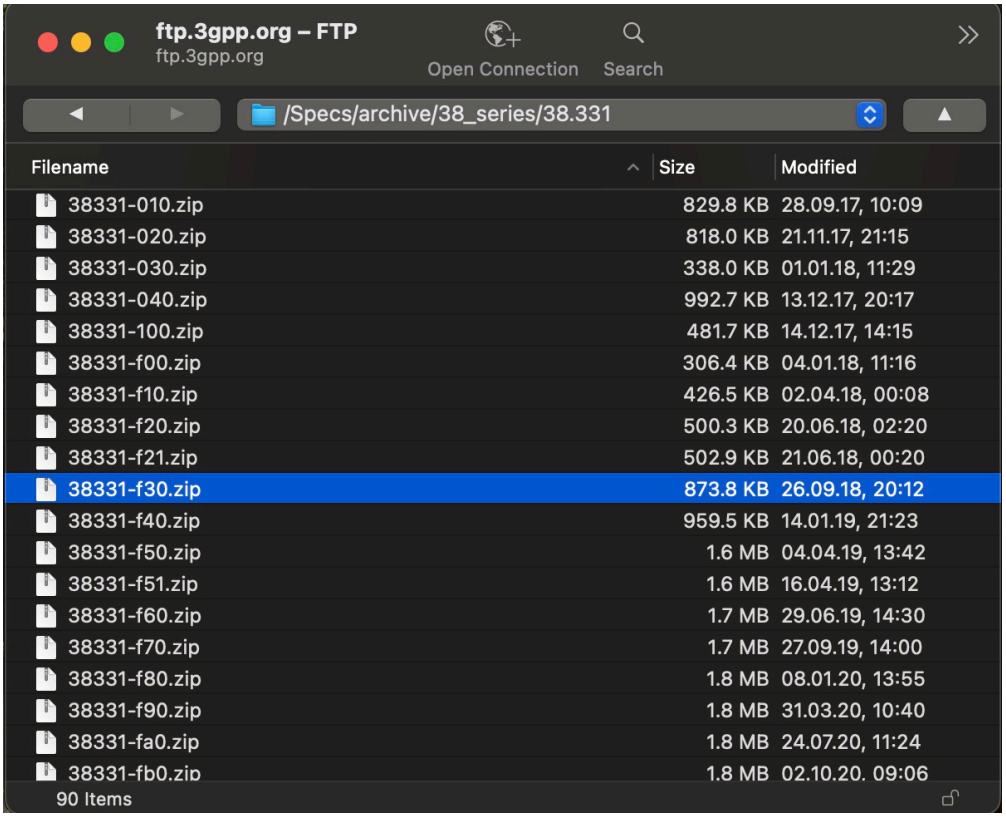
200. The above search was performed at the time of writing this report. According to my personal experience, in September 2018 or around that timeframe it would have been similarly straightforward to locate a path to download version 15.3.0 of TS 38.321.

201. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that this document was available to all 3GPP members and the general public by September 25, 2018, at the latest.

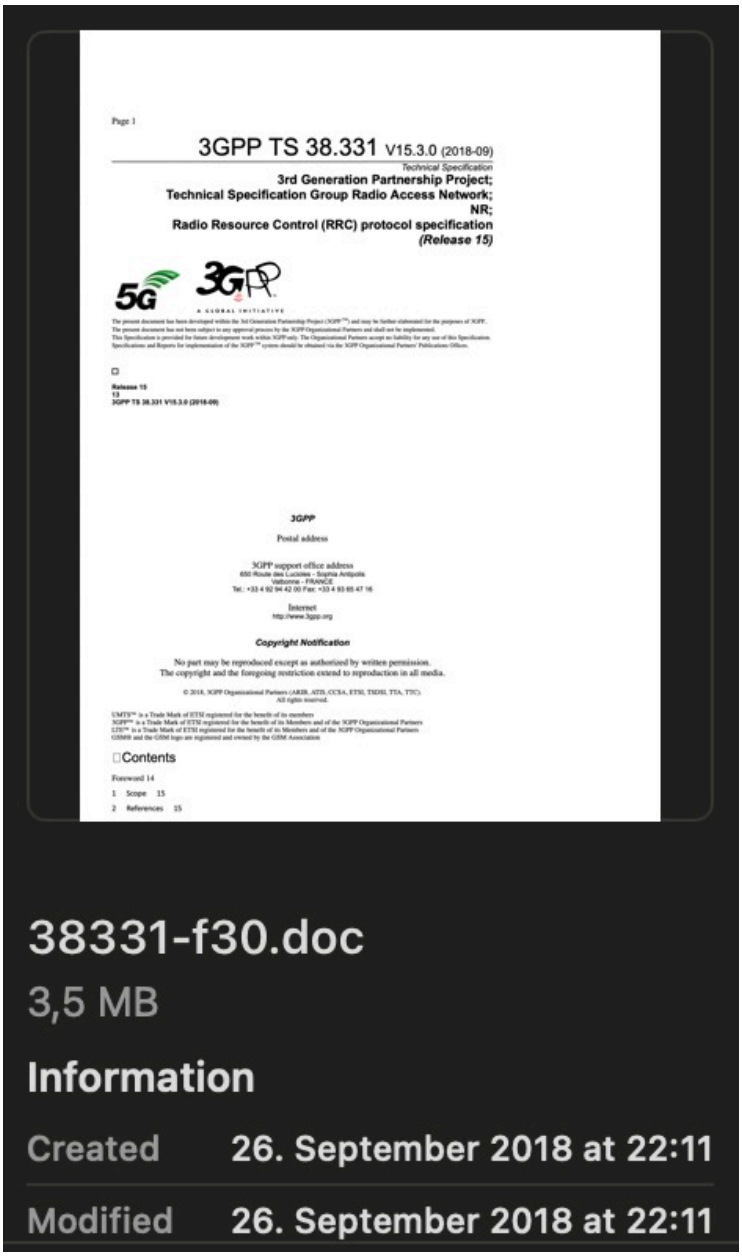
16. TS 38.331 V15.3.0

202. Based on my personal knowledge and my review of 3GPP's business records, I recognize Ex. 1021 as a true and correct copy of version 15.3.0 of technical specification 3GPP TS 38.331 ("3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Radio Resource Control (RRC) protocol specification (Release 15)"), which shows on its cover page "2018-09" as the year (2018) and month (September) during which this document was released by 3GPP.

203. The document was published and freely available on 3GPP's FTP server by September 26, 2018. This is confirmed by the date stamp shown on the historic 3GPP FTP server for the corresponding downloadable file ("38331-f30.zip"), as maintained by the Internet Archive at https://web.archive.org/web/20181006191054/http://www.3gpp.org:80/ftp/Specs/archive/38_series/38.331. This information is also shown on the date stamp for the present-day listing of the same document on the 3GPP FTP server at https://www.3gpp.org/ftp/Specs/archive/38_series/38.331, as shown by the screenshot below:



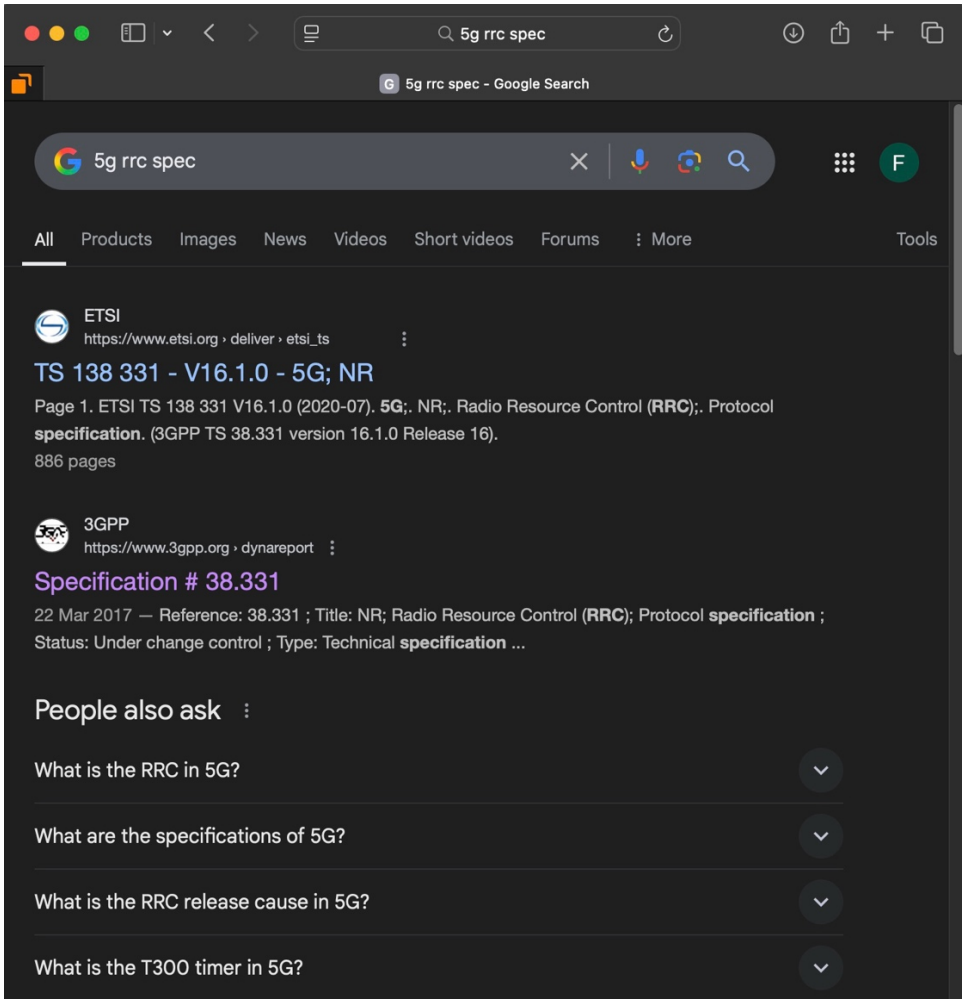
204. In addition, metadata information for the downloaded and extracted specification file states a last "Modified" date of "26. September 2018", as shown in the screenshot below:



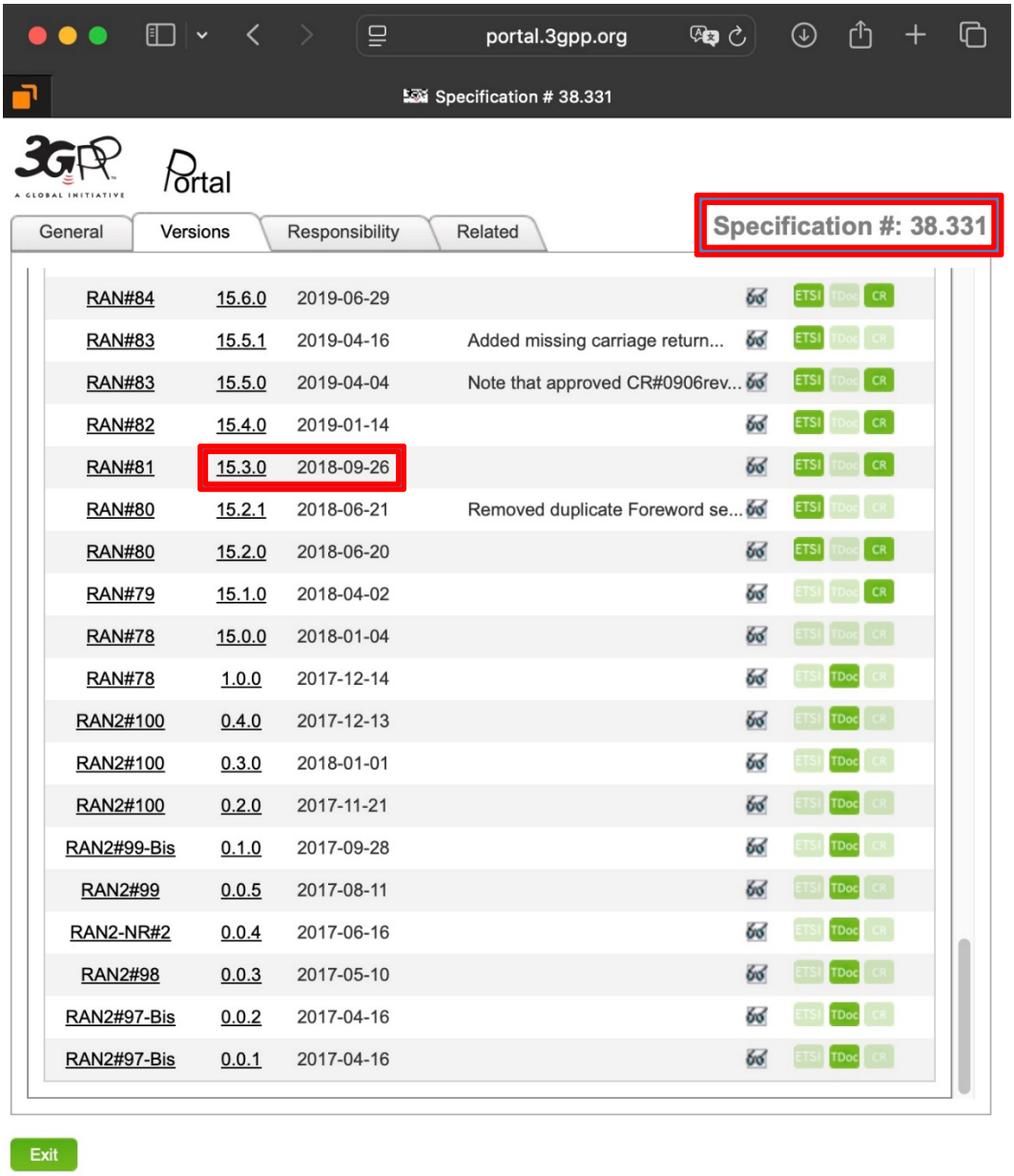
205. This last modified date is well aligned with the September 26, 2018, upload date of the document, and the standard business practice among 3GPP participants to upload documents shortly after completing them.

206. Furthermore, the availability of new RAN2 specification versions including TS 38.331 V15.3.0 was announced by the RAN WG2 secretary via the public 3GPP_TSG_RAN_WG2 email exploder on September 26, 2018, as shown in Appendix I. As of today, the 3GPP_TSG_RAN_WG2 email exploder has around 1100 subscribers at https://list.etsi.org/scripts/wa.exe?INDEX. According to my experience I would expect a similar or only slightly smaller number of subscribers around 2018.

207. I believe that a person without prior knowledge of 3GPP and/or the technical specification (TS) number would have been able to easily find the TS for download via internet search. For instance, a Google search for "5g rrc spec" provides the TS number "38.331" as one of the top results as can be seen in the screenshot below:



208. Following the provided search result link "Specification # 38.331" leads to a 3GPP web page offering under the tab "Versions" download links to all versions of TS 38.331 including version 15.3.0, as shown by the screenshot below:



209. The above example search illustrates that it is very easy for an interested member of the public without prior knowledge of the TS number and even without prior knowledge of 3GPP to locate any version of TS 38.331, including version 15.3.0, for download.

210. The above search was performed at the time of writing this report. According to my personal experience, in September 2018 or around that timeframe it would have been similarly straightforward to locate a path to download version 15.3.0 of TS 38.331.

211. Thus, based on my personal knowledge and experience with ETSI's and 3GPP's standard business practices, this information tells me that this document was available to all 3GPP members and the general public by September 26, 2018, at the latest.

V. AVAILABILITY FOR CROSS-EXAMINATION

212. In signing this declaration, I recognize that the declaration may be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will cooperate to the best of my ability to appear for cross examination within the United States during the time allotted for cross examination.

A. Right To Supplement

213. I reserve the right to supplement my opinions in the future to respond to any arguments that the Patent Owner raises and to take into account new information as it becomes available to me.

B. Signature

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

215. I declare under penalty of perjury that the foregoing is true and correct.

Dated: July 18, 2025



Friedhelm Rodermund

Appendix A

CURRICULUM VITAE

I. PERSONAL DATA

Name: **Friedhelm RODERMUND**

Mailing address: Am Steiner Graben 18
56077 Koblenz, Germany

Phone: +49 172 2606489

Email: fred@iotecc.com

II. PROFESSIONAL EXPERIENCE

Summary

Senior expert in telecommunications and Internet of Things (IoT) technology. 25 years of experience within the mobile communications industry, and several years in the IoT domain in various roles such as project management, technology innovation and evolution, standards development, technology strategy, patent creation and patent litigations, and development/introduction of new services.

Recognized standards expert who was actively involved in leading roles in the development of key standards for mobile telephony/data and service anablers across standards development organizations such as 3GPP, ETSI, GSMA, IETF, OMA, and oneM2M. Currently focussing on standards for the Internet of Things including ETSI and 3GPP standards such as 5G and 6G, and OMA Lightweight M2M (LwM2M).

Founder and director of IOTECC GmbH which provides consulting services around technologies and standards enabling the Internet of Things, and consulting and expert services related to patents for mobile telcommunications and IoT.

01/2015 – present **IOTECC GmbH** **Koblenz, Germany**

Founder and CEO

- Mobile telecommunications, Internet of Things (IoT) technology and standards consulting
- Telecommunications and IoT patent consulting
  - Consulting services around telecommunications and IoT patents in particular related to 3GPP, ETSI and OMA standards
  - State of the art/prior art research services related to patent filing e.g. for 5G and 6G
  - Prior art research, essentiality assessment, patent infringement analysis related to litigations and validity actions
  - Advising on IP strategy
  - Advising on Standards Development Organisations (SDO) e.g. ETSI and 3GPP working processes and IPR policy
  - Conducting seminar on Standards Essential Patents (SEPs) for the Internet of Things at the Technical University of Ilmenau, Germany
  - Experienced expert witness (please see section III for a list of supported actions)

11/2014 – 12/2014 **Friedhelm Rodermund Consulting** **Koblenz, Germany**

Internet of Things (IoT) Consultant

- IoT standards development and introduction of new IoT services

01/2011 – 10/2014 **Vodafone Germany / Vodafone Group R&D** **Düsseldorf, Germany**

Senior Standards Strategist
- Representing Vodafone in various standardisation bodies
- Creating technical standards for the Internet of Things
- Work item lead, technical editor and key contributor of Open Mobile Alliance (OMA) "Lightweight M2M (LwM2M)" – the new standard for the Internet of Things
- Advising and supporting various IoT/M2M projects related to e.g. smart metering
- Advising on the introduction of new IoT/M2M technologies and services
- Leading Proof of Concepts of emerging technologies
- Involved in innovation projects
- Supporting the creation and protection of Intellectual Property

01/2009 – 12/2010 **Vodafone Germany** **Düsseldorf, Germany**

Vice Chairman Open Mobile Alliance (OMA) Device Management (DM)
- Responsible for Vodafone's Device Management standardisation
- As OMA DM Vice Chairman, co-leading the group, chairing committee meetings and web conferences, steering the technical direction, management of the different work items
- Editor of several specifications, rapporteur of various work items
- Support of projects for the introduction of device management
- Delegate to 3GPP SA1 with responsiblity for the introduction of MTC (machine type communications) related service/network requirements

01/2005 – 12/2008 **Vodafone Germany** **Düsseldorf, Germany**

Project Manager Mobile Broadcast Standards
- Responsible for Mobile Broadcast standardisation across different broadcast systems/standards bodies and across all Vodafone local operations
- Responsible for Mobile Broadcast standardisation strategy development and implementation
- Delegation Lead for the Open Mobile Alliance (OMA) BCAST working group
- Initiated and managed the BCAST device profile development in the BMCO Forum
- Leading the "Service Protection" (pay-TV) stream of the German DVB-H Consortium
- Filed several patents
- Supporting patent litigations and patent portfolio evaluation (various technical areas)

04/2003 – 12/2003 **GSM Association** **London, United Kingdom**

Member of the MMS Task Force
- Verification of the MMS operator interworking framework
- Supporting the definition and specification of the MMS functional evolution
- Acting as a "link" between 3GPP and GSMA in the area of MMS

06/1998 – 12/2004 **European Telecommunications Standards Institute (ETSI)**
Sophia Antipolis, France

01/2002 – 12/2004: Secretary 3GPP Technical Specifications Group *"Terminals"* and Terminals Working Group 2 *"Terminal Services and Capabilities"*

Samsung Exhibit 1029, Page 131 of 684

01/1999 – 12/2001: Secretary 3GPP Terminals Working Group 2 *"Terminal Services and Capabilities"* and GERAN 3 *"Base Station Testing"*

06/1998 – 03/1999: Secretary ETSI SMG4 *"Data Services"* and SMG8 *"Base Station Testing"*

- Supported the establishment of 3GPP (3rd Generation Partnership Project) as the leading standards organization for mobile telecommunications
- Project manager and secretary of TSG "Terminals" reponsbile for Terminal Conformance Testing, Terminal Services and Capabilities, Universal Subscriber Identity Module (USIM)
- Project manager and secretary of Terminals Working Group 2 "Terminal Services and Capabilities" that was responsible for Terminal Execution Environments, Messaging including Short Message Service (SMS), Cell Broadcast Service (CBS), Enhanced Messaging Service (EMS), Multimedia Messaging Service (MMS), Terminal Interfaces incl. AT-commands, Generic User Profile, Data Synchronization and others
- Establishment and management of the Work Plan and follow-up and report on the progress of the related work items
- Advising the chairmen and the standards groups on technical, procedural and political issues
- Editorship of various GSM and UMTS technical specifications
- Responsible for presenting the technical results of the working groups to the parent body
- Responsible for the communication with other standards bodies inside and outside 3GPP
- PR activities (articles, interviews)

12/1993 – 06/1998 Mannesmann Mobilfunk GmbH Düsseldorf, Germany

System Engineer and Project Manager in Quality Assurance and Technical Standards

- Leadership and management of acceptance test projects in the area of GSM Base Station Controller (BSC) and GSM Base Station (BTS) hardware and software.
- Leading project teams of around 15 people
- Responsible for the clearance of releasing new software/hardware into the network
- Supported Request for Quotations, supplier evaluation and pre-selection, project manager of System Verification as a central part of the supplier selection process.
- Representation of Mannesmann Mobilfunk to the ETSI standardization group "Standardization Technical Committee SMG3 System Architecture"
- Conduction of product and hardware development quality audits
- Representative of Mannesmann Mobilfunk in A-interface interoperability testing activities
- Member of BSS product planning group which was defining operator requirements for future BSS releases
- Development of process improvements for type acceptance

III. LIST OF SUPPORTED PATENT LITIGATIONS AND VALIDITY ACTIONS

2025

Pantech Corp. v. OnePlus Technology Co., Ltd
Inter Partes Review matters
On behalf of OnePlus
Counsel: Bayes PLLC
Role: Expert witness and consulting services

2025

Pantech Corp. v. OnePlus Technology Co., Ltd.
Inter Partes Review matters
On behalf of OnePlus
Counsel: Leydig, Voit & Mayer, Ltd.
Role: Expert witness and consulting services

2025

Apex Beam Technologies LLC v. Apple Inc.
Inter Partes Review matters
On behalf of Apple
Counsel: Fish&Richardson P.C.
Role: Expert witness and consulting services

2024

Pantech Corporation v. Oppo Mobile Telecommunications Corp., Ltd.
Inter Partes Review matters
On behalf of Oppo
Counsel: Bayes PLLC
Role: Expert witness and consulting services

2024

Pantech Corp. et al. v. LG Electronics Inc. et al.
Civil Action No. 5:22-cv-00113-RWS-JBB (E.D.Tx.)
On behalf of LG Electronics
Counsel: Ropes & Gray LLP
Role: Expert witness and consulting services

2024

Ericsson v. Lenovo
Inter Partes Review matters
On behalf of Lenovo
Counsel: Kirkland & Ellis LLP
Role: Expert witness and consulting services

2024

Pantech Corp. et al. v. OnePlus Technology Co., Ltd.
Civil Action No. 5:22-cv-00069-RWS (E.D.Tx.)
On behalf of OnePlus
Counsel: Leydig, Voit & Mayer, Ltd.
Role: Expert witness and consulting services

2024

G+ Communications, LLC, v. Samsung Electronics Co., Ltd.
Civil Action No. 2:22-CV-78 (E.D.Tx.)
On behalf of Samsung
Counsel: Fish&Richardson P.C.
Role: Expert witness and consulting services

2023

Unified Patents, LLC v. Helios Streaming LLC

Inter Partes Review matters
On behalf of Unified Patents
Counsel: Akin
Role: Expert witness and consulting services

2023

Unified Patents, LLC v. SLS Manager Technologies
Inter Partes Review matters
On behalf of Unified Patents
Counsel: Unified Patents
Role: Expert witness and consulting services

2023

Headwater Research LLC v. Samsung Electronics Co., Ltd.
Inter Partes Review matters
On behalf of Samsung
Counsel: Fish&Richardson P.C.
Role: Expert witness and consulting services

2023

Pantech Corp. et al. v. LG Electronics Inc. et al.
Inter Partes Review matters
On behalf of LG Electronics
Counsel: Ropes & Gray LLP
Role: Expert witness and consulting services

2023

Apple Computer Trading (Shanghai) Co., Ltd, Apple Electronics Products Commerce (Beijing) Co., Ltd. v. Optis Cellular Technology LLC
Shenzhen, China, Intermediate People's Court
On behalf of Apple
Counsel: WilmerHale
Role: Expert witness and consulting services

2023

Huawei Technologies Co., Ltd. v. MediaTek Inc.
Inter Partes Review matters
On behalf of MediaTek
Counsel: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.
Role: Expert witness and consulting service

2023

Apex Beam Technologies LLC v. Samsung
Inter Partes Review matters
On behalf of Samsung
Counsel: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.
Role: Expert witness and consulting services

2022

Constellation Designs LLC v. LG Electronics, Inc.
Inter Partes Review matters
On behalf of LG Electronics
Counsel: Fish&Richardson P.C.
Role: Expert witness and consulting services

2022

Unified Patents, LLC v. Togail Technologies LTD.
Inter Partes Review matters
On behalf of Unified Patents
Counsel: Duane Morris LLP
Role: Expert witness and consulting services

2022

Ericsson v. Apple
Certain Mobile Telephones, Tablet Computers With Cellular Connectivity, And Smart Watches With Cellular Connectivity, Components Thereof, And Products Containing Same, Inv. No. 337-TA-1299 (U.S.I.T.C.)
On behalf of Apple
Counsel: WilmerHale
Role: Expert and consulting services

2022

Ericsson v. Apple
Civil Action No. 2:21-cv-376 (E.D.Tex.)
On behalf of Apple
Counsel: WilmerHale
Role: Expert and consulting services

2022

Intellectual Ventures II LLC v. Toyota Motor Cooperation.
Inter Partes Review matters
On behalf of Toyota
Counsel: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.
Role: Expert witness and consulting services

2022

Ericsson v. Apple
2nd Business Court, Rio de Janeiro, Brazil
On behalf of Apple
Counsel: WilmerHale
Role: Expert and consulting services

2022

Ericsson v. Apple
Civil Court, Bogotá, Columbia
On behalf of Apple
Counsel: WilmerHale
Role: Expert and consulting services

2022

Proven Networks LLC. v. NetApp Inc.
Inter Partes Review matters
On behalf of NetApp
Counsel: Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P., Ropes & Gray LLP
Role: Expert witness and consulting services

2022

Ericsson v. Apple
Inter Partes Review matters
On behalf of Apple
Counsel: Fish&Richardson, Erise IP
Role: Expert witness and consulting services

2021

AEGIS 11 LLC v. Hisense Company, Ltd. and Hisense USA Corporation
Inter Partes Review matters
On behalf of Hisense
Counsel: Orrik Herrington & Sutcliffe LLP
Role: Expert witness and consulting services

2021

Nokia v. Lenovo
Certain Electronic Devices, Including Computers, Tablet Computers, and Components and Modules Thereof, Inv. No. 337-TA-1208 (U.S.I.T.C.)

On behalf of Lenovo
Counsel: WilmerHale
Role: Expert witness and consulting services

2021

Optis Cellular Technology LLC et al. v. Apple
Claim No. HP-2019-000006 (High Court of Justice, Business and Property Courts of England and Wales)
On behalf of Apple
Counsel: WilmerHale
Role: Expert witness and consulting services

2021

Ericsson v. Samsung
Inter Partes Review matters
On behalf of Samsung
Counsel: Kirkland&Ellis LLP, Fish&Richardson
Role: Expert witness and consulting services

2020

Panoptis Patent Management LLC et al. v. Apple Inc.
Civil Action No. 2:19-cv-66 (E.D. Tex.)
On behalf of Apple
Counsel: WilmerHale
Role: Expert witness at bench trial

2020

Sol IP, LLC v. AT&T Mobility, LLC et al.
Civil Action No. 2:18-cv-526 (E.D. Tex.)
On behalf of AT&T, Verizon, Sprint
Counsel: Gibson Dunn
Role: Expert witness and consulting services

2020

Bell Northern Research LLC v. LG Electronics Inc. et al.
Civil Action No. 18-CV-2864-CAB-BLM (S.D. Cal.)
On behalf of LG Electronics Inc.
Counsel: Fish&Richardson
Role: Expert witness and consulting services

2019

Conversant Wireless Licensing S.a.r.l. v. LG Electronics Deutschland GmbH
Civil Action No. 7 O 3277/18 (Landgericht Munich, Germany)
On behalf of LG Electronics Deutschland GmbH
Counsel: Wildanger Kehrwald Graf von Schwerin & Partner mbB
Role: Expert witness and consulting services

2019

Bell Northern Research, LLC v. Huawei Device Co., Ltd, et al.
Civil Action No. 3:18-cv-01784-CAB-BLM
On behalf of Huawei
Counsel: Fish&Richardson
Role: Expert witness and consulting services

2019

Uniloc USA, Inc., et al. v. Samsung Electronics America, Inc. and Samsung Electronics Co. Ltd.
Civil Action Nos. 2:18-cv-00040-JRG, 2:18-cv-00041-JRG, 2:18-cv-00042-JRG and 2:18-cv-00044-JRG (United States District Court for the Eastern District of Texas)
On behalf of Samsung
Counsel: Greenberg Traurig
Role: Expert witness and consulting services

2019

Uniloc USA, Inc., et al. v. Huawei Device USA, Inc. et al.
Civil Action No. 2:18-cv- 00072-JRG-RSP (E.D. Tex.)
On behalf of Huawei
Counsel: McGuireWoods
Role: Expert witness and consulting services

2019

Microsoft Corporation v. Uniloc 2017 LLC
Inter Partes Review of U.S. Pat. No. 7,167,487
Inter Partes Review of U.S. Pat. No. 7,075,917
On behalf of Microsoft and on behalf of Apple as joinder petitioner
Counsel: Klarquist Sparkman (Microsoft), Erise IP (Apple)
Role: Expert witness and consulting services

2019

Qualcomm v. KFTC
South Korean Case, Seoul High Court
On behalf of intervenor Apple supporting the KFTC
Counsel: Boies Schiller Flexner
Role: Expert witness

2018/19

Evolved Wireless, LLC v. Apple, Inc.
Civil Action No. 1:15-cv-00542-JFB-SRF
On behalf of Apple
Counsel: DLA Piper
Role: Expert witness and consulting services

2018/19

Cisco Systems Inc. v. Traxcell Technologies
Inter Partes Review of Traxcell Technologies patents
On behalf of Cisco
Counsel: King&Spalding
Role: Expert witness and consulting services

2018/19

Qualcomm Inc. v. Apple Inc.
Civil Action No. 3:17- cv-02398-DMS-MDD (United States District Court for the Southern District of California)
Civil Action No. 3:17-cv-02402-WQH-MDD
Certain Mobile Electronic Devices and Radio Frequency and Processing Components Thereof (II), Inv. No. 337-TA-1093
Inter Partes Review of U.S. PATENT NO. 9,154,356
Cases IPR2019-00047, IPR2019-00048, IPR2019-00049, IPR2019-00128, IPR2019-00129
On behalf of Apple and Intel
Counsel: WilmerHale
Role: Expert witness and consulting services

2018/19

Apple Inc. v. Qualcomm Inc.
Civil Action No. 3:17-CV-00108-GPC-MDD (United States District Court for the Southern District of California)
On behalf of Apple
Counsel: Fish&Richardson, Boies Schiller Flexner
Role: Expert witness and consulting services

2018

3G Licensing, S.A. et al. v. LG Electronics Inc. et al
Inter Partes Review of U.S. Patent No. 7,995,091
On behalf of LG Electronics

Counsel: Fish&Richardson
Role: Expert witness

2017

Huawei Technologies Co. LTD. v. T-Mobile US, Inc. & T-Mobile USA, Inc.
E.D. Tex. Case Nos. 2:16-cv-00052-JRG-RSP; 2:16-cv-00055-JRG-RSP; 2:16-cv-00056-JRG-RSP; and 2:16-cv-00057-JRG-RSP
On behalf of T-Mobile
Counsel: Gibson Dunn
Role: Expert witness and consulting services

2016

Koninklijke KPN N.V. v. Samsung Electronics America, Inc. et al.
Civil Action No. 14-cv-1165
On behalf of Samsung Electronics
Counsel: Baker Botts
Role: Expert witness and consulting services

2016

SSH v. Sony
OLG Düsseldorf, Germany
On behalf of SSH
Counsel: Cohausz&Florack
Role: Technical expert support

2015/16

LG Electronics v. Core Wireless Licensing S.A.R.L.
Inter Parles Review of U.S. Patent No. 8,165,049
On behalf of LG Electronics
Counsel: Greenberg Traurig
Role: Expert witness

2015/16

Core Wireless Licensing S.A.R.L. v. LG Electronics Inc. and LG Electronics MobileComm U.S.A., Inc
Civil Action No. 2:14-cv-911 (lead case) and Civil Action No. 2:14-cv-912 (consolidated)
On behalf of LG Electronics
Counsel: Greenberg Traurig, Sidley Austin
Role: Expert witness

2015

Intellectual Ventures I LLC v. T-Mobile USA, Inc. & T-Mobile US, Inc.
D. Del. Case No. 1:13-cv-01632
Intellectual Ventures II LLC v. T-Mobile USA, Inc. & T-Mobile US, Inc.
D. Del. Case No. 1:13-cv-01633
On behalf of T-Mobile
Counsel: Gibson Dunn
Role: Technical expert support

IV. EDUCATION

10/1984 – 10/1993 **University of Technology Aachen** **Aachen, Germany**
Graduate of Electrical Engineering with a focus on telecommunications technologies (Dipl.-Ing. TH)

10/1992 – 04/1993 **University of Technology Trondheim** **Trondheim, Norway**
Diploma Thesis "Design of a dual processor computer for digital signal processing in power electronics"

V. LANGUAGES

German, English, French

VI. PUBLICATIONS (selection)

- ”Standardessentielle Patente (SEPs) für das Internet der Dinge (IoT)”, PATINFO 2025 Proceedings, May 2025
- “The need for standardisation in the M2M services layer”, Global Telecoms Business, February 2014
- Co-authored white paper “Lightweight M2M: Enabling device management and applications for the internet of things”, Open Mobile Alliance, March 2014
- “Objects are a new way to create M2M applications”, Global Telecoms Business, April 2014
- “The need for standardisation in the M2M services layer”, M2M Now, July 2015
- “Objects are a new way to create M2M applications”, Global Telecoms Business, April 2014
- Co-authored white paper “Lightweight M2M: Enabling device management and applications for the internet of things”, Open Mobile Alliance, March 2014
- “The need for standardisation in the M2M services layer”, Global Telecoms Business, February 2014
- ”Unlocking the internet of things and driving the need for interoperability”, Global Telecoms Business, December 2013

Appendix B

Appendix	Description
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D	Document list of RAN WG1 meeting #94 held on August 20-24, 2018, in Gothenburg, Sweden
E	Report of RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China
F	Document list of RAN WG1 meeting #94bis held on October 8-12, 2018, in Chengdu, China
G	Email sent on October 1, 2018, via the public 3GPP_TSG_RAN_WG1 email exploder sharing R1-1811634
H	Email sent on September 25, 2018, via the public 3GPP_TSG_RAN_WG2 email exploder announcing the availability of TS 38.321 V15.3.0
I	Email sent on September 26, 2018, via the public 3GPP_TSG_RAN_WG2 email exploder announcing the availability of TS 38.331 V15.3.0

Appendix C

3GPP TSG RAN WG1 Meeting #94bis **R1-1810051**
Chengdu, China, 8th – 12th October 2018

Source: **MCC Support**

Title: **Final Report of 3GPP TSG RAN WG1 #94 v1.0.0 (Gothenburg, Sweden, 20th – 24th August 2018)**

Document for: **Approval**



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Main facts summary

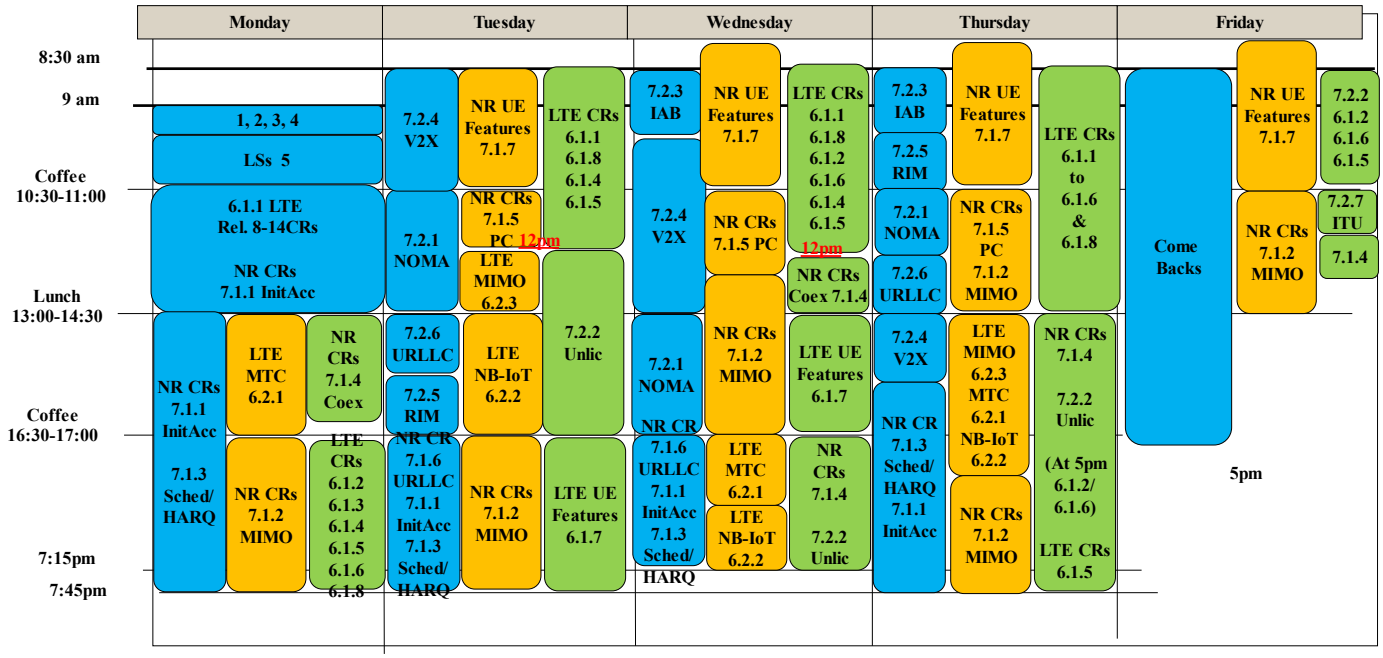
The 3GPP TSG WG RAN1#94 meeting, hosted by the European Friends of 3GPP, was held at the Gothia Towers Hotel, Göteborg, Sweden.
The meeting started at 9:00 on Monday 20th August and finished at 17:07 on Friday 24th August 2018.
The number of attending delegates, having confirmed their participation through the electronic check-in application, was 499**.**
Note that the number of registered was 622.

ETSI Workshop "Writing World Class standards" took place during the week (organizer: Milan Zoric from ETSI).

- Total number of attendees was 65.
- Per RAN group, split is as follows: RAN 1 (28), RAN2 (21), RAN3 (1), RAN4 (10), RAN5 (5)

Milan was very pleased with the atmosphere and attentiveness of attendees as well as with questions raised and discussions that took place. Thanks you all who have participated.

The schedule of the week was as follows:



The list of action points that require RAN1 post meeting follow-up is listed in Annex F (end of document).

The number of contributions for this meeting was **2017**.

Note: The amount of documents includes those discussed during the email discussion session post meeting.

	Contribution is agreed/approved
	Contribution is not pursued (no consensus)
	Further discussion is required – come-back needed
	Working assumption
	Specific action needed from MCC
	Contribution is for email discussion/approval

1 Opening of the meeting

Mr Wanshi Chen (RAN1 Chairman) welcomed the participants of the RAN WG1 #94 meeting and opened the meeting at 09:00.

Ms Sorour Falahati (Ericsson) on behalf of the European Friends of 3GPP, Apple, BlackBerry, Deutsche Telekom, Ericsson, Huawei, Intel, InterDigital, KPN, Motorola, Nokia, Orange, Qualcomm, SIMAlliance, Sony, Telefonica, Telenor, Thales, TIM, Vodafone, welcomed the delegates, and detailed the domestic arrangements for the full week.

1.1 Call for IPR

The attention of the members of this Technical Specification Group was drawn to the fact ***that 3GPP Individual Members have the obligation*** *under the IPR Policies of their respective Organizational Partners to* ***inform their respective*** *Organizational Partners* ***of Essential IPRs they become aware of****.*
The members take note that they are hereby invited:

- *to investigate whether their organization or any other organization owns IPRs which were, or were likely to become Essential in respect of the work of 3GPP.*
- *to notify their respective Organizational Partners of all potential IPRs, e.g., for ETSI, by means of the IPR Information Statement and the Licensing declaration forms (e.g. see the ETSI IPR forms http://webapp.etsi.org/Ipr/).*

1.2 Competition law statement

The Chairman also drew Member's attention to the fact that 3GPP activities are subject to antitrust and competition laws and that compliance with said laws is therefore required of any participant of this WG meeting including the Chairman and Vice Chairmen. In case of question, please contact your legal counsel.
The present meeting will be conducted with strict impartiality and in the interests of 3GPP.
Furthermore, the Chairman reminded Members that timely submission of work items/contributions in advance of WG meetings is important to allow for full and fair consideration of such matters.

1.3 Network usage conditions

The PCG has laid down the following network usage conditions:

Users shall not use the network to engage in illegal activities. This includes activities such as copyright violation, hacking, espionage or any other activity that may be prohibited by local laws.

Users shall not engage in non-work related activities that consume excessive bandwidth or cause significant degradation of the performance of the network.
Since the **network is a shared resource**, users should exercise some basic etiquette when using the 3GPP network at a meeting. It is understood that high bandwidth applications such as downloading large files or video streaming might be required for business purposes, but delegates should be strongly discouraged in performing these activities for personal use. Downloading a movie or doing something in an interactive environment for personal use essentially wastes bandwidth that others need to make the meeting effective. The meeting chairman should remind end users that the network is a shared resource; the more one user grabs, the less there is for another. Email and its attachments already take up significant bandwidth (certain email programs are not very bandwidth efficient). In case of need the chair can ask the delegates to restrict IT usage to things that are essential for the meeting itself.

1. DON'T place your WiFi device in ad-hoc mode
2. DON'T set up a personal hotspot in the meeting room
3. DO try 802.11a if your WiFi device supports it
4. DON'T manually allocate an IP address
5. DON'T be a bandwidth hog by streaming video, playing online games, or downloading huge files
6. DON'T use packet probing software which clogs the local network (e.g., packet sniffers or port scanners)

1.4 Check-in for Registered Delegates

The attention of the delegates to this meeting was drawn to the fact that it is not permitted to check in other delegates on their behalf. In the event of technical difficulties preventing check-in, delegates should present themselves in person to the Secretary.

1.5 Aspects related to RAN1 Meeting Management

Delegates are encouraged to check R1-1721392 for some thoughts on RAN1 meeting management.

RAN1 chair recalled the absolute necessity to follow the rules laid down in the above document.

2 Approval of Agenda

R1-1808190 **Draft Agenda of RAN1#94 meeting** **RAN1 Chair**

Wanshi Chen (RAN1 Chair) proposed the agenda for the meeting, as well the schedule of the week.
Discussion: No comments.
Decision: The agenda is approved.

Announcement was made regarding the ETSI Worshop "Writing World Class standards"
The workshop aims at improving the overall quality of our deliverables; as contributors to the RAN1 specifications, companies are invited to participate. Brief description of the workshop content includes:

- What makes a World Class Standard
- Well written requirements
  - Complete, precise, unambiguous, necessary, etc.
- Use of shall, should and may
- Requirements and their context and conditions
- Typical causes of misunderstanding
  - Poor language, wrong document structure, ambiguity, verbosity, vagueness, etc.

3 Highlights from RAN plenary

R1-1808002 **Highlights from RAN#80** **RAN1 Chair**

Discussion: Ad-Jan 2019 meeting is confirmed - RAN1 chair clarified that no LTE, no NR CRs will be considered and the ad-hoc meeting schedule should be focused on other NR stuff (mainly new SI...)
Intel: Why is the uncertainty on NOMA higher than to other features? RAN1 chair --> refer to RAN plenary discussion, mainly the way to make progress is the issue.
Decision: The document is noted.

4 Approval of Minutes from previous meeting

R1-1808001 **Report of RAN1#93 meeting** **MCC (ETSI)**

The document was presented by Patrick Merias from MCC (ETSI Mobile Competence Center) and provides the report from last RAN1#93 meeting in Busan.
Discussion: MCC recalled that all CRs presented for approval at RAN#80 were duly implemented. Nevertheless, eV2X CR to 36.211 (draft CR endorsed as a result of post RAN1#92bis email discussion prior to RAN1#93) was accidently forgotten. Formal CR should be treated in the corresponding LTE maintenance session (see 6.1.3).
Decision: The document is approved.

5 Incoming Liaison Statements

R1-1808179 **LS on Joint ETSI - OSA Workshop: Open Implementations & Standardization** **ETSI**

Joint ETSI - OSA Event on Open Implementations and Standardization. Preceded by a one day training on 11 December, the Joint ETSI - OSA Workshop: Open Implementations and Standardization will take place on 12-13 December 2018 at ETSI premises in Sophia Antipolis, France.
Decision: The document is noted.

LTE

// 6.1.1 related

R1-1808022 **Wi-Fi Alliance Coexistence Test Plan for LTE-LAA Version 1.1.10** **Wi-Fi Alliance**
R1-1808023 **Reply LS on PSCCH/PSSCH subframe numbering issue in partial network coverage** **RAN2, Ericsson**

//6.1.3 related

R1-1808027 **Reply LS to RAN1 on RRC parameters for V2X Phase 2** **RAN2, LG Electronics**

//6.1.5 related

R1-1808005 LS response on NB-IoT downlink channel quality determination and report RAN4, Ericsson
R1-1808011 Reply LS on Narrowband measurement accuracy improvements RAN4, Huawei
R1-1808024 Reply LS on narrowband measurement RAN2, Huawei

// 6.1.9 related

R1-1808032 LS on final RAN2 agreements for euCA RAN2, Nokia

The following LSs are noted (not presented online unless explicitly requested)

R1-1808006 Reply LS on updates for TS 36.300 RAN3, Huawei
R1-1808013 LS on eFeMTC CRS muting RAN4, Huawei
R1-1808026 Reply LS on PC5 transmission mechanism selection RAN2, LG Electronics
R1-1808031 Reply LS on CP latency reduction RAN2, Ericsson

NR

// General

R1-1808003 LS on the feasibility of 1 symbol GP for 60KHz in FR1 and 120KHz in FR2 RAN4, MediaTek
Discussion: Panasonic --> RAN1 understanding is that GP length is assumed per UE, the LS content seems different? MediaTek will check with RAN4 and clarify offline the RAN4 requirements
Decision: The document is noted.

R1-1808176 LS on clarification of useServingCellTimingForSync RAN4, MediaTek
R1-1809228 [draft] Response LS on clarification of useServingCellTimingForSync LG Electronics Inc.

//7.1.1 related

R1-1808004 LS on RMSI CORESET configuration for a band with 15kHz SSB SCS and 10MHz minimum channel bandwidth RAN4, CATT, Samsung

R1-1808025 Reply LS on RMSI 9773SET configuration for a band with 15kHz SSB SCS and 10MHz minimum channel bandwidth RAN2, CATT

R1-1808860 LS on ssb-PositionsInBurst mismatch in SIB1 and ServingcellConfigCommon RAN2, vivo
Decision: The document is noted. Reply LS is necessary
R1-1808214 Discussion on ssb-PositionsInBurst mismatch in SIB1 and ServingcellConfigCommon vivo
R1-1809710 Draft Reply LS Discussion on ssb-PositionsInBurst mismatch in SIB1 and ServingcellConfigCommon Nokia, Nokia Shanghai Bell (Revision of R1-1808964)
R1-1809255 Draft Reply LS on ssb-PositionsInBurst mismatch in SIB1 and ServingcellConfigCommon Ericsson

R1-1808028 Reply LS on Agreements on Paging RAN2, Qualcomm

R1-1808172 LS on Further Agreements on Paging Occasions RAN2, Qualcomm
Discussion: Debate on the fact that RAN2 sent that LS from July ad-hoc meeting, and agreed in principle by email after the ad-hoc a CR not fully aligned with the LS.
Companies are encouraged to check with their RAN2 colleagues to make sure there is no unconsistency in RAN1 understanding.
Decision: The document is noted.
R1-1809226 [draft] Response LS on Further Agreements on Paging Occasions LG Electronics Inc.
R1-1809374 [Draft] LS Reply on Further Agreements on Paging Occasions Nokia, Nokia Shanghai Bell

R1-1808169 LS on short message transmission using DCI RAN2, Ericsson
Decision: The document is noted. Reply LS is necessary
R1-1808454 [draft] Response LS on short message transmission using DCI LG Electronics
R1-1808566 On short message transmission using DCI Nokia, Nokia Shanghai Bell
R1-1808567 [DRAFT] Reply LS On short message transmission using DCI Nokia, Nokia Shanghai Bell

R1-1808168 **LS on overlapping SIB1 and SI messages RAN2, Ericsson**
Decision: The document is noted. Reply LS is necessary
R1-1808650 [DRAFT] Reply LS on Overlapping SIB1 and SI messages Intel Corporation
R1-1809372 [Draft] LS Reply on overlapping SIB1 and SI messages Nokia, Nokia Shanghai Bell

R1-1808167 **Reply LS on numberOfRA-PreamblesGroupA RAN2, Nokia**
RAN2 reached a conclusion the current specification is clear and no changes are being made. The proposal by RAN1 would have added more overhead unnecessarily to the RRC signaling.
No impact to RAN1 spec
Decision: The document is noted.

R1-1808175 **LS on RA preambles mapping to SSBs RAN2, ZTE**
R1-1808963 Draft Reply LS on RA preambles mapping to SSBs Nokia, Nokia Shanghai Bell

//7.1.2 related
R1-1808166 **LS on termination of contention-free BFR RAN2, Intel**
Decision: The document is noted. Reply LS is necessary (also related to 7.1.3.1).
R1-1808366 Draft reply LS to RAN2 on termination of contention-free BFR CATT
R1-1808649 Draft reply to LS on beam failure recovery Intel Corporation
R1-1808729 DRAFT Reply LS on termination of contention-free BFR Samsung
Withdrawn
R1-1808884 Discussion on the reply to "LS on termination of contention-free BFR" Guangdong OPPO Mobile Telecom
R1-1809234 [DRAFT] LS Response to RAN2 LS to RAN1 on LS on termination of contention-free Nokia, Nokia Shanghai Bell
R1-1809395 Draft reply LS on termination of contention-free BFR Motorola Mobility, Lenovo

//7.1.3 related
(in response to R1-1807732 (R2-1808992))
R1-1809133 Draft reply LS on PDCCH common search space configurations NTT DOCOMO, INC.

R1-1808173 **LS on additional TDD configuration periodicities RAN2, Nokia**
Decision: The document is noted. Reply LS is necessary. See 7.1.3.1
R1-1809390 On Additional TDD configuration periodicities Nokia, Nokia Shanghai Bell, SPRINT Corporation
R1-1809391 DRAFT Response LS on additional TDD configuration periodicities Nokia, Nokia Shanghai Bell, SPRINT Corporation

R1-1808171 **Reply LS on Bandwidth configuration for initial BWP RAN2, NTT DOCOMO**
RAN2 agreed to support both options. Both options are supported for a UE capable of basic BWP operation with restriction (#6-1) as mandatory without IOT bit.
Option 1: *BWP-DownlinkCommon/UplinkCommon* for *initialDownlink/UplinkBWP* (BWP ID #0) plus *BWP-Downlink/Uplink* for one configured *downlink/uplinkBWP* (BWP ID #1);
Option 2: *BWP-DownlinkCommon/UplinkCommon* and *BWP-DownlinkDedicated/UplinkDedicated* for *initialDownlink/UplinkBWP* (BWP ID #0).
Decision: The document is noted. Check offline how this is going to be applied and corresponding spec impacts, if any.

R1-1808174 **LS on Active DL BWPs overlapping/non-overlapping with Initial DL BWPRAN2, ZTE**
Decision: The document is noted. Reply LS is necessary (related to many other aspects)
R1-1808651 [DRAFT] Reply LS on Active DL BWPs overlapping/non-overlapping with Initial DL BWP Intel Corporation
R1-1808947 Draft reply LS on Active DL BWPs overlapping/non-overlapping with Initial DL BWP Huawei, HiSilicon

R1-1809373 [Draft] LS Reply on Active DL BWPs overlapping/non-overlapping with Initial DL BWP Nokia, Nokia Shanghai Bell
R1-1809396 Draft reply LS on Active DL BWPs overlapping/non-overlapping with Initial DL BWP Motorola Mobility, Lenovo

// 7.1.4 related
R1-1808007 LS on NR Cell Information signalled over X2 for EN-DC RAN3, Ericsson
R1-1808029 Reply LS on UE power class and UE capability on SRS carrier switch RAN2, NTT DOCOMO
Decision: The document is noted. Reply LS is necessary
R1-1809124 Draft reply LS on UE power class and UE capability on SRS carrier switch Huawei

//7.1.7 related
R1-1808017 LS on UE feature list RAN4, NTT DOCOMO, Intel
R1-1808020 LS on NR UE feature list RAN, NTT DOCOMO
R1-1808859 LS on fallback interpretation of UE FeatureSetDown(Up)LinkPerCC capability fields RAN2, Intel

// 7.2.4 related
R1-1808008 Additional Reply LS on eV2X evaluation methodology SAE C-V2X TC Advanced Applications Task-Force, AT&T
R1-1809720 LS on Prioritised Use Cases and Requirements for consideration in Rel-16 NR-V2X5GAA WG1

// Others
R1-1808303 Liaison ESOA (EMEA Satellite Operators Association) on 5G for Satellite Systems ESOA, Thales

The following LSs are noted (not presented online unless explicitly requested)
R1-1808009 LS reply on UL timing difference in EN-DC RAN4, Intel Corporation
R1-1808014 LS on 2RX requirements for vehicle mounted NR UE RAN4, LG Electronics
R1-1808015 RAN4 response LS on Coexistence of NR-NR and NR-LTE networks RAN4, Qualcomm Incorporated
R1-1808018 LS reply on Coexistence of NR-NR and NR-LTE networks with synchronised, unsynchronised and semi-synchronised operation in 3400-3800 MHz RAN, Huawei
R1-1808019 LS reply on minimum number of RX antennae for NR vehicular Ues RAN, Samsung (Harman)
R1-1808021 LS on L2 measurement specification for NR in R15 SA5, Ericsson
R1-1808030 LS on RAN2 progress on ANR RAN2, vivo
R1-1808170 Reply LS on NR Cell Information signalled over X2 for EN-DC RAN2, Ericsson
R1-1808177 LS on potential enhancement of DR-mode of operation SA2, Intel
R1-1808178 LS on the transmission of video over PC5 interface SA4, Samsung
R1-1808180 IEEE 802.11 WG LS to 3GPP RAN4 on certain channel combinations for LAA in 5GHz IEEE 802.11 Working Group
R1-1808181 IEEE 802.11 WG LS to 3GPP RAN in relation to a proposed joint Coexistence Workshop IEEE 802.11 Working Group
Discussion: Should be further discussed in RAN as proposed timeslots for the workshop may not fit with RAN1 future schedule.
Decision: The document is noted.

LS received during the week.

R1-1809876 LS on OSI acquisition RAN2, Qualcomm
Decision: The document is noted.

R1-1809892 LS on default configuration for L1 parameter RAN2, NTT DOCOMO
RAN2 asks RAN1 to define the default value for the L1 parameters required during the transition from RRC IDLE/INACTIVE to RRC CONNECTED state but for which the values are not provided via MIB or SIB.
Decision: The document is noted.

R1-1809942 LS on UE capability for simultaneousTxSUL-NonSUL RAN2, Huawei
Decision: The document is noted. Treated under 7.1.7

R1-1809948 **LS response on NPBCH-based RRM measurement for FeNB-IoT UE** **RAN4, Qualcomm**
Decision: The document is noted. Treated under 6.1.5

R1-1810001 **Reply LS on SRS carrier switching** **RAN4, Huawei**
Decision: The document is noted.

6 E-UTRA

6.1 Maintenance of E-UTRA Releases 8 – 15

For 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6,

- No individual CRs are allowed. Only text proposals are allowed.
  - Later on editors will aggregate all endorsed text proposals for a jumbo CR per spec

Friday
Editors to prepare CRs incorporating the TPs/agreements/working assumptions by August 30th for 6.1.2/6.1.3/6.1.4/6.1.5/6.1.6, respectively, for comments and endorsement d by Sept. 4th

6.1.1 Maintenance of E-UTRA Release 8 – 14

Friday
R1-1809664 **Chairman's notes of AI 6.1.1 Maintenance of E-UTRA Release 8 – 14** **Ad-hoc chair (Ericsson)**
Decision: The document is endorsed, content is incorporated below.

NB-IoT
NPRS
R1-1808113 **On handling new and legacy NPRS for in-band operation mode** **Huawei, HiSilicon**
R1-1808114 Correction to NPRS mapping Huawei, HiSilicon
R1-1808992 **draft CR on NPRS enhancement** **Ericsson**
R1-1809000 **Remaining details for enhanced NPRS** **Qualcomm Incorporated**
Discuss further offline. Come back later
R1-1809592 **WF on NPRS Remaining Issues** **Qualcomm, Huawei, HiSilicon, Ericsson**

Agreement:
- If the periodicity configured for legacy NPRS is equal to that of new NPRS,
  - The UE is not expected to be configured with overlapped REs between legacy NPRS and new NPRS.
- Otherwise,
  - A RE configured for legacy NPRS shall not be used for new NPRS.

R1-1809599 (Revision of R1-1808114) **Correction to NPRS mapping** **Huawei, HiSilicon, Qualcomm, Ericsson**
Final CR agreed in R1-1809605 (Rel-14, TS36.211, CR0454), R1-1809606 (Rel-15, TS36.211, CR0455)

R1-1808994 **Transmission of NPSS/NSSS/NPBCH** **Qualcomm Incorporated**
Conclusion:
- The described behaviour as in R1-1808994 is the common understanding in RAN1
  - No CR is necessary

R1-1809003 **Correction for interference randomization for NB-IoT** **Qualcomm Incorporated**
The draft CR in R1-1809003 is endorsed (with correction of typo "randomziaiton" in the reason for change) – final CR agreed in R1-1809535 (CR 0452, Rel-14), & R1-1809536 (CR 0453, Rel-15)

eMTC
R1-1808995 **PRG for eMTC** **Qualcomm Incorporated**
The draft CR is endorsed in principle (need to move the sentence starting with "otherwise…." before the table to the non-BL/CE case). Come back later for final CR (R1-1809537, CR 1121, Rel-13), (R1-1809538, CR 1122, Rel-14) , (R1-1809539, CR 1123, Rel-15)

Final CR agreed (R1-1809537, CR 1121, Rel-13), (R1-1809538, CR 1122, Rel-14) , (R1-1809539, CR 1123, Rel-15)

R1-1808996 **Correction for HARQ-ACK delay in eMTC** **Qualcomm Incorporated**
Discuss further offline. Come back later
R1-1809635 **(Revision of 1808996)** **Correction for HARQ-ACK delay in eMTC** **Qualcomm Incorporated**
Final CRs agreed in R1-1809653 (TS36.213, Rel-14, CR1156) and R1-1809654 (TS36.213, Rel-15, CR1157)

R1-1809004 **Correction on DCI for HARQ-ACK bundling** **Qualcomm Incorporated**
The draft CR is endorsed in principle. Further discuss offline to refine the wording. Come back later. R1-1809540 (CR0298, Rel-14), R1-1809541 (CR0299, Rel-15)
Final CR approved in R1-1809540 (CR0298, Rel-14), R1-1809541 (CR0299, Rel-15)

R1-1809378 Clarification of number of PDSCH repetitions when R_CSI is 1 in LTE-MTC Ericsson
Conclusion:
- For the issue raised in R1-1809378, the agreements cited are applicable only to TDD.
  - No CR is necessary

eCA
R1-1808593 **Correction on TDD HARQ-ACK reporting procedure for different UL/DL configurations** **Huawei, HiSilicon**
The draft CR is endorsed. Final CRs agreed in R1-1809542 (Rel-13, 1124), R1-1809543 (Rel-14, 1125), R1-1809544 (Rel-15, 1126)

R1-1808594 **Correction on PUCCH format 4 HARQ-ACK procedure without adaptive codebook** **Huawei, HiSilicon**
The CR is agreed. Shadow CRs for Rel-14 & 15 agreed in R1-1809545 (Rel-14, 1127), R1-1809546 (Rel-15, 1128)

MUST
R1-1808652 **Draft CR: Corrections to modulation signalling in MUST** **Intel Corporation**
Discuss further offline. Come back later
R1-1809610 **(Revision of R1-1808652)** **Draft CR: Corrections to modulation signalling in MUST** **Intel Corporation**
Final CRs agreed in R1-1809636 (TS36.212, Rel-14, CR0302) and R1-1809637 (TS36.212, Rel-15, CR0303)

MIMO
R1-1808653 **Draft CR: Correction to PDSCH RE mapping in TM10** **Intel Corporation**
The draft CR is endorsed. Final CRs agreed in R1-1809547 (Rel-13, 1129), R1-1809548 (Rel-14, 1130), R1-1809549 (Rel-15, 1131)

R1-1808997 **Rate matching for A-CSI-RS** **Qualcomm Incorporated**
Discuss further offline. Come back later
Decision: For email approval till 8/31 – Alberto (Qualcomm)

R1-1809005 **Correction on advanced CSI codebook** **Qualcomm Incorporated**
The CR is endorsed (by updating the WI code by removing the dash in between). Final CRs agreed in R1-1809550 (Rel-14, CR1132), R1-1809551 (Rel-15, CR1133)

SRS carrier switching
R1-1808993 **HARQ reference configuration for SRS carrier switching** **Qualcomm Incorporated**
The draft CR is endorsed in principle, with the following points for further discussion:
- Changes in 7.3.3 & 10.1.2A (neither/nor vs. either/or or other ways)
- Changes in Section 13
- Conditions for the parameter

Final CRs to be prepared in R1-1809552 (Rel-14, CR 1134), R1-1809553 (Rel-15, CR 1135)
Decision: CRs are postponed as proponent couldn't find enough time to converge in all the details.

R1-1809001 **Discussion on CA capability for SRS carrier switching** **Qualcomm Incorporated**
For the first issue, further discussion offline. Come back later
The second TP raised in R1-1809001 is endorsed. Final CRs agreed in R1-1809554 (Rel-14, CR 1136) & R1-1809555 (Rel-15, CR 1137)

feMBMS
R1-1808998 **Capability for FeMBMS** **Qualcomm Incorporated**
The CR is endorsed in principle (further refine wording offline). Final CRs agreed in R1-1809556 (Rel-14, CR1138) & R1-1809557 (Rel-15, CR1139)

UL Capacity Enhanements
R1-1808999 **SRS transmission in UpPTS for special subframe configuration 10** **Qualcomm Incorporated**
The CR is endorsed in principle (further refine wording offline, & further check whether or not there are other missing parts. Note that the impact spec should be 36.213). Final CRs agreed in R1-1809558 (Rel-14, CR1140), R1-1809559 (Rel-15, CR1141)

R1-1809006 **HARQ-ACK payload size determination for crs-less special subframe configuration 10** **Qualcomm Incorporated**
The draft CR is endorsed. Final CRs agreed in R1-1809560 (Rel-14, CR1142), R1-1809561 (Rel-15, CR1143)

Antenna Selection
R1-1809002 Discussion on closed loop PUSCH antenna selection Qualcomm Incorporated
Continue discussion offline. Come back later.

Agreement:
Clarify that the intended UE behaviour for closed loop PUSCH antenna selection is "Most recent command" = "latest DCI received at or before n-4" for Rel-14 and later UEs.
R1-1809607 **Clarification for antenna selection** **Qualcomm Incorporated**
Final CRs agreed in R1-1809638 (TS 36.213, Rel-14, CR1148) and in R1-1809639 (TS36.213, Rel-15, CR1149)

R1-1809244 **Correction on transmit antenna selection** **CMCC**
Continue discussion offline. Come back later.
R1-1809633 **Change request on UE transmit antenna selection** **CMCC**
Final CRs agreed in R1-1809640 (TS36.213, Rel-12, CR1150), R1-1809641 (TS36.213, Rel-13, CR1151), R1-1809642 (TS36.213, Rel-14, CR1152) and R1-1809643 (TS36.213, Rel-15, CR1153)

R1-1809634 **Change request on 1T2R antenna switching of SRS** **CMCC**
Final CR agreed in R1-1809644 (TS36.213, Rel-15, CR1154)

6.1.2 Maintenance of Release 15 Shortened TTI and processing time for LTE

LTE_sTTIandPT-Core; WID in RP-171468.

Friday
R1-1809665 **Chairman's notes of AI 6.1.2 Maintenance of Release 15 Shortened TTI and processing time for LTE** **Ad-hoc chair (Ericsson)**
Decision: The document is endorsed, content is incorporated below.

R1-1809597 **Outcome of sTTI offline** **Ericsson**

6.1.2.1 Maintenance for shortened processing time for 1ms TTI

None

6.1.2.2 Maintenance for shortened TTI with shortened processing time

R1-1809625 DRAFT LS on additional UE capabilities for sTTI Ericsson
R1-1809683 DRAFT LS on sTTI Ericsson
Decision: The draft LS is endorsed and final LS is approved in R1-1809687.

6.1.2.2.1 Aspects related to interaction between different TTI lengths

R1-1809293 TP on collision handling for subslot-PUSCH Guangdong OPPO Mobile Telecom, CAICT
R1-1809601 (Revision of R1-1809293) TP on collision handling for subslot-PUSCH Oppo

R1-1809367 Corrections on interaction between different TTI lengths Huawei, HiSilicon

Conclusion:
UE processing of MSG3 PUSCH is not interrupted by sPUSCH grants (as per current specification).

6.1.2.2.2 Aspects related to DL control channel

R1-1809241 Correction on the starting SCCE index for an aggregation level Ericsson
The text proposals in R1-1809241 are endorsed.

6.1.2.2.3 Aspects related to UL control channel

R1-1809216 Aspects related to UL control channel Qualcomm Incorporated
The text proposal in R1-1809216 is endorsed with the following modification:
Add SR after HARQ-ACK in "$O_{\text{UCI}}(i)$ is the total number of HARQ-ACK~~, RI,CQI,PMI~~ bits including CRC bits transmitted on PUCCH format 4 in slot/subslot I"

R1-1809218 Corrections on PRB determination for subslot PUCCH format 1a/1b ZTE
R1-1809350 Corrections on UCI mapping in 36.212 Huawei, HiSilicon, LG Electronics, Nokia, Nokia Shanghai Bell
The text proposals in R1-1809350 are endorsed.

6.1.2.2.4 Aspects related to DL data channel

R1-1808455 Corrections related to CSI feedback LG Electronics
The text proposal in Section 2.2 of R1-1808455 is endorsed.

Agreement:
UE capability on the maximum number of CSI processes to be updated is defined separately for

- {slot,slot}
- {subslot,slot}
- {subslot,subslot} processimg timeline set 1
- {subslot,subslot} processimg timeline set 2

Note: This replaces the existing UE capability on the maximum number of CSI processes to be updated for sTTI. RAN2 should be informed about this.

R1-1809217 Aspects related to DL data channel Qualcomm Incorporated
Late submission
R1-1809354 Correction on rate matching for SPS sPDSCH Huawei, HiSilicon

Agreement:
The sPDCCH rate matching for dynamic retransmissions of SPS sPDSCH applies the same mode as for scheduled sPDSCH scrambled with C-RNTI.

R1-1809579 **Correction on rate matching for SPS sPDSCH** **Huawei, HiSilicon**
The text proposal in R1-1809579 is endorsed.

R1-1809364 **Corrections on SFBC sPDSCH RE mapping** **Huawei, HiSilicon, Nokia, Nokia Shanghai Bell, Ericsson, LG Electronics**
The text proposal in R1-1809364 is endorsed.

R1-1809365 **Corrections on spreading sequence for sPDSCH DMRS** **Huawei, HiSilicon, LG Electronics, Nokia, Nokia Shanghai Bell, ZTE, Ericsson**
The text proposal in R1-1809365 is endorsed.

R1-1809384 Corrections to CSI reporting for shorter TTI in 36.213 – TP#1 Nokia, Nokia Shanghai Bell, Ericsson
R1-1809578 (Revision of R1-1809384) **Corrections to CSI reporting for shorter TTI in 36.213 – TP#1** **Nokia, Nokia Shanghai Bell**
The text proposal in R1-1809578 is endorsed.

R1-1809385 **Correction to slot/subslot PDSCH RBG numbering/order for Resource Allocation Type 0 in 36.213 – TP#2** **Nokia, Nokia Shanghai Bell, LG Electronics, Ericsson, Huawei, HiSilicon**
The text proposal in R1-1809385 is endorsed

R1-1809386 **Correction to PUSCH/PDSCH processing skipping in case of DCI Format 7-X reception in 36.213 – TP#4** **Nokia, Nokia Shanghai Bell, LG Electronics, Ericsson, Huawei, HiSilicon**
The text proposal in R1-1809386 is endorsed

6.1.2.2.5 Aspects related to UL data channel

R1-1809007 **Aspects related to UL Data Channel** **Qualcomm Incorporated**

Agreement:
The sRBG size and starting point granularity for 2/3os and 7os sPUSCH is for 1.4 MHz and 3 MHz as per table below (the same as legacy).

	1.4 MHz	3 MHz
sRBG size	1	1
Starting point granularity	1	1

Agreement:
For PUSCH without UL-SCH, define a UE capability per UL sTTI length whether to support BPRE derivation based on the actual derived O_CQI. Define an RRC parameter *uplinkPower-CSIPayload* to configure a UE to derive BPRE based on either the actual value of O_CQI or the largest value of O_CQI across all RI values. In case the UE does not support the capability, the UE will derive BPRE based on the largest value of O_CQI across all RI values.

The text proposal in section 3 of R1-1809007 is endorsed

R1-1809581 **Clarification for UL Resource Allocation Type 0** **Qualcomm Incorporated**
The text proposal in R1-1809581 is endorsed

Agreement:
In case of sPUSCH in UpPTS, the following TBS scaling factors apply depending on the number of symbols, X:
- $X \leq 3$: 0.125
- $X > 3$: 0.375

R1-1809580 **TBS Scaling for Slot TTI in UpPTS** **Qualcomm Incorporated**
The text proposal in R1-1809580 is endorsed

R1-1809351 Corrections on UL power control in case of UL DMRS sharing Huawei, HiSilicon

R1-1809366 Corrections on RV determination for sPUSCH Huawei, HiSilicon, LG Electronics, Nokia, Nokia Shanghai Bell, ZTE, Ericsson
The text proposal in R1-1809366 is endorsed.

R1-1809387 Correction of transport block size determination for sPUSCH in 36.213 – TP#3 Nokia, Nokia Shanghai Bell, LG Electronics, Ericsson, Huawei, HiSilicon
The text proposal in R1-1809387 is endorsed

R1-1809388 Correction of UL HARQ process definition for SPT PUSCH & sPUSCH in 36.213 – TP#5 Nokia, Nokia Shanghai Bell, Ericsson

Agreement:
Define a pseudo HARQ-ID to subframe mapping for synchronous HARQ (HARQ process pool sharing) for improved asynchronous and synchronous HARQ coexistence.

R1-1809389 Correction to sPUSCH resource allocation in 36.213 – TP#15 Nokia, Nokia Shanghai Bell, Huawei, HiSilicon, LG Electronics, Ericsson
The text proposal in R1-1809389 is endorsed

6.1.2.2.6 Aspects related to FS2

R1-1808456 eIMTA support with sTTI operation LG Electronics
The text proposal in R1-1808456 is endorsed

R1-1809363 Corrections on DAI timing for FS2 with sTTI Huawei, HiSilicon, Ericsson
The text proposals in R1-1809363 are endorsed

6.1.2.3 Other

R1-1808457 Corrections on collision handling between subslot UL SPS and SPUCCH LG Electronics
The text proposal in R1-1808457 is endorsed

R1-1809352 Corrections on HARQ-ACK feedback for DL SPS Huawei, HiSilicon
The text proposal in R1-1809352 is endorsed

R1-1809353 Remaining issues on SPS Huawei, HiSilicon

6.1.3 Maintenance of Release 15 3GPP V2X Phase 2

LTE_eV2X-Core; WID in RP-171740.

Friday

R1-1809666 Chairman's notes of AI 6.1.3 Maintenance of Release 15 3GPP V2X Phase 2 Ad-hoc chair (Ericsson)
Decision: The document is endorsed, content is incorporated below.

R1-1808328 Introduction of eV2X Ericsson
In the e-mail discussion following RAN1#92bis, draft CR for introducing eV2X functionality in 36.211 was endorsed. However, by mistake, the endorsed CR was submitted in R1-1807408 as a draft CR and not a final CR, resulting in the CR package to RAN including the CRs for 36.212 and 36.213 only but not 36.211. Thus, the current RAN1 specifications are incomplete in terms of eV2X support.
The changes in the current CR (R1-1808328) is identical to the already endorsed draft CR in R1-1807408 but is based on version 15.2.0 instead of 15.1.0.

Decision: CR0451 to 36.211 Rel-15 is agreed.

6.1.3.1 Maintenance for Carrier Aggregation (up to 8 PC5 carriers)

R1-1808902 Discussion on synchronization carrier configuration Guangdong OPPO Mobile Telecom

6.1.3.2 Maintenance for Support for 64-QAM

R1-1808873 Text proposal to support 64-QAM in eV2X Guangdong OPPO Mobile Telecom

6.1.3.3 Maintenance for Resource pool sharing between mode-3 and mode-4 users

R1-1808903 Discussion on necessary L1 support for mode 3 sensing and reporting Guangdong OPPO Mobile Telecom

6.1.3.4 Maintenance for Maximum time reduction between packet arrival at layer 1 and resource selection for transmission

R1-1808874 Text proposal to support maximum time reduction in eV2X Guangdong OPPO Mobile Telecom

6.1.3.5 Other

R1-1808367 Corrections to the PSCCH decoding capability in TS 36.213 CATT
Agreed in R1-1809656 (rev1, CR1119, TS36.213, Rel-15)
Friday: Spec 36.213 editor commented that this is an individual CR, proponent did not follow the guidance set in the agenda of the meeting.
RAN1 chair: The decision is cancelled, CR is declared "not pursued" while the corresponding changes will be incorporated by editor.

R1-1809292 [Draft] LS on RRC parameters SL_SLSS_Tx_Enabled for V2X Phase 2Guangdong OPPO Mobile Telecom

6.1.4 Maintenance of Release 15 Even further enhanced MTC for LTE

LTE_eMTC4-Core; WID in RP-172811.

Friday
R1-1809667 Chairman's notes of AI 6.1.4 Maintenance of Release 15 Even further enhanced MTC for LTE Ad-hoc chair (Ericsson)
Decision: The document is endorsed, content is incorporated below.

6.1.4.1 Maintenance for Resynchronization signal

R1-1808623 Remaining collision issues for RSS transmission ZTE
R1-1808984 Maintenance issues for Resynchronization signal for Rel-15 LTE-MTC Ericsson
R1-1809008 Maintenance for RSS Qualcomm Incorporated

R1-1809531 Feature summary of 6.1.4.1 Maintenance for Resynchronization signal Ericsson
R1-1809591 Remaining issues for 6.1.4.1 Maintenance for Resynchronization signal Ericsson

Agreement:
The whole RSS of the subframe is dropped if any RSS PRB pair overlaps with any PSS/SSS/PBCH PRB pair.

Agreement:
The whole RSS of the subframe is dropped if any RSS PRB pair overlaps with any PRB pair carrying SIB1-BR or other SI.

Agreement:
A UE may assume that RSS punctures PRB pairs belonging to MPDCCH not associated with a RAR and PRB pairs belonging to PDSCH not addressed by RA-RNTI.

Agreement:

A UE may assume that the whole WUS subframe is dropped if WUS PRB pairs partially or fully overlap with RSS PRB pairs

R1-1809618 **Text proposals for 6.1.4.1 Maintenance for Resynchronization signal** **Ericsson**
The text proposals in R1-1809618 are endorsed.

6.1.4.2 Maintenance for Early data transmission

R1-1808125 Corrections on EDT for eMTC Huawei, HiSilicon
R1-1808624 Remaining issue for MTC EDT ZTE
R1-1808985 **Maintenance issues for Early data transmission for Rel-15 LTE-MTC** **Ericsson**

R1-1809565 **Feature lead summary of Maintenance for Early data transmission in eMTC** **Huawei**

Agreement:
In 36.213, specify the number of PUSCH repetition for EDT Msg3 retransmissions, similarly as done in 36.213 for NB-IoT

R1-1809645 **Updated feature lead summary of Maintenance for Early data transmission in eMTC** **Huawei**
The text proposal in Section 3.2 of R1-1809645 is endorsed with the following modifications in both places where the text occurs in the text proposal.
"….is the smallest integer multiple of M that is equal to or larger than $TBS_{Msg3}/TBS_{Msg3,\max} \cdot N_{Msg3}$ where TBS_{Msg3} is the TBS corresponding to the PUSCH ~~re~~transmission scheduled by the Random Access Response Grant, and $TBS_{Msg3,\max}$ is the value of the higher layer parameter *edt-TBS-r15*. $M = 4$ if $N_{Msg3} > 4$, $M = 1$ otherwise"

The text proposal in Section 3.5 of R1-1809645 is endorsed with a modification to change "is set to'true'" to "set to true" in the captions of the two tables.

Agreement:
The following text proposal is agreed:
---------- Start of Text proposal----------
6.2 Random Access Response Grant
7 <unchanged part>
The repetition number field in the random access response grant configured by higher layers indicates the repetition level (N_{Msg3}) for the initial transmission of Msg3 PUSCH as given in Table 6.2-C for CEmodeA and Table 6.2-D for CEmodeB, where
- Y_A is determined by higher layer parameter *pusch-maxNumRepetitionCEmodeA-r13* if it is signaled, otherwise $Y_A = 8$,
- Y_B is determined by higher layer parameter *pusch-maxNumRepetitionCEmodeB-r13* if it is signaled, otherwise $Y_B = 512$.

- If the higher layers indicate EDT to the physical layer as defined in [8] and if the UE is configured with higher layer parameter *edt-smallTBS-Enabled-r15*, the repetition ~~level~~ number for the initial transmission of Msg3 PUSCH is the smallest ~~value~~ integer multiple of M ~~from the set {1, 2, 4, 8, 16, 32, 64, 128, 192, 256, 384, 512, 768, 1024, 1536, 2048}~~ that is equal to or larger than $TBS_{Msg3}/TBS_{Msg3,\max} \cdot N_{Msg3}$ where TBS_{Msg3} is the TBS of Msg3 PUSCH as determined in subclause 8.6.2, and $TBS_{Msg3,\max}$ is the value of the higher layer parameter *edt-TBS-r15*. $M = 4$ if $N_{Msg3} > 4$, $M = 1$ otherwise.

8 <unchanged part>
---------- end of Text proposal----------

6.1.4.3 Maintenance for Wake-up signal

R1-1808126 **Corrections on MWUS Huawei, HiSilicon, Ericsson, Qualcomm, LG, Samsung, ZTE**
R1-1808986 Maintenance issues for Wake-up signal for Rel-15 LTE-MTC Ericsson
R1-1809009 **Maintenance for wake-up signal Qualcomm Incorporated**

R1-1809520 **Summary of 6.1.4.3 Maintenance for MWUS** **Qualcomm Incorporated**
The text proposals in R1-1808126 are endorsed.

The text proposal in Section 2.3 of R1-1809520 is endorsed.

R1-1809657 **Remaining issues of 6.1.4.3 Maintenance for MWUS** **Qualcomm Incorporated**

Agreement:
===== start of TP =====
6.11B.2 Mapping to resource elements
The same antenna port shall be used for all symbols of the MWUS within a subframe. The UE shall not assume that the MWUS is transmitted on the same antenna port as any of the downlink reference signals or synchronization signals. If only one CRS port is configured by the eNB, the UE may assume the transmission of all MWUS subframes is using the same antenna port; otherwise, the UE ~~can assume the transmission of MWUS in at least one subframe is using the same antenna port~~may assume the same antenna port is used for MWUS transmission in DL subframes w_0+2n and w_0+2n+1, where w_0 is the first DL subframe of the MWUS transmission as specified in [4], and n=0,1,…. .
===== end of TP =====

R1-1809661 Draft LS on WUS transmission scheme Qualcomm

6.1.4.4 Maintenance for PUSCH sub-PRB allocation

R1-1808625 Remaining issue for Sub-PRB allocation ZTE
R1-1808987 Maintenance issues for PUSCH sub-PRB allocation for Rel-15 LTE-MTC Ericsson
R1-1809010 Maintenance for PUSCH subPRB allocation Qualcomm Incorporated
R1-1809104 Discussion on RV determination for sub-PRB allocation Sharp

R1-1809529 **Rel15 MTC Sub-PRB PUSCH Maintenance Summary** **Sierra Wireless**

Agreement:
Cyclic repetition is not supported for PUSCH sub-PRB transmissions in CE Mode B

Agreement:
For CE Mode A and B, RV cycling is supported for PUSCH sub-PRB repetitions.
- RV changes per repetition which occurs every (RU Size *number of RU) transmission subframes.
- For CE Mode A, the first RV is indicated in DCI and subsequent RVs continue following the RV order 0, 2, 3, 1;
- For CE Mode B, the first RV is always 0 and the RV order is always 0, 2, 3, 1.

The text proposals in Section 2.3, 2.4, 2.5, 2.6, 2.7, of R1-1809529 are endorsed.

The text proposal in Section 2.8 excluding the changes to Section 8.1.6 of TS36.213 are endorsed.

R1-1809627 **Rel15 Part II - MTC Sub-PRB PUSCH Maintenance Summary** **Sierra Wireless**
The text proposal in Section 2.1 of R1-1809627 is endorsed.

Agreement:
For Sub-PRB in CE Mode A, the UE considers the DCI valid even if the number of transmitted subframes is greater than 'pusch-maxNumRepetitionCEmodeA'.

6.1.4.5 Maintenance for Flexible PDSCH/PUSCH starting PRB

R1-1808127 Corrections on more flexible PDSCH/PUSCH resource allocation Huawei, HiSilicon
R1-1808988 Maintenance issues for Flexible PDSCH/PUSCH starting PRB for Rel-15 LTE-MTC Ericsson
R1-1809011 Maintenance for flexible starting PRB Qualcomm Incorporated

R1-1809526 **Summary of Flexible PDSCH/PUSCH starting PRB** **Samsung**

Agreement:
Update the size of RA field in TS 36.212 clause 5.3.3.1.10 to ceil{log2(6 NULRB)} for FDD

Agreement:

If frequency hopping is enabled for PDSCH, the PDSCH shall be transmitted in subframe i within the $N_{\text{abs}}^{\text{PDSCH}}$ consecutive downlink subframes using the PRB resources of the narrowband $\boldsymbol{n_{NB}^{(i)}}$ with same RIV as that of narrowband $\boldsymbol{n_{NB}^{(i_0)}}$.

Agreement:

If frequency hopping is enabled for PUSCH, and the UE is not configured with ce-PUSCH-FlexibleStartPRB-AllocConfig, PUSCH is transmitted in subframe i within the $N_{\text{abs}}^{\text{PUSCH}}$ consecutive uplink subframes using the PRB resources of the narrowband $n_{NB}^{(i)}$ with same RIV as that of narrowband $n_{NB}^{(i_0)}$.

Agreement:

- For PDSCH CEModeA: Propose to reduce the allocated length to satisfy the condition that L_{CRBs} shall not exceed $(\bar{N}_{RB}^{DL} - n_{NB,0} - RB_{start})$.
- For PUSCH CEModeA: L_{CRBs} shall not exceed $(N_{RB}^{UL} - RB_{START})$.
- For PUSCH CEModeB: Limit the starting/end RB for '110' and '111' within system bandwidth.

R1-1809628 **Summary of Flexible PDSCH/PUSCH starting PRB** **Samsung**

Agreement:

L=2,3,4,5,6 are supported for flexible PUSCH starting PRB in TDD.

Agreement:

Update the size of RA field in TS 36.212 clause 5.3.3.1.10 to $\lceil \log_2(5 \times N_{RB}^{UL}) \rceil$ for TDD.

Agreement:

- For PDSCH CEModeA: if a RIV entry is to align the starting RB to the RBG boundaries, a set of two PRGs starts from the corresponding RBstart; if a RIV entry is to align the ending RB to the RBG boundaries, a set of two PRG ends at the corresponding RBstart+LCRBs-1.
- For PDSCH CEModeB: the narrowband is shifted to align with the RBG boundaries. The set of two PRGs are aligned with the shifted narrowband.

The text proposals in Section 5 of R1-1809628 are endorsed.

6.1.4.6 Other

R1-1808123 Discussion on flexible DL starting PRB allocation in CEMode A Huawei, HiSilicon
R1-1808124 Discussion on the flexible starting PRB for PUSCH resource allocation in FDD Huawei, HiSilicon
R1-1808561 Discussion on the flexible starting PRB for PUSCH resource allocation in TDD Huawei, HiSilicon

6.1.5 Maintenance of Release 15 Further enhancements of NB-IoT

NB_IOTenh2-Core; WID in RP-172063.

Friday

R1-1809668 **Chairman's notes of AI 6.1.5 Maintenance of Release 15 Further enhancements of NB-IoT** **Ad-hoc chair (Ericsson)**

Decision: The document is endorsed, content is incorporated below.

R1-1809678 **[DRAFT] LS on additional RRC parameters for Rel-15 NB-IoT** **Huawei**

Decision: The draft LS is endorsed and final LS is approved in R1-1809679.

R1-1809948 **LS response on NPBCH-based RRM measurement for FeNB-IoT UE** **RAN4, Qualcomm**

R1-1809685 **Introduction of NPBCH based measurements** **Qualcomm Incorporated**

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The text proposal in R1-1809685 is endorsed.

R1-1809686 [DRAFT] LS on NPBCH-based measurements Qualcomm Incorporated
Decision: The draft LS is endorsed and final LS is approved in R1-1809689.

R1-1809126 Clarification on the cyclic repetition L of Early Data Transmission NTT DOCOMO, INC.

6.1.5.1 Maintenance for Latency and power consumption reduction

R1-1809502 Correction to NRS subframes and additional SIB1-NB-to-subframe mapping LG Electronics
Revision of R1-1808458
R1-1809603 **Correction to NRS subframes and additional SIB1-NB-to-subframe mapping** **LG Electronics**
The text proposals in R1-1809603 are endorsed.

6.1.5.1.1 Power consumption reduction for paging and connected-mode DRX

R1-1808128 **Corrections on NWUS Huawei, HiSilicon, Ericsson, Qualcomm, LG, Samsung, ZTE**
R1-1808989 Maintenance issues for Wake-up signal for Rel-15 NB-IoT Ericsson
R1-1809012 Maintenance for wake-up signal Qualcomm Incorporated

R1-1809566 **Feature lead summary on NB-IoT Rel-15 NWUS maintenance** **Huawei, HiSilicon**

Agreement:
The text proposals in R1-1808128 are agreed.

R1-1809662 **Updated feature lead summary on NB-IoT Rel-15 NWUS maintenance** **Huawei, HiSilicon**

The following text proposal is endorsed:
---------- Beginning of TP ----------
10.2.6B.2 Mapping to resource elements
The same antenna port shall be used for all symbols of the NWUS within a subframe. The UE shall not assume that the NWUS is transmitted on the same antenna port as any of the downlink reference signals or synchronization signals. If only one NRS port is configured by the eNB, the UE may assume the transmission of all NWUS subframes is using the same antenna port; otherwise, the UE ~~can assume the transmission of NWUS in at least one subframe is using the same antenna port.~~ may assume the same antenna port is used for NWUS transmission in DL subframes $w0+2n$ and $w0+2n+1$, where $w0$ is the first DL subframe of the NWUS transmission as specified in [4], and $n=0,1,\ldots$.
---------- End of TP ----------

6.1.5.1.2 Data transmission during the random access procedure

R1-1808129 Corrections on EDT for NB-IoT Huawei, HiSilicon

R1-1809567 **Feature lead summary of EDT during RACH in feNB-IoT** **Huawei, HiSilicon**

The text proposal in Section 3.1 of R1-1809567 is endorsed with modifications to change “were selected” to “would have been selected” and “would end” to “would have ended”.

The text proposal in Section 3.2 of R1-1809567 is agreed excluding the insertion of “16.3.3 and”.

R1-1809684 **Updated feature lead summary of EDT during RACH in feNB-IoT** **Huawei, HiSilicon**
The text proposals in Sections 3.5.1 and 3.5.2 of R1-1809684 are endorsed.

R1-1809663 Clarification of TBS for retransmission of EDT Msg3 Sharp

6.1.5.1.3 Physical layer scheduling request

R1-1808130 **Corrections on physical layer SR** **Huawei, HiSilicon**
R1-1808626 Remaining issues for scheduling request ZTE

R1-1809568 **Feature lead summary of physical layer SR in feNB-IoT Huawei, HiSilicon**

The text proposal in Section 2.2, 2.3 of R1-1809568 is endorsed.

Conclusion:
For an NB-IOT UE, in case an NPDCCH candidate partially or fully overlaps with an uplink SR transmission, the prioritization between the two is up to UE implementation.

Agreement:
The following text proposal is endorsed.
---------- Start of Text Proposal ----------
---------- Unchanged parts omitted ----------
16.5.3 UE procedure for transmitting SR
If the UE is configured with higher layer parameter *sr-without-HARQ-ACK-Config*, the UE is configured with Narrowband Random access channel parameters (NPRACH configuration) for SR transmission by higher layers.
The UE shall, if requested by higher layers for transmitting SR, start transmission of a narrowband random access preamble on the configured NB-IoT carrier at the next available NPRACH resource, unless the transmission would overlap with any subframe(s) of NPDSCH reception. The narrowband preamble is transmitted on the allocated subcarrier and a number of NPRACH repetitions for the associated NPRACH repetition level as indicated by higher layers. The narrowband preamble is transmitted with transmission power P_{NPRACH}, as determined in subclause 16.3.2, commencing on the indicated NPRACH resource.
---------- Unchanged parts omitted ----------
---------- End of Text Proposal ----------

6.1.5.1.4 Semi-persistent scheduling

R1-1808131 Corrections on SPS Huawei, HiSilicon
R1-1808627 Maintenance for semi-persistence scheduling ZTE

R1-1809569 **Feature lead summary of SPS in NB-IoT Huawei, HiSilicon**

Agreement:
For collisions between UL SPS transmission for BSR and NPDSCH, BSR is not transmitted, and remains pending. Adopt the TP below.
----------**Start of Text Proposal**----------
16.5.1 UE procedure for transmitting format 1 narrowband physical uplink shared channel
< Unchanged parts are omitted >

Table 16.5.1-1A: k_0 for DCI format N0 for TDD.

I_{Delay}	k_0
0	0
1	8
2	16
3	32

If a NPUSCH transmission without a corresponding NPDCCH collides partially or fully with a NPDSCH transmission, the NPUSCH transmission is dropped.
< Unchanged parts are omitted >
---------- **End of Text Proposal** ----------

Conclusion:
For an NB-IOT UE, in case an NPDCCH candidate partially or fully overlaps with an UL SPS transmission, the prioritization between the two is up to UE implementation.

Conclusion:
The time between SPS NPUSCHs is always equal to *semiPersistSchedIntervalUL* i.e. not related to the scheduling delay.

6.1.5.2 Maintenance for NPRACH range enhancements

R1-1808132 Corrections on NPRACH range enhancements Huawei, HiSilicon
R1-1808459 Discussion on NPRACH preamble formats for NPDCCH order LG Electronics
R1-1809013 Maintance for NPRACH range enhancements Qualcomm Incorporated

R1-1809563 Summary of Rel15 Maintenance for NPRACH range enhancements Ericsson
The text proposals in Sections 2.1, 2.2, 2.4 of R1-1809563 are agreed.

Agreement:
The following text proposal is endorsed.
===== start TP =====
16.1.2 Timing synchronization
Upon reception of a timing advance command, the UE shall adjust uplink transmission timing for NPUSCH based on the received timing advance command.
The timing advance command indicates the change of the uplink timing relative to the current uplink timing as multiples of 16 T_s . The start timing of the random access preamble is specified in [3].
In case of random access response, an 11-bit timing advance command [8], T_A, indicates N_{TA} values by index values of T_A = 0, 1, 2, ..., ~~1282~~1536, where an amount of the time alignment is given by $N_{TA} = T_A \times 16$. N_{TA} is defined in [3].
===== end of TP =====

6.1.5.3 Maintenance for TDD

6.1.5.3.1 Downlink aspects

R1-1808133 Corrections on DL aspects for TDD Huawei, HiSilicon
R1-1808460 Correction on RE mapping rule in a DwPTS LG Electronics
R1-1808628 Remaining issue for TDD DL aspects ZTE
R1-1809014 Maintenance for DL aspects of TDD Qualcomm Incorporated
R1-1809230 Maintenance issues for TDD DL aspects for Rel-15 NB-IoT Ericsson

R1-1809613 Feature lead summary of DL aspects for TDD NB-IoT ZTE
R1-1809631 Feature lead summary of DL aspects for TDD NB-IoT ZTE
The text proposals in Section 1.1, 2.2, of R1-1809631 are endorsed.

Agreement:
Clarify that the starting OFDM symbol in the special subframe for NPDCCH/NPDSCH with repetition shall be same as that of the normal DL subframe

Agreement:
NPDSCH/NPDCCH with repetitions is rate matched in a special subframe around REs that are used for NRS in a downlink subframe but not carrying NRS in a special subframe when $\boldsymbol{l} = \boldsymbol{N}^{\mathrm{DL}}_{\mathrm{symb}} - \mathbf{2}, \boldsymbol{N}^{\mathrm{DL}}_{\mathrm{symb}} - \mathbf{1}$.

Agreement:
For NPDCCH with repetitions, NPDCCH is punctured by NRS REs in a special subframe when $\boldsymbol{l} = \boldsymbol{N}^{\mathrm{DL}}_{\mathrm{symb}} - \mathbf{5}, \boldsymbol{N}^{\mathrm{DL}}_{\mathrm{symb}} - \mathbf{4}$.
Also specify that rate matching is done according to the available REs within DwPTS for NPDCCH without repetition

Agreement:
Add the operation of insertion of <NIL> elements for NPDCCH with repetitions in the spec for TDD.

R1-1809675 Feature lead summary of DL aspects for TDD NB-IoT ZTE

R1-1809690 Text proposal for DL aspects for TDD NB-IoT Huawei, HiSilicon, ZTE
The text proposals in R1-1809690 are endorsed.

6.1.5.3.2 Uplink aspects

R1-1808134	Corrections on UL aspects for TDD	Huawei, HiSilicon
R1-1808461	Clarification on valid UL subframe caused by symbol groups dropping	LG Electronics
R1-1808629	Maintenance for TDD UL aspects	ZTE
R1-1808990	Maintenance issues for TDD UL aspects for Rel-15 NB-IoT	Ericsson
R1-1809015	Maintenance for UL aspects of TDD	Qualcomm Incorporated

R1-1809632 Feature lead summary of maintenance of UL aspects for TDD NB-IoT ZTE

The text proposal in Section 1 of R1-1809632 is endorsed.

R1-1809655 DRAFT LS on UL PRB to DL PRB center offset for TDD NB-IoT Ericsson
R1-1809680 DRAFT LS on UL PRB to DL PRB center offset for TDD NB-IoT Ericsson

Decision: Final LS is approved in R1-1809681 with a modification to change "Study Item: NB_IOTenh2" to "Work Item: NB_IOTenh2-Core"

The text proposal in Section 3.1 of R1-1809632 is endorsed with "… by the higher layer parameter" changed to "… by higher layers".

Conclusion:
It is common understanding in RAN1 that NPUSCH is only transmitted in NB-IoT uplink subframe for TDD.

The text proposals in Sections 4.1, 4.2, 4.3, 5 of R1-1809632 is endorsed.

Agreement:
Text capturing the following should be added in TS36.211 (it is up to the editor how to include the text in the specifications):
The valid uplink subframes which are not used for NPRACH transmission due to insufficient number of consecutive valid uplink subframes to transmit G symbol groups back-to-back are not part of the NPRACH resource.

6.1.5.3.3 Common aspects

R1-1808135	Corrections on common aspects for TDD	Huawei, HiSilicon
R1-1808991	Maintenance issues for TDD DL/UL common aspects for Rel-15 NB-IoT	Ericsson
R1-1809016	Maintenance for Common aspects of TDD	Qualcomm Incorporated

R1-1809629 Summary of TDD Common aspects LG Electronics

Agreement:
Update the section of 10.0.1.2 in TS36.211 to capture the agreement that DwPTS in special subframe configuration 0 and 5 for normal cyclic prefix is not used for NPDCCH and NPDSCH transmission for inband operation mode.

The text proposal in Annex A-2 is endorsed. Spec editor to check on alignment of parameter names with other specifications.

Conclusion:
It is common understanding that the special subframe configuration 0 and 5 are not indicated as NB-IoT DL subframe for inband NB-IoT carrier.

Agreement:
Update the section of 16.6 in TS36.213 to capture the agreement that UL/DL interlaced transmission and reception for single-HARQ capable UE is not supported.

The text proposal in Annex B-2 is endorsed.

Agreement:
Update the sections of 10.2.3.4 and 10.2.5.5 in TS36.211 in order to implement interference randomization for NPDSCH and NPDCCH, respectively, in TDD without capabilities.

- For NPDSCH, the relevant TP can be found in Section 2 of R1-1809016 and also in Annex C-2
- For NPDCCH, the relevant TP can be found in Section 2 of R1-1809016 and also in Annex D-2

Note: Editor to update these sections on interference randomization to be consistent with the FDD case

Agreement:
Update the section of 16.2.1.1.1 in TS36.213 in order to define an enhanced random access power control mechanism in TDD to be the same as FDD.

The text proposal in Annex E of R1-1809629 is endorsed.

Agreement:
Add section 10.2.2.4 in TS36.211 for description of guard period for TDD which UE needs to switch the direction of transceiver from uplink to downlink.

The text proposal for Section 10.2.2.4 in TS36.211 in R1-1809629 is endorsed. The relevant TP can be found in Annex G-3

6.1.5.4 Other

R1-1808562 **Corrections on additional SIB1-NB transmission** **Huawei, HiSilicon**
The text proposal in Annex A of R1-1808562 is endorsed.

R1-1808630 **Clarification of valid subframe issue for additional SIB-NB transmission** **ZTE**

6.1.6 Maintenance of Release 15 Ultra Reliable Low Latency Communication for LTE

LTE_HRLLC-Core; WID in RP-181259.

Friday
R1-1809669 **Chairman's notes of AI 6.1.6 Maintenance of Release 15 Ultra Reliable Low Latency Communication for LTE** **Ad-hoc chair (Ericsson)**
Decision: The document is endorsed, content is incorporated below.

R1-1809598 **Outcome of HRLLC Offline** **Ericsson**

R1-1809682 **DRAFT LS on additional UE capabilities for HRLLC** **Ericsson**
R1-1809688 **DRAFT LS on HRLLC** **Ericsson**
Decision: The draft LS is endorsed and final LS is approved in R1-1809691.

6.1.6.1 Maintenance for Blind/HARQ-less Repetition for Scheduled DL-SCH Operation

R1-1808462 **Corrections on blind/HARQ-less PDSCH repetition** **LG Electronics**
The text proposals in Sections 2.2, 3.2 and 5.2 of R1-1808462 are endorsed.

R1-1809649 (Revision of 1809630) **Corrections on PDSCH repetition for TDD** **LG Electronics**
The text proposal in R1-1809649 is endorsed.

R1-1809355 **Text proposal to section 7.1 of TS 36.213 on the configurable HARQ process numbers** **Huawei, HiSilicon**

6.1.6.2 Maintenance for Repetition Enhancements for UL SPS Operation

R1-1808463 **Corrections on power control for UL SPS operation** **LG Electronics**
The text proposal in R1-1808463 is endorsed.

Agreement:
- An RRC parameter for TPC index is to be introduced for subframe UL SPS configurations

- If a UE is configured with multiple UL SPS configurations in a serving cell, the same TPC index for DCI format 3/3A applies to all the UL SPS configurations in the serving cell

R1-1809242 **On multiple UL SPS configuration handling for URLLC** **Ericsson**
Conclusion:
In the event of a resource conflict in the same serving cell between the initial transmisions within a configured grant bundle from multiple different UL SPS configurations configured with Uplink Semi-Persistent Scheduling C-RNTI, the UE behaviour is undefined

R1-1809357 **Clarification on validation of UL SPS with repetition for one UL SPS configuration** **Huawei, HiSilicon, LG Electronics, Nokia, Nokia Shanghai Bell**

6.1.6.3 Other

R1-1808912 **Further discussion on CFI configuration for LTE HRLLC** **Guangdong OPPO Mobile Telecom**

Agreement:
For TDD, semi-static CFI pattern per subframe in the radioframe is adopted in addition to existing signalling of CFI per MBSFN and non-MBSFN subframes. Only one CFI signaling shall be configured (either per MBSF/non-MBSFN subframe, or, per subframe in the radio frame). The corresponding RRC parameter names are *cfi-Radioframe-patternSubframe* and *cfi-Radioframe-patternSlot.*

Agreement:
When the UE is configured with RRC parameters and CFI pattern in the radio frame for subframe PDSCH and CFI pattern in the radio frame for slot PDSCH, the two configured values shall be the same.

R1-1809583 **TP to 36.211 and 36.213 on handling of CFI pattern** **Oppo**
The text proposals in R1-1809583 are endorsed.

R1-1808913 Ls on RRC parameter list for HRLLC Guangdong OPPO Mobile Telecom
R1-1808914 List of physical layer related RRC parameters for LTE HRLLC Guangdong OPPO Mobile Telecom
R1-1809356 Clarification on subframe-PDSCH repetition on MBSFN or non-MBSFN subframes Huawei, HiSilicon, LG Electronics

Agreement:
MBSFN subframes are treated similarly as UL subframes for TDD i.e. the subframe based. PDSCH repetition resumes after MBSFN subframe(s)

R1-1809582 **Clarification on subframe-PDSCH repetition on MBSFN or non-MBSFN subframes** **Huawei, HiSilicon**
The text proposals in R1-1809582 are endorsed.

R1-1809358 **Clarification on UE procedure for receiving PDSCH when configured with repetition** **Huawei, HiSilicon**
R1-1809359 **Clarification on specification impact of no more than one DCI validation for UL SPS** **Huawei, HiSilicon**
R1-1809360 **Clarification on redundancy version determination for UL SPS with repetition** **Huawei, HiSilicon, LG Electronics**
The text proposal in R1-1809360 is endorsed.

R1-1809361 **Clarification on resource mapping for HARQ-less PDSCH repetition** **Huawei, HiSilicon**
R1-1809362 Clarification on resource mapping for UL SPS with repetition Huawei, HiSilicon

6.1.7 LTE Release 15 UE features

Friday
R1-1809670 **Chairman's notes of AI 6.1.7 LTE Release 15 UE feature** **Ad-hoc chair (NTT DOCOMO)**

Decision: The document is endorsed, content is incorporated below.

R1-1809017 Views on Rel-15 UE features Qualcomm Incorporated
R1-1809127 LTE UE features NTT DOCOMO, INC.
Late submission
R1-1809243 UE feature list for LTE release 15 Ericsson
Late submission
R1-1809368 Views on LTE Rel-15 UE features Huawei, HiSilicon

R1-1809619 Rel-15 LTE UE feature list NTT DOCOMO, INC.

R1-1809616 Draft LS on Rel-15 LTE UE feature list NTTDOCOMO, INC
Final LS is agreed in R1-1809617.

6.1.8 Other

Including any potential CRs for Rel-15 Enhancements to LTE operation in unlicensed spectrum, Enhancements for high capacity stationary wireless link and introduction of 1024 QAM for LTE, Further enhancements to Coordinated Multi-Point (CoMP) Operation for LTE, Enhanced LTE Support for Aerial Vehicles, Enhancing CA Utilization, modulation enhancements, 2Tx/4Tx SRS switching, CP latency reduction, etc

Friday
R1-1809671 Chairman's notes of AI 6.1.8 Others Ad-hoc chair (Ericsson)
Decision: The document is endorsed, content is incorporated below.

FeLAA
R1-1808587 Discussion on the partial PUSCH mode field for FeLAA in 36.212 Huawei, HiSilicon
R1-1808139 Correction on the partial PUSCH mode field for FeLAA in 36.212 Huawei, HiSilicon
Final CR agreed in R1-1809576 (Rel-15, CR0300, TS 36.212)

R1-1808140 Correction on starting position of Partial PUSCH Mode 1 for FeLAA in 37.213 Huawei, HiSilicon
R1-1809623 Correction on starting position of Partial PUSCH Mode 1 for FeLAA in 37.213 Huawei, HiSilicon, Ericsson
Final CR agreed in R1-1809647 (TS37.213, Rel-15, CR0002)

R1-1808464 Discussion on AUL-initiated COT sharing for LAA LG Electronics
R1-1809626 Correction on COT length for AUL transmission LG Electronics
Final CR agreed in R1-1809648 (TS37.213, Rel-15, CR0003)

R1-1808585 Discussion on the AUL-UCI payload for FeLAA in 36.212 Huawei, HiSilicon
R1-1808595 Correction on the AUL-UCI payload for FeLAA in 36.212 Huawei, HiSilicon

R1-1808589 Correction on the interpretation of HARQ-ACK bitmap for FeLAA in 36.212 Huawei, HiSilicon
R1-1809577 Correction on the interpretation of HARQ-ACK bitmap for FeLAA in 36.212 Huawei, HiSilicon

R1-1808590 Correction on DL CP extention for FeLAA in 36.211 Huawei, HiSilicon
R1-1809602 Correction on DL CP extension for FeLAA in 36.211 Huawei, HiSilicon
Final CR agreed in R1-1809650 (TS36.211, Rel-15, CR0456)

R1-1808591 Correction on RRC parameters for FeLAA in 37.213 Huawei, HiSilicon
R1-1809281 Correction to indication of UE-to-eNodeB COT sharing Nokia, Nokia Shanghai Bell, Ericsson
R1-1809622 Correction on RRC parameters for FeLAA in 37.213 Huawei, HiSilicon, Nokia, Nokia Shanghai Bell, Ericsson

R1-1809280 Correction to determination of ending symbol for AUL transmissions Nokia, Nokia Shanghai Bell, Ericsson
R1-1809620 Correction to determination of ending symbol for AUL transmissions Nokia, Nokia Shanghai Bell, Ericsson, Huawei, HiSilicon
Final CR agreed in R1-1809651 (TS36.211, Rel-15, CR0457)

R1-1809369 Correction to AUL-UCI resource allocation in 36.213 Nokia, Nokia Shanghai Bell
R1-1809621 Correction to AUL-UCI resource allocation in 36.213 Nokia, Nokia Shanghai Bell
Final CR agreed in R1-1809652 (TS36.213, Rel-15, CR1155)

FeCoMP
R1-1808141 Correction on CRI definition in 36.213 Huawei, HiSilicon

R1-1808586 Discussion on aperiodic CSI triggering for feCoMP Huawei, HiSilicon
R1-1808592 Correction on aperiodic CSI triggering for feCoMP in 36.213 Huawei, HiSilicon
Final CR agreed in R1-1809586 (Rel-15, TS36.213, CR1144)

Modulation enhancements
R1-1808654 Correction to alternative 6-bit MCS Intel Corporation
R1-1809021 Remaining details for modulation enhancements Qualcomm Incorporated

Agreement:
UE is not expected to be scheduled with a modulation order higher than the configured CQI table
The text proposal in Section 2 of R1-1809021 is endorsed.
Final CR capturing the agreement and the TP to be submitted R1-1809587 (TS36.213, Rel-15, CR1145)
Final CR agreed in R1-1809608 (revision of R1-1809587 to capture 1024 QAM table) (TS36.213, Rel-15, CR1145rev1)

1024 QAM
R1-1809018 Correction of RRC parameter name for 1024QAM rate matching Qualcomm Incorporated
Final CR agreed in R1-1809588 (TS36.212, Rel-15, CR0301)

R1-1809019 Applicability of 1024QAM to SPS C-RNTI Qualcomm Incorporated
Final CR agreed in R1-1809589 (TS36.213, Rel-15, CR1146)

R1-1809020 Removal of R_CSI form 1024QAM CSI table Qualcomm Incorporated
Final CR agreed in R1-1809590 (TS36.213, Rel-15, CR1147)

R1-1809298 Motivation for Correction to CSI reporting for 1024QAM (36.213) Nokia, Nokia Shanghai Bell
R1-1809299 Correction to CSI reporting for 1024QAM Nokia, Nokia Shanghai Bell

R1-1809604 [Draft] LS on Restriction of 1024QAM CSI reporting Nokia
Decision: The draft LS is endorsed and final LS is approved in R1-1809609

Others
R1-1808584 Discussion on PRG size for TM9 and TM10 Huawei, HiSilicon
R1-1809472 On configurable wideband PRG size for TM9 and TM10 Ericsson
R1-1808588 Introduction of configured PRG size for TM9 and TM10 in 36.213 Huawei, HiSilicon

R1-1809249 Introduction of NR-SS-SINR Ericsson

6.2 LTE Release 16

6.2.1 Additional MTC Enhancements

LTE_eMTC5-Core; WID in RP-181450. Please refer to the WID for detailed scoping

Friday

R1-1809672 **Chairman's notes of AI 6.2.1 Additional MTC Enhancements** **Ad-hoc chair (Samsung)**

Decision: The document is endorsed, content is incorporated below.

R1-1808033 **WI work plan for Rel-16 LTE-MTC** **Ericsson**

6.2.1.1 UE-group wake-up signal

R1-1809521 **Summary of 6.2.1.1 UE group MWUS** **Qualcomm**

Agreement

UE-group WUSs are only multiplexed in the same NB as associated PO

- FFS TDM/FDM/CDM for UE-group MWUS multiplexing

Agreement

- UE-group MWUS is supported based on eNB's and UE's capability.
- Whether the network supports UE-group MWUS is done by higher layer signalling.
- FFS: The number of UE groups is configured by SIB.
- Note that the UE-group MWUS is UE optional

Agreement

Rel-16 UE-group MWUS sequence should consider at least

- Fallback to legacy UE behavior
- Inter-cell interference randomization
- UE group ID for different UE-group MWUS
- Reuse of Rel-15 sequences is not precluded
- Effect of sequence detection on UE complexity

Agreement

Study the RAN1 consequence of UE-grouping on the following basis:

- UE ID
- Coverage
- DRX/eDRX
- Gap configuration
- Services

R1-1808034	UE-group wake-up signal in LTE-MTC	Ericsson
R1-1808121	Support of sub-groups for MWUS	Huawei, HiSilicon
R1-1808215	On UE-group wake-up signal for eMTC	vivo
R1-1808347	UE-group wake-up signal for MTC	Sony
R1-1808430	UE-group wake-up signal for MTC	Nokia, Nokia Shanghai Bell
R1-1808465	Discussion on UE-grouping wake up signal in MTC	LG Electronics
R1-1808631	Discussion on Wake-up signal for MTC	ZTE
R1-1808655	UE-group wake-up signal for eMTC	Intel Corporation
R1-1808730	UE-group wake-up signal for eMTC	Samsung
R1-1809022	UE-group wake-up signal	Qualcomm Incorporated
R1-1809128	UE-group wake-up signal for Rel.16 IoT	NTT DOCOMO, INC.

6.2.1.2 Support for transmission in preconfigured UL resources

R1-1809528 LTE-M Preconfigured UL Resources Summary Sierra Wireless

Agreement
Idle mode based pre-configured UL resources is supported for UEs in possession of a valid TA
- FFS: Validation mechanism for TA
- FFS: How the pre-configured UL resources is acquired

Agreement
For transmission in preconfigured UL resources, the UE may use the latest TA of which its validity can be confirmed

Agreement
Study both shared and dedicated resource for preconfigured UL resources. If both shared and dedicated resources are supported, strive for commonality in design of both resource types.

Agreement
HARQ procedures for transmission in preconfigured UL resources should be studied and the following aspects should be considered:
- Whether to support HARQ;
  - If supported, details of HARQ design including the number of HARQ processes;
- Whether ACK/NACK is necessary

Fallback mechanisms should be considered, e.g. fallback to legacy RACH/EDT procedures.

R1-1808035 Support for transmission in preconfigured UL resources in LTE-MTC Ericsson
R1-1808118 UL transmission in preconfigured resource Huawei, HiSilicon
R1-1808348 Transmission in preconfigured UL resources Sony
R1-1808357 Pre-configured UL Resources Design Considerations Sierra Wireless, S.A.
R1-1808431 Transmission in preconfigured UL resources Nokia, Nokia Shanghai Bell
R1-1808466 Discussion on preconfigured UL resources in MTC LG Electronics
R1-1808632 Support for transmission in preconfigured UL resources for MTC ZTE
R1-1808656 UL transmission in preconfigured resources for eMTC Intel Corporation
R1-1808731 Discussion on transmission in preconfigured UL reosurces for MTC Samsung
R1-1809023 Support for transmission in preconfigured UL resources Qualcomm Incorporated
R1-1809129 UL transmission scheme in preconfigured resources NTT DOCOMO, INC.

6.2.1.3 Scheduling of multiple DL/UL transport blocks

R1-1809562 Feature lead summary Scheduling of multiple DL UL transport blocks Ericsson

Agreement
Specify scheduling of multiple transport blocks for both CE Mode A and B

Agreement
The possibility of scheduling multiple DL/UL transport blocks is configured via RRC. Details TBD

Agreement
When scheduling of multiple TBs is enabled, the number of scheduled transport blocks (>= 1) should be dynamically selected via DCI. The maximum number of scheduled transport blocks with one single DCI is [TBD].
- The number of blind decodes for MPDCCH is not increased as a result of scheduling multiple TBs

Conclusion
When multiple TBs are scheduled by one DCI, study interleaving amongst TBs from different HARQ process in cases of repetitions

- Companies are encouraged to submit evaluation results in the next RAN1 meeting

Agreement
One DCI to schedule multiple TBs for SC-MCCH is not supported

R1-1809615 **Updated Feature lead summary Scheduling of multiple DL UL transport blocks** (Revision of R1-1809562) **Ericsson**

Working assumption
For unicast, when multiple DL/UL transport blocks are assigned by a single DCI, each transport block corresponds to a unique HARQ process.

R1-1808036 Scheduling of multiple DL/UL transport blocks in LTE-MTC Ericsson
R1-1808117 Scheduling of multiple transport blocks Huawei, HiSilicon
R1-1808349 Support of scheduling of multiple DL / UL transport blocks for MTC Sony
R1-1808355 Multiple TB Grant Design for Unicast Sierra Wireless, S.A.
R1-1808432 Scheduling of multiple DL/UL transport blocks Nokia, Nokia Shanghai Bell
R1-1808467 Discussion on multiple transmission blocks scheduling in MTC LG Electronics
R1-1808557 Design of scheduling of multiple DL/UL transport blocks for Rel.16 MTC Lenovo, Motorola Mobility
R1-1808633 Consideration on scheduling enhancement for MTC ZTE
R1-1808732 Discussion on scheduling of multiple TBs for MTC Samsung
R1-1809024 Scheduling of multiple DL/UL transport blocks Qualcomm Incorporated

6.2.1.4 Coexistence of LTE-MTC with NR

R1-1809564 Feature lead summary for Coexistence of LTE-MTC with NR Ericsson

Observation: From RAN1 perspective, no issues were identified that would prevent the coexistence of NR and eMTC

Agreement
- RAN1 studies additional specification enhancement for improving the performance of coexistence of eMTC with NR.

R1-1808037 Coexistence of LTE-MTC with NR Ericsson
R1-1808122 On eMTC co-existence with NR Huawei, HiSilicon
R1-1808350 Coexistence of eMTC with NR Sony
R1-1808433 Coexistence of eMTC with NR Nokia, Nokia Shanghai Bell
R1-1808468 Discussion on coexistence of LTE-MTC with NR LG Electronics
R1-1808634 Coexistence of LTE-MTC with NR ZTE
R1-1809025 Coexistence of LTE-MTC with NR Qualcomm Incorporated

6.2.1.5 Support of Quality report in Msg3

R1-1809527 Feature summary of 6.2.1.5 Support of quality report in Msg3 Samsung

Agreement
Prioritize the following alternatives for DL quality report in Msg3 in MTC, for CE Mode A and CE Mode B separately:
- CQI (for CE Mode A)
- Repetition number related to UE decoding of actual or hypothetical MPDCCH/PDSCH
  - FFS if aggregation level needs to be reported when repetition number equal to 1
- RSRP/RSRQ

Companies are encouraged to provide details and/or performance evaluation results

Agreement
Whether the DL quality report is included in Msg3 is indicated in SIB and/or RAR.
Above applies in case the UE supports DL quality report in Msg3.

R1-1808038 Support of quality report in Msg3 in LTE-MTC Ericsson
R1-1808119 Channel quality reporting in Msg3 Huawei, HiSilicon
R1-1808351 On providing quality report in Message 3 Sony
R1-1808434 Support of Quality report in Msg3 Nokia, Nokia Shanghai Bell
R1-1808469 Downlink channel quality report during random access procedure LG Electronics
R1-1808635 Specify Msg3 quality reporting at least for EDT ZTE
R1-1808733 Discussion on quality report in Msg3 for MTC Samsung
R1-1809026 Support of Quality report in msg3 Qualcomm Incorporated
R1-1809469 DL quality reporting in Msg3 for eMTC Intel Corporation

6.2.1.6 MPDCCH performance improvement

R1-1809570 Draft summary of MPDCCH performance improvement Huawei, HiSi

Agreement
CRS for improving channel estimation on USS MPDCCH is supported

Agreement
The relation between the MPDCCH DMRS and CRS is defined for enabling improved channel estimation. FFS the details on specifying the relation (e.g., whether the 'definition' means predefined in specification or done by signalling, relation between the CRS ports and DMRS ports, power offset between DMRS-CRS).

Agreement
eNB enables/disables "CRS for improving channel estimation on MPDCCH" via dedicated or broadcasted RRC signaling. FFS the details on the signaling.

Agreement
CRS for improving channel estimation on Type0-MPDCCH CSS MPDCCH is supported.

R1-1808039 MPDCCH performance improvement in LTE-MTC Ericsson
R1-1808120 On MPDCCH performance improvement Huawei, HiSilicon
R1-1808352 On MPDCCH performance improvement Sony
R1-1808435 MPDCCH performance improvement Nokia, Nokia Shanghai Bell
R1-1808470 Discussion on MPDCCH performance improvement LG Electronics
R1-1808636 Consideration on MPDCCH improvement by using CRS ZTE
R1-1808657 MPDCCH performance improvement Intel Corporation
R1-1808734 Discussion on MPDCCH performance improvement using CRS for MTC Samsung
R1-1809027 Usage of CRS for MPDCCH Qualcomm Incorporated

6.2.1.7 CE mode A and B improvements for non-BL UEs

R1-1809534 Summary of CE mode A and B improvements for non-BL UEs LG Electronics

Agreement
Study on the performance benefit of dual layer DL reception when it is supported for non-BL UEs in CE mode A. Companies are encouraged to submit evaluation results.
- UE complexity should be also considered
- Prioritize SNR region relevant to CE mode A

Agreement
Study on the performance benefit of CSI-RS based CSI feedback when it is supported for non-BL UEs in CE mode A.
- UE complexity should be also considered
- Prioritize SNR region relevant to CE mode A

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R1-1808040 CE mode A and B improvements for LTE-MTC non-BL UEs Ericsson
R1-1808115 Coverage enhancement for Non-BL UE Huawei, HiSilicon
R1-1808436 CE mode A and B improvements for non-BL UEs Nokia, Nokia Shanghai Bell
R1-1808471 CE mode improvements for non-BL Ues LG Electronics
R1-1808637 Discussion on CE mode A and B improvements for non-BL UEs ZTE
R1-1808658 Improvement for non-BL UEs in CE mode Intel Corporation
R1-1808735 Discussion on CE Mode A and Mode B improvements for non-BL UEs Samsung
R1-1809028 CE Mode A and B improvements for non-BL Ues Qualcomm Incorporated

6.2.1.8 Use of LTE Control Channel Region for DL Transmission

R1-1809530 Use of LTE Control Channel Region for DL Transmission Summary Nokia, Nokia Shanghai Bell

Agreement
FFS whether and for what broadcast transmission (e.g. SIBs, paging, SC-PTM, Msg2, etc) use of LTE control channel region for MPDCCH and PDSCH are applied

Agreement
The following options can be considered for transmission of MPDCCH and PDSCH in LTE control channel region:
For MPDCCH
- Option 1: All or part of the MPDCCH are mapped into the DL control region.
- Option 2: MPDCCH are rate-matched to all OFDM symbols. FFS on RE mapping details.

For PDSCH
- Option A: All or part of the PDSCH are mapped into the DL control region.
- Option B: PDSCH are rate-matched to all OFDM symbols. FFS on RE mapping details.

R1-1808041 Use of LTE control channel region for DL transmission in LTE-MTC Ericsson
R1-1808116 DL transmission on LTE control channel region Huawei, HiSilicon
R1-1808353 DL transmission in the LTE control channel region Sony
R1-1808437 Consideration on the usage of LTE control channel region Nokia, Nokia Shanghai Bell
R1-1808472 On the use of LTE control channel region for LTE-MTC DL transmission LG Electronics
R1-1808558 Design of Use of LTE Control Channel Region for DL Transmission Lenovo, Motorola Mobility
R1-1808638 Discussion on use of LTE control channel region for DL transmission ZTE
R1-1808659 Standalone deployment for eMTC Intel Corporation
R1-1808736 Discussion on use of control channel region Samsung
R1-1809029 Use of control region for eMTC Ues Qualcomm Incorporated
R1-1809130 DL transmission in LTE control channel region NTT DOCOMO, INC.
R1-1809173 Initial views on the use of LTE control channel region for DL transmission Xiaomi Communications

6.2.1.9 Use of RSS for measurement improvements

R1-1809503 Summary on the use of RSS for measurement improvements Sony

Agreement
From RAN1 perspective, it is feasible to use RSS for measuring RSRP for cells at least for IDLE mode mobility
- RAN1 to identify the related parameters in the next RAN1 meeting

R1-1808042 Use of RSS for measurement improvements in LTE-MTC Ericsson
R1-1808354 On Measurement performance improvements for MTC Sony
R1-1808438 Use of RSS for measurement improvements Nokia, Nokia Shanghai Bell
R1-1808473 Discussion on the use of RSS for measurement improvement LG Electronics
R1-1808560 Considerations on improving DL measurement accuracy Huawei, HiSilicon
R1-1808639 Discussion on use of RSS for measurement improvement ZTE
R1-1809030 Use of RSS for RRM measurements Qualcomm Incorporated

6.2.2 Additional Enhancements for NB-IoT

NB_IOTenh3-Core; WID in RP-181451. Please refer to the WID for detailed scoping

Friday

R1-1809673 **Chairman's notes of AI 6.2.2 Additional Enhancements for NB-IoT** **Ad-hoc chair (Samsung)**

Decision: The document is endorsed, content is incorporated below.

R1-1808106 **Additional enhancements for NB-IoT workplan** **Huawei, HiSilicon**

6.2.2.1 UE-group wake-up signal

R1-1809532 **Feature summary of 6.2.2.1 UE-group wake-up signal** **Ericsson**

Agreement:
UE-group WUSs are only multiplexed in the same carrier as associated PO

- FFS TDM/CDM for UE-group NWUS multiplexing

Agreement
Rel-16 UE-group NWUS sequence should consider at least

- Fallback to legacy UE behavior
- Inter-cell interference randomization
- UE group ID for different UE-group NWUS
- Reuse of Rel-15 sequences is not precluded
- Effect of sequence detection on UE complexity

Agreement
Study the RAN1 consequence of UE-grouping on the following basis:

- UE ID
- Coverage
- DRX/eDRX
- Gap configuration
- Services

R1-1808043	UE-group wake-up signal in NB-IoT	Ericsson
R1-1808107	On support for UE-group wake-up signal	Huawei, HiSilicon
R1-1808216	On UE-group wake-up signal for NB-IoT	vivo
R1-1808439	UE group wake-up signal for NB-IoT	Nokia, Nokia Shanghai Bell
R1-1808474	Discussion on UE-grouping wake up signal in NB-IoT	LG Electronics
R1-1808640	Discussion on Wake-up signal for NB-IoT	ZTE
R1-1808660	UE-group wake-up signal for NB-IoT	Intel Corporation
R1-1808737	UE-group wake-up signal for eMTC	Samsung
R1-1808959	UE-Group WUS in NB-IoT	MediaTek Inc.
R1-1809031	UE-group wake-up signal	Qualcomm Incorporated
R1-1809131	UE-group wake-up signal for Rel.16 IoT	NTT DOCOMO, INC.
R1-1809483	UE-group wake-up signal for NB-IoT	Sony

6.2.2.2 Support for transmission in preconfigured UL resources

R1-1809571 **Feature lead summary of Support for transmission in preconfigured UL resources** **Huawei, HiSi**

Agreement
Idle mode based pre-configured UL resources is supported for UEs in possession of a valid TA

- FFS: Validation mechanism for TA
- FFS: How the pre-configured UL resources is acquired

Agreement
For transmission in preconfigured UL resources, the UE may use the latest TA of which its validity can be confirmed

Agreement
Study both shared and dedicated resource for preconfigured UL resources. If both shared and dedicated resources are supported, strive for commonality in design of both resource types.

Agreement
HARQ procedures for transmission in preconfigured UL resources should be studied and the following aspects should be considered:

- Whether to support HARQ;
  - If supported, details of HARQ design including the number of HARQ processes;
- Whether ACK/NACK is necessary

Fallback mechanisms should be considered, e.g. fallback to legacy RACH/EDT procedures.

R1-1808044 Support for transmission in preconfigured UL resources in NB-IoT Ericsson
R1-1808108 On support for transmission in preconfigured UL resources Huawei, HiSilicon
R1-1808358 Pre-configured UL Resources Design Considerations Sierra Wireless, S.A.
R1-1808440 Preconfigured Grant for Uplink transmission Nokia, Nokia Shanghai Bell
R1-1808475 Discussion on preconfigured UL resources in NB-IoT LG Electronics
R1-1808641 Support for transmission in preconfigured UL resources for NB-IoT ZTE
R1-1808661 UL transmission in preconfigured resources for NB-IoT Intel Corporation
R1-1808738 Discussion on transmission in preconfigured UL reosurces for NB-IOT Samsung
R1-1808960 Early Data Transmission on Preconfigured UL resources in NB-IoT MediaTek Inc.
R1-1809032 Support for transmission in preconfigured UL resources Qualcomm Incorporated
R1-1809132 UL transmission scheme in preconfigured resources NTT DOCOMO, INC.

6.2.2.3 Scheduling of multiple DL/UL transport blocks

R1-1809523 Feature lead summary of scheduling enhancement for NB-IoT ZTE

Agreement
For unicast, scheduling multiple DL/UL transport blocks with single DCI is supported.

Agreement

- One DCI to schedule multiple TBs for SC-MCCH is not supported

Agreement
For Unicast, the possibility of scheduling multiple DL/UL transport blocks is configured via RRC. Details TBD

Agreement
For unicast, the number of TBs scheduled should be dynamically indicated in the DCI, the maximum number of TBs is FFS

R1-1808045 Scheduling of multiple DL/UL transport blocks in NB-IoT Ericsson
R1-1808109 Discussion on scheduling multiple DL/UL transport blocks for SC-PTM and unicast Huawei, HiSilicon
R1-1808356 Multiple TB Grant Design for Unicast Sierra Wireless, S.A.
R1-1808441 Scheduling of multiple DL/UL transport blocks Nokia, Nokia Shanghai Bell
R1-1808476 Discussion on multiple transmission blocks scheduling in NB-IoT LG Electronics
R1-1808559 Design of scheduling of multiple DL/UL transport blocks for Rel.16 NBIoT Lenovo, Motorola Mobility
R1-1808642 Consideration on scheduling enhancement for NB-IoT ZTE
R1-1808739 Discission on scheduling of multiple TBs for NB-IoT Samsung
R1-1809033 Scheduling of multiple DL/UL transport blocks Qualcomm Incorporated

6.2.2.4 Coexistence of NB-IoT with NR

R1-1809572 Feature lead summary of Coexistence of NB-IoT with NR Huawei, HiSi

Observation
From RAN1 perspective, no issues were identified that would prevent the coexistence of NR and NB-IoT
Note that similar observation will be made for eMTC

Agreement
RAN1 studies additional specification enhancement for improving the performance of coexistence of NB-IoT with NR.
Note that similar agreement will be made for eMTC

R1-1808046	Coexistence of NB-IoT with NR	Ericsson
R1-1808112	Discussion on NB-IoT coexistence with NR	Huawei, HiSilicon
R1-1808442	Coexistence of NB-IoT with NR	Nokia, Nokia Shanghai Bell
R1-1808477	Discussion on coexistence of NB-IoT with NR	LG Electronics
R1-1808643	Discussion on coexistence of NB-IoT with NR	ZTE
R1-1808958	Coexistence of NB-IoT with NR	MediaTek Inc.
R1-1809034	Coexistence of NB-IoT with NR	Qualcomm Incorporated

6.2.2.5 *Support of Quality report in Msg3 for non-anchor access*

R1-1809600 Feature lead summary on support of quality report in Msg3 for non-anchor access Huawei, HiSi

Agreement
For channel quality report in Msg3 on non-anchor access, the channel quality definition is denoted by the number of repetitions that the UE needs to decode hypothetical NPDCCH with BLER of 1%

- FFS: Whether the details on the hypothetical NPDCCH are specified or not

Working Assumption
For channel quality report in Msg3 on non-anchor access, UE performs the channel quality measurement on the carrier it monitors to receive Msg2 (i.e. RAR)

- FFS: Whether the UE performs measurement on other carriers

Agreement
For non-anchor access, RAN1 further studies how UEs report the measured channel quality

R1-1808047	Support of quality report in Msg3 for non-anchor access in NB-IoT	Ericsson
R1-1808110	On support of Msg3 quality reporting for non-anchor access	Huawei, HiSilicon
R1-1808443	Support of Quality report in Msg3 for non-anchor access	Nokia, Nokia Shanghai Bell
R1-1808478	Downlink channel quality report during random access procedure on a non-anchor carrier	LG Electronics
R1-1808644	Support of Quality report in Msg3 for non-anchor access	ZTE
R1-1808740	Discussion on quality report in Msg3 for NB-IoT	Samsung
R1-1808961	Quality report in Msg3 on non-anchor carrier	MediaTek Inc.
R1-1808962	NRS support on non-anchor carrier	MediaTek Inc.
R1-1809035	Support of quality report in msg3 for non-anchor	Qualcomm Incorporated
R1-1809471	DL quality reporting in Msg3 for non-anchor access in NB-IoT	Intel Corporation

6.2.2.6 *Presence of NRS on a non-anchor carrier for paging*

R1-1809522 Feature lead summary of presence of NRS on a non-anchor carrier for paging Qualcomm

Agreement (confirmed by Friday)
The presence of NRS on subframes which will contain NRS even when no paging NPDCCH is transmitted is enabled by broadcast signalling.

- Above applies only for non-anchor carriers

Agreement (confirmed by Friday)
For the objective on presence of NRS on a non-anchor carrier for paging, consider the following use case:

- Early termination of NPDCCH / WUS

Above is not intended to restrict the study of other use cases in other WGs which may or may not have RAN1 specification impact

R1-1808048 Presence of NRS on a non-anchor carrier for paging in NB-IoT Ericsson
R1-1808111 NRS presence on non-anchor carriers for paging Huawei, HiSilicon
R1-1808444 Presence of NRS on a non-anchor carrier for paging Nokia, Nokia Shanghai Bell
R1-1808479 Discussion on NRS on an a non-anchor carrier LG Electronics
R1-1808645 NRS on non-anchor PRB ZTE
R1-1808741 Discussion on NRS presence on non-anchor carrier Samsung
R1-1809036 Presence of NRS on a non-anchor carrier for paging Qualcomm Incorporated

6.2.2.7 Other

R1-1808921 Early UL Transmission for NB-IoT and HD-FDD eMTC Sequans Communications

6.2.3 DL MIMO efficiency enhancements for LTE

LTE_DL_MIMO_EE-Core; WID in RP-181485. Please refer to the WID for detailed scoping

Friday
R1-1809674 Chairman's notes of AI 6.2.3 DL MIMO efficiency enhancements for LTE Ad-hoc chair (Samsung)
Decision: The document is endorsed, content is incorporated below.

R1-1808138 Work plan of DL MIMO efficiency enhancements for LTE Huawei, HiSilicon

6.2.3.1 Support of enhancing SRS capacity and coverage

R1-1808368 Discussion on SRS capacity and coverage enhancement CATT

6.2.3.1.1 Additional SRS symbols

R1-1809584 Feature summary on additional SRS symbols for LTE Huawei, HiSi

Agreement
The work for additional SRS symbols in this WI should consider the following scenarios

- TDD for non-CA
- TDD only CA
- FDD-TDD CA

RAN1 will strive for a common framework for all scenarios

R1-1809659 Outcome of offline discussion for additional SRS symbols Huawei, HiSi

Agreement
The time location of possible additional SRS symbols in one normal UL subframe for a cell include the following

- Option 1: All symbols in one slot can be used for SRS from cell perspective
  - E.g., The other slot in the subframe may be used for PUSCH transmission for sTTI-capable UE.
- Option 2: All symbols in one subframe can be used for SRS from cell perspective
- Option 3: A subset of symbols in one slot can be used for SRS from cell perspective
  - E.g., The other slot in the subframe may be used for PUSCH transmission for sTTI-capable UE.
- Other options are not precluded
- FFS whether it has spec impacts or not for cell-specific configuration
- Companies are encouraged to study and evaluate considering
  - Performance (eg, DL performance improvement, degradation on UL performance including legacy UL for legacy UEs)
  - Specification impact
  - UE complexity

- RF impact
- RAN1 will finalize on the performance metrics and evaluation methodology in RAN1#94bis
- System level parameters, evaluation methodology, and the need for system level evaluation can be discussed in the next RAN1 meeting

Conclusion

For link level evaluation, companies are encouraged to submit evaluations results based on following assumptions as a starting point, which is to be checked in next RAN1 meeting.

Parameter	Value
Carrier frequency	2 GHz
Bandwidth	20 MHz (or 10MHz)
Duplex	TDD, LTE Configuration 2
Subcarrier spacing	15 kHz
Polarization	eNB: X pole (+/-45°) UE: + pol (0/90°)
Macro eNB antenna array	$(M, N, P) = (2,4,2)$ with vertical spacing 0.8λ and horizontal spacing 0.5λ
Macro eNB antenna element model (only applicable to CDL and other details FFS)	Elevation beamwidth = 65º
	Azimuth beamwidth = 65º
UE Speed	3km/h, 30km/h, 60km/h
UE antenna	2 receive antennas Isotropic (0 dBi)
CP	Normal CP

R1-1808136 Discussion on SRS transmission on more than one symbols of normal UL subframe Huawei, HiSilicon
R1-1808192 Discussion on additional SRS symbols ZTE
R1-1808227 Discussion on SRS enhancements vivo
R1-1808369 Consideration on multiple SRS symbols in a subframe CATT
R1-1809574 Views on additional symbols for SRS Mitsubishi Electric Co. (revision of R1-1808445)
R1-1808480 Enhancements on SRS resource allocation LG Electronics
R1-1808547 Additional SRS symbols Lenovo, Motorola Mobility
R1-1808662 Additional SRS symbols Intel Corporation
R1-1808742 Discussions on additional SRS symbols Samsung
R1-1809037 Additional SRS symbols Qualcomm Incorporated
R1-1809191 On multi-symbol SRS enhancements Ericsson
R1-1809215 A potential scenario for additional SRS symbols SoftBank Corp.
R1-1809376 Discussion on introduction of additional SRS symbols Nokia, Nokia Shanghai Bell

6.2.3.1.2 Virtual cell ID for SRS

R1-1809585 Feature summary on virtual cell ID for SRS Huawei, HiSilicon

Agreement

For SRS, $\boldsymbol{n_{ID}^{RS}} = \boldsymbol{n_{ID}^{SRS}}$ if $\boldsymbol{n_{ID}^{SRS}}$ is configured by higher layer, otherwise $\boldsymbol{n_{ID}^{RS}} = \boldsymbol{N_{ID}^{cell}}$, where $\boldsymbol{n_{ID}^{RS}}$ is within the range from 0 to 503.

R1-1808137 On virtual cell ID for SRS sequence generation Huawei, HiSilicon
R1-1808193 Discussion on virtual cell ID for SRS ZTE
R1-1808446 Views on SRS virtual cell ID Mitsubishi Electric Co.
R1-1808481 Discussion on VCID for SRS sequence LG Electronics
R1-1808548 Virtual cell ID for SRS Lenovo, Motorola Mobility
R1-1808663 Virtual cell ID support for SRS Intel Corporation
R1-1808743 Discussions on virtual cell ID for SRS Samsung
R1-1808957 Virtual Cell ID for SRS Capacity Enhancements MediaTek Inc.
R1-1809038 Virtual cell ID for SRS Qualcomm Incorporated
R1-1809192 On virtual cell ID for SRS Ericsson

R1-1809377 Introduction of virtual cell id for SRS Nokia, Nokia Shanghai Bell

6.2.3.1.3 Other

R1-1809193 Simulation assumptions and evaluation methodology for SRS enhancements Ericsson

6.2.3.2 Other

R1-1809194 Possible enhancements to Advanced CSI reporting Ericsson

6.2.4 Other

R1-1809229 Virtual cell ID for SRS Qualcomm Incorporated
Withdrawn

7 NR

7.1 Maintenance of Release 15 NR

WID in RP-181474

Only essential corrections. Notes:

- No individual CRs are allowed. Only text proposals are allowed.
  - Later on editors will aggregate all endorsed text proposals for a jumbo CR per spec
- Editors are encouraged to submit editor's CR before the meeting reflecting additional comments received after the endorsed & frozen NR specifications. If submitted, please submit under agenda 7.

R1-1808744 Updates to TS 38.213 Samsung
R1-1808329 TP to 38.211 on handling of initial BWP configuration (response to R2-1810943) Ericsson
R1-1808071 Corrections for TR38.811 Chapter 6 Non-Terrestrial Networks channel models Huawei, HiSilicon

Monday guidance
Conclusion:

- Editors to check the specifictions w.r.t. whether there are cases when the corresponding RRC parameter name is missing. If so, to make necessary updates to include the RRC parameter name in the first occurrence in the specs.
- Editors to update the definition of symbols (Section 3.2) and abbreviations as necessary in the corresponding specs
- Notes: companies are encouraged to inform the editors regarding potential updates for the above two bullets

Wednesday
Conclusion:

- Companies are encouraged to check editor errors within and across different specs, and notify the editors of misalignments to be captured in editors' CR update
  - One example, in 38.211, the following update is necessary

Table 6.3.2.4.1-2: Orthogonal sequences $w_i(m) = e^{j2\pi\phi(m)/N_{SF,m'}^{PUCCH,1}}$ $w_i(m) = e^{j2\pi\varphi(m)/N_{SF}}$ for PUCCH format **1.**

Friday
Editors to prepare CRs incorporating the TPs/agreements/working assumptions by August 30th , for review/comment and endorsement by Sept. 4th.

7.1.1 Maintenance for Initial access and mobility

7.1.1.1 Maintenance for Downlink signals and channels

Including sync, PBCH, RMSI, OSI, and Paging.

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R1-1809703 **Summary of synchronization signals and PBCH Ericsson**
Decision: The document is noted.

Issue of k_SSB: discuss offline

Conclusion:
- Editor to clarify that in the first occurrence of u_0 the largest subcarrier spacing configuration among all subcarrier spacing configurations provided in the cell-specific higher layer parameter *scs-SpecificCarrierList*

Agreement:
- Agree to the TP to section 7.4.3.1 of 38.211

===== start of TP =====

For an SS/PBCH block, the UE shall assume
- antenna port $p = 4000$ is used for transmission of PSS, SSS, PBCH and DM-RS for PBCH,
- the same cyclic prefix length and subcarrier spacing for the PSS, SSS, PBCH and DM-RS for PBCH,

===== end of TP =====

Issue regarding SSB Position Indication in *ServingcellConfigCommon*

Proposal:
From the above cases, if the subcarrier spacing of SS/PBCH blocks is not provided with the higher layer parameter *subcarrierSpacing*, the applicable ones for a cell depend on a respective frequency band, as provided in [8-1, TS 38.101-1] and [8-2, TS 38.101-2]. Case B shall be applied when a 30kHz subcarrier spacing for the SS/PBCH block is indicated from higher layer for frequency bands with a default 15kHz subcarrier spacing provided in [8-1, TS 38.101-1]. A same case applies for all SS/PBCH blocks on the cell.
Also discuss some conditions for intra-band case

Wednesday
R1-1809808 **Summary of synchronization signals and PBCH Ericsson**
Decision: The document is noted.

Proposal from offline:
- k_SSB shall be restricted to:
  - for {SSB SCS, RMSI SCS} = {30 kHz, 15 kHz}, {30 kHz, 30 kHz}, {120 kHz, 60 kHz}, or {240 kHz, 120 kHz}, k_SSB should be restricted as an integer multiple of 2;
  - for {SSB SCS, RMSI SCS} = {240 kHz, 60 kHz}, k_SSB should be restricted as an integer multiple of 4.
- Add a table to section 7.4.3.1 of 38.211 with the above restrictions in k_SSB
- Send LS to RAN4 informing them of this decision (Draft in R1-1809809)

Concerns of LGE, Huawei
RAN4 may have already define such restriction
Discuss further offline

Proposals for the LS from RAN2(R1-1808860):
For the first action:
- The functionality of the 8+8 group bitmap format for SSB position indicated in SIB1 was intended to provide cell specific indication of SSB transmission that should be used during initial access procedures and possibly measurement purposes. The original intention of the full bitmap format for SSB position indicated in dedicated RRC to CONNECTED mode UEs are for PDSCH rate-matching purposes only, and the additional flexibility is to provide flexible resource utilization of resources occupied by SSB for PDSCH transmission.

For the second action:
- Although originally it's RAN1's understanding that the target cell can provide an updated full bitmap for rate matching purposes, if needed, for enhanced flexibility, it however creates some complexity in ensuring consistency in the signaled SSB position between the two methods (8+8 vs. 64-bit bitmap), especially in light of the necessary PRACH procedure. As a result, RAN1 agrees that the two signaling methods shall indicate the same SSB position in Rel-15.

Agreements:

- At least for FR2, if the subcarrier spacing of SS/PBCH blocks is provided with the higher layer parameter subcarrierSpacing, a UE is not expected to be configured with different subcarrier spacings of SS/PBCH blocks for cells in intra-band contiguous carrier aggregation.
    - Check further offline regarding FR1
- To adopt the following TP to section 4.1 of 38.213:

===== start of TP =====

From the above cases, if the subcarrier spacing of SS/PBCH blocks is not provided by the higher layer parameter *subcarrierSpacing*, the applicable ones for a cell depend on a respective frequency band, as provided in [8-1, TS 38.101-1] and [8-2, TS 38.101-2]. A same case applies for all SS/PBCH blocks on the cell. If 30kHz SS/PBCH block subcarrier spacing is indicated by higher layer parameter *subcarrierSpacing*, Case B shall be applied for frequency bands with only 15kHz SS/PBCH block subcarrier spacing as specified in [8-1, TS 38.101-1], and the case specified for 30kHz SS/PBCH block subcarrier spacing in [8-1, TS 38.101-1] shall be applied for bands with 30 kHz SS/PBCH block subcarrier spacing or both 15kHz and 30 kHz SS/PBCH block subcarrier spacing as specified in [8-1, TS 38.101-1].

===== end of TP =====

Thursday

R1-1809879 Summary of synchronization signals and PBCH Ericsson

Decision: The document is noted.

Conclusion:

- It is RAN1's understanding that subcarrier alignment can be achieved by setting point A correctly
- UE's are not expected to handle cases where point A has been set so that subcarriers are not aligned
- As an example, by configuring k_SSB to the values below, alignment can be achieved.
    - for {SSB SCS, RMSI SCS} = {30 kHz, 15 kHz}, {30 kHz, 30 kHz}, {120 kHz, 60 kHz}, or {240 kHz, 120 kHz}, k_SSB should be restricted as an integer multiple of 2;
    - for {SSB SCS, RMSI SCS} = {240 kHz, 60 kHz}, k_SSB should be restricted as an integer multiple of 4
- No RAN1 specification impact.

Agreements:

- For the LS from RAN2(R1-1808860):
    - For the first action:
        - The functionality of the 8+8 group bitmap format for SSB position indicated in SIB1 was intended to provide cell specific indication of SSB transmission that should be used for SSB-RO association and rate matching purpose for both IDLE, INACTIVE, and CONNECTED UEs. The original intention of the full bitmap format for SSB position indicated in dedicated RRC to CONNECTED mode UEs are for UE-specific PDSCH rate-matching purposes only, and the additional flexibility is to provide flexible resource utilization of resources occupied by SSB for PDSCH transmission.
    - For the second action:
        - Based on the above, from RAN1's perspective, the solution would have been to have the 8+8 bitmap in *ServingCellConfigCommonSIB* and *ServingCellConfigCommon* and the full 64-bit bitmap in *ServingCellConfig*, but RAN1 realizes that this is a too late change for Rel-15. Although originally it was RAN1's intention that the target cell can provide an updated full bitmap for rate matching purposes only, if needed, the current signaling creates some complexity in ensuring consistency in the signaled SSB position between the two methods (8+8 vs. 64-bit bitmap), especially related to the RACH procedure. As a result, RAN1 agrees that the two signaling methods shall indicate the same SSB position in Rel-15.
    - No RAN1 specification impact from the above conclusion.
- Reply LS to RAN2 in R1-1809880.

Agreement: The TP in section 7.3 of R1-1809879 is endorsed (38.213)

Friday

R1-1809880 Draft reply LS on ssb-PositionsInBurst mismatch in SIB1 and ServingcellConfigCommon Ericsson

Decision: The draft LS is endorsed and final LS is approved in R1-1809958.

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R1-1809709 **Summary of Remaining RMSI Issues** **CATT**
Decision: The document is noted.

Conclusion:
- Editor to correct the format issue with respect to the caption of table 13.2 of 38.213.

Wednesday
R1-1809794 **Summary of Remaining RMSI Issues** **CATT**
Decision: The document is noted.

Agreements:
- It is RAN1 understanding that UE is not required to decode SI messages until SIB1 has been successfully decoded.
  - No RAN1 spec impact
- From RAN1 perspective, it is not required to avoid supporting transmission of SIB1 and SI message in the same SI transmission window
  - Use one reserved bit in DCI with CRC scrambled by SI-RNTI to indicate UE whether SIB1 or SI message is scheduled

Friday
R1-1809854 **Summary of Remaining RMSI Issues** **CATT**
Decision: The document is noted.

Agreement: The TP in Section 2 of R1-1809854 for Section 7.4.3.1 of 38.211 is endorsed.

R1-1809714 **Summary of Other System Information Delivery** **Samsung**
Decision: The document is noted.

Issue regarding whether or not to avoid supporting transmission of SIB1 and SI message in the same SI transmission window

Wednesday
R1-1809782 **Summary of Other System Information Delivery** **Samsung**
Decision: The document is noted.

Agreements:
To adopt the following TP to 7.3.1.2.1 of 38.212:
===== start of TP =====
- Redundancy version – 2 bits as defined in Table 7.3.1.1.1-2
- System information indicator – 1 bit as defined in Table 7.3.1.2.1-2.
- Reserved bits – [~~16~~15] bits

/// texts omitted

Table 7.3.1.2.1-2: System information indicator

Bit field	System information to be present
0	SIB1
1	SI message

===== end of TP =====

R1-1809783 **[draft] LS response on overlapping SIB1 and SI message** **Samsung**
Decision: The draft LS is endorsed and final LS is approved in R1-1809850.

Agreements:

- If a UE is not provided higher layer parameter searchSpaceOtherSystemInformation for Type0A-PDCCH common search space set, the UE determines the Type0A-PDCCH common search space set as the same as Type0-PDCCH common search space set (i.e., default Type0A-PDCCH common search space set).
- If a UE is not provided higher layer parameter pagingSearchSpace for Type2-PDCCH common search space set, the UE determines the Type2-PDCCH common search space set as the same as Type0-PDCCH common search space set (i.e., default Type2-PDCCH common search space set).
- Separate default Type0A-PDCCH common search space set is not needed.
- Separate default Type2-PDCCH common search space set is not needed.
    - Note: the above 2 sub-bullets have no spec impact

R1-1809737 **Summary on Paging** **Huawei**
Decision: The document is noted.

Agreements:

- Remove the square bracket from '[8]' from TS 38.212, section 7.3.1.2.1
    - It implies that there are 6 spare bits dedicated for future use
    - Note: when scheduling information is not present, all other information fields (other than the short message indicator) are reserved which can be potentially for future use
- Send reply RAN2 of RAN1 decision above (R1-1809760)

Wednesday
R1-1809760 **Reply LS on short message transmission using DCI** **RAN1, Huawei**
Decision: The document is approved.

Friday
R1-1809925 **Summary on Paging** **Huawei**

Agreements:
Regarding the issues related to RAN2 LS in R1-1808172:

- It is RAN1 understanding that the Paging Frame (PF) is a starting point for the first PO (defined by 'S' valid PDCCH monitoring occasions). In addition, the concatenated POs corresponding to one PF can overlap into the next radio frame(s) and/or next PF(s). Based on this understanding, RAN1 has the following questions:
    - Is the first PDCCH monitoring occasion of the first PO of a PF starting from the starting location of the pagingSearchSpace in that frame?
    - RAN1 would like to understand the motivation of introducing PF_offset? Is it intended to avoid overlapping such as to avoid the collision of valid PDCCH monitoring occasion and e.g. SSB transmission.
- Within the UE PO for the non-default association, RAN1 is considering the valid PDCCH monitoring occasion associated to which SSB index to limit the UE monitoring time.
- RAN1 is also discussing if paging PDSCH resource allocation impacts the validity of paging PDCCH monitoring occasion.

Draft LS in R1-1809959
R1-1809959 **[draft] Reply LS on Further Agreements on Paging Occasions** **Huawei**
Decision: The draft LS is endorsed (updating "RAN2 answers" to "RAN2 to answer") and final LS is approved in R1-1809965.

R1-1809721 Maintenance for Downlink signals and channels ZTE (Revision of R1-1808163)
R1-1808217 Remaining issues on broadcast signals and channels vivo
R1-1809722 Remaining issues on downlink signals and channels for initial access MediaTek Inc. (Revision of R1-1808268)
R1-1808370 Remaining issues of broadcasting signals and channels CATT
R1-1808482 Maintenance for Downlink signals and channels LG Electronics
R1-1808622 Remaining issue on synchronization signal NEC Corporation

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R1-1808664	Corrections to Initial Access DL Channels and Signals	Intel Corporation
R1-1808745	Remaining Issues on Synchronization and System information	Samsung
R1-1808890	Maintenance for Downlink signals and channels	Guangdong OPPO Mobile Telecom
R1-1808922	Remaining issues on downlink signals and channels	Huawei, HiSilicon
R1-1809105	Remaining issues on OFDM baseband signal generation	Sharp
R1-1809134	Maintenance for NR initial access	NTT DOCOMO, INC.
R1-1809245	Discussion on remaining issues of SSB and RMSI	CMCC
R1-1809700	Maintenance for Downlink signals and channels	Ericsson (Revision of R1-1809256)
R1-1809370	On issues related to DL signals and channels	Nokia, Nokia Shanghai Bell
R1-1809417	Maintenance for downlink signals and channels for initial access	Qualcomm Incorporated

7.1.1.2 Maintenance for Physical random access channel and procedure

R1-1809736 Maintenance for physical random access channel Convida

Decision: The document is noted.

Proposals:

For unpaired spectrum, a PRACH occasion in a PRACH slot is invalid if it precedes a SS/PBCH block in the PRACH slot or starts less than N_{gap} symbols after a last SS/PBCH block transmission symbol, where N_{gap} is provided in Table 8.2-2.

If a UE is provided higher layer parameter *tdd-UL-DL-ConfigurationCommon*, or is also provided higher layer parameter *tdd-UL-DL-ConfigurationCommon2*, a PRACH occasion in a PRACH slot is also invalid if

- it is not within UL symbols, ~~or~~and
- it ~~does not precede a SS/PBCH block in the PRACH slot and~~ starts ~~at least~~less than N_{gap} symbols after a last downlink symbol ~~and at least~~ N_{gap} ~~symbols after a last SS/PBCH block transmission symbol~~, where N_{gap} is provided in Table 8.2-2.

- To discuss further offline the issue of "Only the valid PRACH occasions are used for performing association between SSB and PRACH occasions".

Agreements:

- To adopt the followingTP in 38.211:

Table 6.3.3.2-3: Random access configurations for FR1 and unpaired spectrum.

95	A2	~~16~~ 2	1	2,3,4,7,8,9	0	1	3	4

Table 6.3.3.2-4: Random access configurations for FR2 and unpaired spectrum.

…								
134	B4	1	0	3,5,7,9,11,13	~~0~~2	1	1	12

Wednesday

R1-1809785 Maintenance for physical random access channel Convida

Decision: The document is noted.

Agreements:

- To adopt the following TP of 5.3.2 of 38.211:

===== start of TP =====

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{L_{RA}-1} a_k^{(p,RA)} \cdot e^{j2\pi\left(k+Kk_1+\bar{k}\right)\Delta f_{RA}\left(t-N_{CP,l}^{RA}T_c-t_{start}^{RA}\right)}$$

$$K = \Delta f / \Delta f_{RA}$$

$$k_1 = k_o^{\mu} + N_{BWP,i}^{start} N_{sc}^{RB} + n_{RA}^{start} N_{sc}^{RB} + n_{RA} N_{RB}^{RA} N_{sc}^{RB} - N_{grid}^{size,\mu} N_{sc}^{RB} / 2$$

$$k_0^{\mu} = \left(N_{grid}^{start,\mu} + N_{grid}^{size,\mu}/2\right) N_{sc}^{RB} - \left(N_{grid}^{start,\mu_0} + N_{grid}^{size,\mu_0}/2\right) N_{sc}^{RB} 2^{\mu-\mu_0}$$

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$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{L_{\text{RA}}-1} a_k^{(p,\text{RA})} \cdot e^{j2\pi\left(k+Kk_1+\bar{k}\right)\Delta f_{\text{RA}}\left(t-N_{\text{CP},l}^{\text{RA}}T_c-t_{\text{start}}^{\text{RA}}\right)}$$

$$K = \Delta f / \Delta f_{\text{RA}}$$

$$k_1 = k_0^{\mu} + \left(N_{\text{BWP},i}^{\text{start}} - N_{grid}^{start,\mu}\right)N_{\text{sc}}^{\text{RB}} + n_{\text{RA}}^{\text{start}}N_{\text{sc}}^{\text{RB}} + n_{\text{RA}}N_{\text{RB}}^{\text{RA}}N_{\text{sc}}^{\text{RB}} - N_{\text{grid}}^{\text{size},\mu}N_{\text{sc}}^{\text{RB}}/2$$

$$k_0^{\mu} = \left(N_{grid}^{start,\mu} + N_{\text{grid}}^{\text{size},\mu}/2\right)N_{\text{sc}}^{\text{RB}} - \left(N_{grid}^{start,\mu_0} + N_{\text{grid}}^{\text{size},\mu_0}/2\right)N_{\text{sc}}^{\text{RB}}2^{\mu_0-\mu}$$

===== end of TP =====

Agreements:

- To adopt the following TP to section 8.1 of 38.213:

===== start of TP =====

For paired spectrum all PRACH occasions are valid.

For unpaired spectrum, if a UE is not provided higher layer parameter *tdd-UL-DL-ConfigurationCommon*, a PRACH occasion in a PRACH slot is valid if it does not precede a SS/PBCH block in the PRACH slot and starts at least N_{gap} symbols after a last SS/PBCH block transmission symbol, where N_{gap} is provided in Table 8.2-2.

If a UE is provided higher layer parameter *tdd-UL-DL-ConfigurationCommon*, or is also provided higher layer parameter *tdd-UL-DL-ConfigurationCommon2*, a PRACH occasion in a PRACH slot is valid if

===== end of TP =====

Friday

R1-1809919 **Maintenance for physical random access channel Convida**

Decision: The document is noted. Companies are encouraged to check section 3.1 of R1-1809919 – aim to conclude in RAN1#94bis

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R1-1809756 **Summary of maintenance for PRACH procedures Qualcomm**

Decision: The document is noted.

Agreements:

- To adopt the following TP to 38.213, Section 8.1:

===== start of TP =====

A UE is provided a number N of SS/PBCH blocks associated with one PRACH occasion and a number R of contention based preambles per SS/PBCH block per valid PRACH occasion by higher layer parameter *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*. If $N < 1$, one SS/PBCH block is mapped to $1/N$ consecutive valid PRACH occasions. If $N \geq 1$, R contention based preambles with consecutive indexes associated with SS/PBCH block n, $0 \leq n \leq N-1$, per valid PRACH occasion start from preamble index ~~n.64/N~~ n· *totalNumberOfRA-Preambles/N*, where *totalNumberOfRA-Preambles* is an integer multiple of *N*. SS/PBCH block indexes are mapped to valid PRACH occasions in the following order where the parameters are described in [4, TS 38.211].

===== end of TP =====

Agreements:

- To adopt the following TP to 38.213, Section 10.1:

===== start of TP =====

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE is not expected to monitor a PDCCH for Type0/0A/2/3-PDCCH common search space, if the SS/PBCH block or the CSI-RS the UE selects for PRACH association, as described in Subclause 8.1, does not have same QCL-TypeD [6, TS 38.214] with a DM-RS for monitoring the PDCCH for Type0/0A/2/3-PDCCH common search space, and if the reception of the PDCCH or PDSCH scrambled by the RNTIs associated for Type0/0A/2/3-PDCCH common search space overlapped with PDCCH or PDSCH scrambled by the RNTIs associated with Type1-PDCCH common search space in at least one symbol.

===== end of TP =====

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Proposals:

- To adopt the following TP to Section 8.2 of 38.213:

If a UE detects a DCI format 1_0 with the CRC scrambled by the corresponding RA-RNTI and receives the corresponding PDSCH that includes the DL-SCH transport block, the UE may assume that the PDSCH and the PDCCH scheduling the PDSCH have same DM-RS antenna port quasi co-location properties, as described in [6, 38.214], as for a SS/PBCH block or a CSI-RS resource the UE used for PRACH association as described in Subclause 8.1, regardless of whether or not the higher layer parameter *TCI-StatesPDCCH* is provided for the CORESET where the PDCCH is received. If the UE attempts to detect the DCI format 1_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers non-contention based random access procedure, the UE may assume that the PDCCH and the PDCCH order have same DM-RS antenna port quasi co-location properties.

Proposals:

In response to a PRACH transmission, a UE attempts to detect a DCI format 1_0 with a CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest control resource set the UE is configured for Type1-PDCCH common search space, as defined in Subclause 10.1, that is zero ~~at least~~ $\left\lceil \left(\Delta \cdot N_{\text{slot}}^{\text{subframe},\mu} \cdot N_{\text{symb}}^{\text{slot}} \right) / T_{sf} \right\rceil$ symbols after the last symbol of the RACH occasion corresponding to the ~~preamble sequence~~ PRACH transmission, where ~~A is defined in [10, TS 38.133] and~~ μ is the subcarrier spacing configuration for Type1-PDCCH common search space. The length of the window in number of slots, based on the subcarrier spacing for Type1-PDCCH common search space as defined in Subclause 10.1, is provided by higher layer parameter *ra-ResponseWindow*.

Wednesday

R1-1809845 **Summary of maintenance for PRACH procedures Qualcomm**

Decision: The document is noted.

Agreements:

- Adopt the following TP to Section 8.2 of 38.213 (change shown in red color)

===== start of TP =====

If a UE detects a DCI format 1_0 with the CRC scrambled by the corresponding RA-RNTI and receives the corresponding PDSCH that includes the DL-SCH transport block, the UE may assume same DM-RS antenna port quasi co-location properties, as described in [6, 38.214], as for a SS/PBCH block or a CSI-RS resource the UE used for PRACH association as described in Subclause 8.1, regardless of whether or not the higher layer parameter *TCI-StatesPDCCH* is provided for the CORESET where the PDCCH is received. If the UE attempts to detect the DCI format 1_0 with CRC scrambled by the corresponding RA-RNTI in response to a PRACH transmission initiated by a PDCCH order that triggers non-contention based random access procedure, the UE may assume that the PDCCH and the PDCCH order have same DM-RS antenna port quasi co-location properties.

===== end of TP =====

Agreement:

- The 1st valid RACH occasion in one association period is used as the starting RACH occasion for ordering in PDCCH order case.

Agreements:

The indexing group of PRACH Mask index should be consecutive PRACH occasions per SSB, i.e., SS/PBCH blocks to PRACH occasions mapping cycle per SSB.

- The indexing of PRACH Mask index should be reset after consecutive PRACH occasions per SSB, i.e., SS/PBCH blocks to PRACH occasions mapping cycle per SSB.
- UE selects the next available PRACH occasion after UE can prepare Msg1 transmission.

Agreements:

- Repetition across multiple slots is not supported for message 3.
- To adopt the following TP to 8.3 of 38.213:

===== start of TP =====
A UE transmits an UL-SCH in an Msg3 PUSCH scheduled by a RAR grant in a corresponding RAR message using redundancy version number 0. Retransmissions, if any, of the UL-SCH in an Msg3 PUSCH are scheduled by a DCI format 0_0 with CRC scrambled by a TC-RNTI provided in the corresponding RAR message [11, TS 38.321].

When the UE is configured with aggregationFactorUL, aggregationFactorUL=1 is assumed for Msg3 PUSCH transmission, regardless of which value of aggregationFactorUL is configured for PUSCH for the active BWP.
===== end of TP =====

Proposal:
In response to a PRACH transmission, a UE attempts to detect a DCI format 1_0 with a CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest control resource set the UE is configured for Type1-PDCCH common search space, as defined in Subclause 10.1, that is one ~~at least~~ $\left\lceil \left(\Delta \cdot N_{\text{slot}}^{\text{subframe},\mu} \cdot N_{\text{symb}}^{\text{slot}}\right) / T_{sf} \right\rceil$ symbol~~s~~, where the symbol duration is based on the subcarrier spacing for Type1-PDCCH common search space as defined in Subclause 10.1, after the last symbol of the RACH occasion corresponding to the ~~preamble sequence~~ PRACH transmission~~, where Δ is defined in [10, TS 38.133] and~~ μ ~~is the subcarrier spacing configuration for Type1-PDCCH common search space~~. The length of the window in number of slots, based on the subcarrier spacing for Type1-PDCCH common search space as defined in Subclause 10.1, is provided by higher layer parameter *ra-ResponseWindow*.

Friday
R1-1809903 **Summary of maintenance for PRACH procedures Qualcomm**
Decision: The document is noted.

Agreements:
- To adopt the following TP to section 8, 38.213:

===== start of TP =====
In response to a PRACH transmission, a UE attempts to detect a DCI format 1_0 with a CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest control resource set the UE is configured for Type1-PDCCH common search space, as defined in Subclause 10.1, that is at least one ~~at least~~ $\left\lceil \left(\Delta \cdot N_{\text{slot}}^{\text{subframe},\mu} \cdot N_{\text{symb}}^{\text{slot}}\right) / T_{sf} \right\rceil$ symbol~~s~~, where the symbol duration is based on the subcarrier spacing for Type1-PDCCH common search space as defined in Subclause 10.1, after the last symbol of the RACH occasion corresponding to the ~~preamble sequence~~ PRACH transmission~~, where Δ is defined in [10, TS 38.133] and~~ μ ~~is the subcarrier spacing configuration for Type1-PDCCH common search space~~. The length of the window in number of slots, based on the subcarrier spacing for Type1-PDCCH common search space as defined in Subclause 10.1, is provided by higher layer parameter *ra-ResponseWindow*.
===== end of TP =====

R1-1808164 Maintenance for Physical random access channel and procedure ZTE
R1-1809512 Remaining issues in PRACH design and RACH procedure MediaTek Inc. (Revision of R1-1808267)
R1-1808310 Corrections on RACH Fujitsu
R1-1808371 Remaining issues of physical random access channel and procedure CATT
R1-1808483 Maintenance for Physical random access channel and procedure LG Electronics
R1-1808542 Remaining issues on RACH procedure vivo
R1-1808665 Corrections to Random Access Channel and Procedures Intel Corporation
R1-1808746 Remaining Issues on Random Access Samsung
R1-1808804 Remaining issues on Physical random access channel and procedure Spreadtrum Communications
R1-1808829 Discussion on ssb-PositionsInBurst mismatch in SIB1 and ServingcellConfigCommon CMCC
R1-1808891 Maintenance for Physical random access channel and procedure Guangdong OPPO Mobile Telecom
R1-1808923 Remaining issues on physical random access channel and procedure Huawei, HiSilicon
R1-1808965 Remaining details on NR Random Access Nokia, Nokia Shanghai Bell
R1-1809135 Maintenance for NR random access NTT DOCOMO, INC.

R1-1809257 Maintenance for Physical random access channel and procedure Ericsson
R1-1809725 Maintenance for Physical random access channel and procedure Qualcomm Incorporated (Revision of R1-1809418)
R1-1809474 Correction on RACH procedure ITL

7.1.1.3 Maintenance for Mobility procedure

Including RRM and RLM

R1-1809732 **Summary of discussion for NR measurements for mobility** Intel
Decision: The document is noted.

Agreements:

- Adopt the following text proposals

----------Text Proposal for Section 7.1.4.5 in TS38.211----------

----omitted----
Zero-power (ZP) and non-zero-power (NZP) CSI-RS are defined
- for a non-zero-power CSI-RS configured by the *NZP-CSI-RS-Resource* IE *or CSI-RS-Resource-Mobility in the CSI-RS-ResourceConfigMobility IE,* the sequence shall be generated according to clause 7.4.1.5.2 and mapped to resource elements according to clause 7.4.1.5.3

----omitted----

…..
at the start of each OFDM symbol where $n_{s,f}^{\mu}$ is the slot number within a radio frame, l is the OFDM symbol number within a slot, and n_{ID} equals the higher-layer parameter s*cramblingID* or *sequenceGenerationConfig.*
----omitted----

The value of ρ is given by the higher-layer parameter *density* in the *CSI-RS-ResourceMapping* IE or the *CSI-RS-ResourceConfigMobility* IE and the number of ports X is given by the higher-layer parameter *nrofPorts*.
----omitted----

The time-domain locations $l_0 \in \{2, 3, \ldots, 12\}$ and $l_1 \in \{2, 3, \ldots, 12\}$ are provided by the higher-layer parameters *firstOFDMSymbolInTimeDomain* and *firstOFDMSymbolInTimeDomain2*, respectively, in the *CSI-RS-ResourceMapping* IE or the *CSI-RS-ResourceConfigMobility* IE and defined relative to the start of a slot.
The frequency-domain location is given by a bitmap provided by the higher-layer parameter *frequencyDomainAllocation* in the *CSI-RS-ResourceMapping* IE or the *CSI-RS-ResourceConfigMobility* IE with the bitmap and value of k_i in Table 7.4.1.5.3-1 given by
- $[b_3 \cdots b_0]$, $k_i = f(i)$ for row 1 of Table 7.4.1.5.3-1
- $[b_{11} \cdots b_0]$, $k_i = f(i)$ for row 2 of Table 7.4.1.5.3-1
- $[b_2 \cdots b_0]$, $k_i = 4f(i)$ for row 4 of Table 7.4.1.5.3-1
- $[b_5 \cdots b_0]$, $k_i = 2f(i)$ for all other cases

where $f(i)$ is the bit number of the ith bit in the bitmap set to one, repeated across every $1/\rho$ of the resource blocks configured for CSI-RS reception by the UE when $\rho \le 1$. The starting position and number of the resource blocks in which the UE shall assume that CSI-RS is transmitted are given by the higher-layer parameters *freqBand* and *density* in the *CSI-RS-ResourceMapping* IE for the bandwidth part given by the higher-layer parameter *bwp-Id* in the *CSI-ResourceConfig* IE, or given by the higer-layer parameters *csi-rs-MeasurementBW* and *density* in the *CSI-RS-ResourceConfigMobility* IE where the the *startPRB* given by *csi-rs-MeasurementBW* is relative to common resource block 0.

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----omitted----

where the periodicity $T_{\text{CSI-RS}}$ (in slots) and slot offset T_{offset} are obtained from the higher layer parameter *CSI-ResourcePeriodicityAndOffset* or *slotconfig*. The UE shall assume that CSI-RS is transmitted in a candidate slot only if all OFDM symbols of that slot corresponding to the configured CSI-RS resource are classified as 'downlink'.

Agreements:
- Adopt the following text proposal to 38.215:

Table 5.1.3-1: NR Carrier RSSI measurement symbols

OFDM signal indication *endSymbol* ~~*SS-RSSI-MeasurementSymbolConfig*~~	Symbol indexes
0	{0,1}
1	{0,1,2,..,10,11}
2	{0,1,2,…, 5}
3	{0,1,2,…, 7}

Agreements:
- To adopt the following TP to TS 38.213 Section 5

===== start of TP =====
If the UE is not provided higher layer parameter *RadioLinkMonitoringRS* and the UE is provided by higher layer parameter *TCI-state* for PDCCH one or more RSs that include one or more of a CSI-RS and/or a SS/PBCH block
- the UE uses for radio link monitoring the RS provided for the active TCI state for PDCCH if the active TCI state for PDCCH includes only one RS
- if the active TCI state for PDCCH includes two RS, the UE expects that one RS has QCL-TypeD and the UE uses the one RS for radio link monitoring; the UE does not expect both RS to have QCL-TypeD
- the UE is not required to use for radio link monitoring an aperiodic or semi-persistent RS

===== end of TP =====

Wednesday

R1-1809793 **Summary of offline discussion for NR mobility** **Intel**

Decision: The document is noted.

Proposal:
- When the configured C-DRX cycle is 80msec or larger, UE does not expect CSI-RS resource outside the C-DRX ON period are available for RRM measurements. Otherwise, UE may assume CSI-RS resources are always available.

Agreements:
- Adopt the following text proposal for TS38.214, 5.1.6.1.3:

===== start of TP =====
For frequency range 2 the associatedSSB is either present for all configured CSI-RS resources or not present for any configured CSI-RS resources per frequency layer.
For any CSI-RS resource configuration, UE shall assume that the value for parameter cdm-Type is 'No CDM', and there is only one anntenna port.
===== end of TP =====

Agreements:
- Adopt the following text proposal for 38.215 Section 5.1.3

===== start of TP =====

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Definition	*<omitted>* If indicated by higher-layers, ~~for a half frame with SS/PBCH blocks~~ the NR Carrier RSSI is measured in slots within a half frame with SS/PBCH blocks that are indicated by the higher layer parameter *measurementSlots* and in ~~from OFDM symbols of the indicated slots and the~~ OFDM symbols ~~are~~ given by Table 5.1.3-1. For intra-frequency measurements, NR Carrier RSSI is measured with timing reference corresponding to the serving cell in the frequency layer For inter-frequency measurements, NR Carrier RSSI is measured with timing reference corresponding to any cell in the target frequency layer Otherwise, if measurement gap is not used, NR Carrier RSSI is measured from OFDM symbols within SMTC window duration and, if measurement gap is used, NR Carrier RSSI is measured from OFDM symbols corresponding to overlapped time span between SMTC window duration and minimum measurement time within the measurement gap. *<omitted>*

===== end of TP =====

Agreements:

- Send an LS to RAN2, informing them that *density* parameter in *CSI-RS-CellMobility* is required for measurement of CSI-RS. RAN1 recommends that RAN2 make appropriate actions to make sure the value of *density* is available in all cases. If a default value is to be determined by RAN2, RAN1 recommends use of d3 as the default value.
- LS to be drafted in R1-1809851

Friday - R1-1809851 [DRAFT] LS on density parameter for CSI-RS-ResourceConfigMobility Intel
Decision: The draft LS is endorsed (assuming RAN4 being deleted from ACTION) and final LS is approved in R1-1809960.

Agreements:

- Send an LS to RAN4 providing motivation for the second BLER pair thresholds for RLM.
  - Draft LS in R1-1809813
- The following is the motivation of the second BLER pair threshold:
  - It has been observed that in LTE, when semi-persistent scheduling is used, the service quality can be adequate also when the SINR is below the level corresponding to a PDCCH BLER of 10%. The most prominent example is for VoLTE.
  - In these cases, it has been observed that the UE triggers RLF also when the voice quality is quite adequate. In other words, RLF may be triggered prematurely.
  - To avoid this situation, RAN1 introduced the additional BLER threshold values for RLM. The main idea was thus that the additional BLER values would be higher than the default values.

R1-1809813 Draft LS on second BLER pair for RLM Ericsson
Decision: The draft LS is endorsed and final LS is approved in R1-1809853.

Friday session
R1-1809933 Summary of offline discussion for NR mobility Intel
Decision: The document is noted.

Agreements:

- Adopt the following text proposal for TS38.214 section 5.1.6.1.3

===== start of TP =====
If a UE is configured with the higher layer parameters *CSI-RS-Resource-Mobility* and *associatedSSB*, the UE may base the timing of the CSI-RS resource on the timing of the cell given by the *cellId* of the CSI-RS resource configuration. Additionally, for a given CSI-RS resource, if the associated SS/PBCH block is configured but not detected by the UE, the UE is not required to monitor the corresponding CSI-RS resource. The higher layer parameter *isQuasiColocated* indicates whether the associated SS/PBCH block given by the *associatedSSB* and the CSI-RS resource(s) are quasi co-located with respect to ['QCL-TypeD'].
If the UE is configured with DRX, UE is not required to perform measurement of CSI-RS resources other than during the active time for measurements based on *CSI-RS-Resource-Mobility.*
If the UE is configured with DRX and DRX cycle in use is larger than 80 msec, UE may not expect CSI-RS resources are available other than during the active time for measurements based on *CSI-RS-Resource-Mobility.* Otherwise, UE may assume CSI-RS are available for measurements based on *CSI-RS-Resource-Mobility.*
===== end of TP =====

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Working asusmption:

- In frequency range 1 unpaired spectrum, UE is not required to perform intra-frequency neighbor cell RRM measurement over SSB or CSI-RS for mobility when UE detects a DCI format 0_0, DCI format 0_1, DCI format 1_0, DCI format 1_1, or DCI format 2_3 triggering the UE to transmit in UL in at least one of the symbols where the SSB or CSI-RS for RRM measurement on neighbor cell is transmitted.
    - Note: this is not intended to have any impact on existing overlapping/overwriting rules related to SFI

Draft LS in R1-1809963, to RAN4 regarding the above and provide feedback if there is any concern.

R1-1809963 [DRAFT] LS on collision of RRM measurement resources with uplink transmissions in FR1 TDD vivo

Decision: The draft LS is endorsed with the following update:

~~Send an LS to RAN4 regarding the above and provide feedback if there is any concern~~

Final LS is approved in R1-1810008.

Proposal:

- To adopt the following TP to section 5 of 38.213:

The downlink radio link quality of the primary cell is monitored by a UE for the purpose of indicating out-of-sync/in-sync status to higher layers. If UE is configured for operation in initial DL BWP and UE is configured to perform monitoring of radio link quality of SS/PBCH block(s) when SS/PBCH block and control resource set multiplexing pattern 2 or 3 is configured in PBCH, UE is expected to perform RLM by monitoring the associated SS/PBCH block. Otherwise, the~~The~~ UE is not required to monitor the downlink radio link quality in DL BWPs other than the active DL BWP on the primary cell.

Proposal:

- Adopt the following text proposal of Section 5, 38.213

For a CSI-RS resource configuration, the higher layer parameter *powerControlOffsetSS* is not applicable and a UE expects to be provided only 'No CDM' from higher layer parameter *cdm-Type,* only '1' and '3' from higher layer parameter *density*, and only '1 port' from higher layer parameter *nrofPorts* [6, TS 38.214].

If a UE is configured with multiple DL BWPs for the serving cell and DL BWP is switched from one to another as defined in Subclause 12, UE updates the RS for radio link monitoring from *RadioLinkMonitoringRS* or TCI-state for PDCCH associated with the previous DL BWP to *RadioLinkMonitoringRS* or TCI-state for PDCCH associated with the current DL BWP.

R1-1809985 Summary of Office discussion for NR mobility Intel

Decision: The document is noted.

Agreements:

- Adopt the following text proposal, section 5 of 38.213

===== start of TP =====

The downlink radio link quality of the primary cell is monitored by a UE for the purpose of indicating out-of-sync/in-sync status to higher layers. The UE is not required to monitor the downlink radio link quality in DL BWPs other than the active DL BWP on the primary cell. When SS/PBCH block and control resource set multiplexing pattern 2 or 3 is configured in PBCH and initial DL BWP is active, UE is expected to perform RLM by monitoring the associated SS/PBCH block.

===== end of TP =====

Agreements:

- Adopt the following text proposal, section 5 of 38.213

===== start of TP =====

For a CSI-RS resource configuration, the higher layer parameter *powerControlOffsetSS* is not applicable and a UE expects to be provided only 'No CDM' from higher layer parameter *cdm-Type,* only '1' and '3' from higher layer parameter *density*, and only '1 port' from higher layer parameter *nrofPorts* [6, TS 38.214].

If a UE is configured with multiple DL BWPs for the serving cell and a new DL BWP is activated, UE uses the RS(s) configured by *RadioLinkMonitoringRS* for the activated DL BWP or RS(s) provided for the active TCI-state for PDCCH if *RadioLinkMonitoringRS* is not configured in the activated DL BWP.

===== end of TP =====

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R1-1808165	Maintenance for Mobility procedure	ZTE
R1-1808218	Remaining issues on mobility procedure	vivo
R1-1808269	Remaining issues in RRM measurement procedure	MediaTek Inc.
R1-1808372	Remaining issues of Mobility procedure	CATT
R1-1808484	Maintenance for Mobility procedure	LG Electronics
R1-1808666	Corrections to NR mobility measurements	Intel Corporation
R1-1808747	Remaining Issues on Measurements for Mobility Management	Samsung
R1-1808892	Remaining issues on NR RRM and RLM	Guangdong OPPO Mobile Telecom
R1-1808924	Remaining issues on mobility procedure	Huawei, HiSilicon
R1-1809136	Maintenance for NR mobility procedure	NTT DOCOMO, INC.
R1-1809258	Maintenance for Mobility procedure	Ericsson
R1-1809371	Issues related to RRM and RLM	Nokia, Nokia Shanghai Bell
R1-1809419	Maintenance for mobility procedure	Qualcomm Incorporated

7.1.1.4 Other

R1-1808925	Correction on TA offset determination in TS38.213	Huawei, HiSilicon
R1-1808929	On RMSI PRB grid	Huawei, HiSilicon
R1-1809420	Maintenance for TA	Qualcomm Incorporated

7.1.2 Maintenance for MIMO

Friday

R1-1809913 Chairman's notes of AI 7.1.2 Maintenance for MIMO Ad-hoc chair (Samsung)

Decision: The document is endorsed, content is incorporated below.

7.1.2.1 Maintenance for Multi-antenna scheme

Including codeword mapping, codebook & non-codebook based tx for UL, PRB bundling for DL, etc.

Please use separate sections for each of the respective sub-topic to facilitate reviews and summary.

R1-1809493 Summary of codeword mapping Samsung

R1-1809742 Issue Summary on Codebook based UL transmission Intel

R1-1809895 Summary for further discussion on codeword mapping Samsung

Agreement

Agree on the following text proposal for 5.1.3.2 of TS38.214

----------Start of TP ----------

In case the higher layer parameter *maxNrofCodeWordsScheduledByDCI* indicates that two codeword transmission is enabled, then ~~a transport block~~ one of the two transport blocks is disabled by DCI format 1_1 if I_{MCS}= 26 and if rv_{id} = 1 for the corresponding transport block~~, otherwise the transport block is enabled~~. If both transport blocks are enabled, transport block 1 and 2 are mapped to codeword 0 and 1 respectively. If only one transport block is enabled, then the enabled transport block is always mapped to the first codeword.

----------End of TP ----------

Conclusion

Note that when two codeword transmission is configured, 'I_{MCS}= 26 and rv_{id} = 1' on both transport blocks is a valid downlink assignment for DCI 1_1

R1-1809744 Summary of issues on UL non-codebook based transmission Nokia, Nokia Shanghai Bell

Agreement:

Agree this TP to 6.1.1.2 of 38.214:

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----------Start of TP ----------

For non-codebook based transmission, the UE does not expect to be configured with both *spatialRelationInfo* for SRS resource and *associatedCSI-RS* in ~~*SRS-ConfigSRS-ResourceSet*~~ for SRS resource set.

For non-codebook based transmission, the UE can be scheduled with DCI format 0_1 when at least one SRS resource is configured in *SRS-ResourceSet* with *usage* set to 'nonCodebook'.

----------End of TP ----------

Agreement

Adopt the following TP for Subclause 6.1.1.2 of TS38.214:

----------Start of TP ----------

6.1.1.2 Non-Codebook based UL transmission

For non-codebook based transmission, the UE can determine its PUSCH precoder and transmission rank based on the wideband SRI when multiple SRS resources are configured, where the SRI is given by the SRS resource indicator in DCI according to subclause 7.3.1.1.2 of [5, 38.212], or the SRI is given by *srs-ResourceIndicator* according to subclause 6.1.2.3. The UE shall use one or multiple SRS resources for SRS transmission, where the number of SRS resources which can be configured to the UE for simultaneously transmission in the same RBs is a UE capability. Only one SRS port for each SRS resource is configured. Only one SRS resource set can be configured with higher layer parameter *usage* in *SRS-ResourceSet* set to 'nonCodebook'. The maximum number of SRS resources that can be configured for non-codebook based uplink transmission is 4. The indicated SRI in slot *n* is associated with the most recent transmission of SRS resource(s) identified by the SRI, where the SRS ~~resource~~ transmission is prior to the PDCCH carrying the SRI before slot *n*.

----------End of TP ----------

Agreement

Adopt the following TP for Subclause 6.1.1.2 of TS38.214:

----------Start of TP ----------

- If aperiodic SRS resource set is configured, the associated NZP-CSI-RS ~~for UL channel measurement~~ is indicated via SRS request field in DCI format 0_1 and 1_1, where *AperiodicSRS-ResourceTrigger* (indicating the association ~~among~~ between aperiodic SRS triggering state and SRS resource sets), triggered SRS resource(s) *srs-ResourceSetId*, *csi-RS (*indicating the associated *NZP-CSI-RS-ResourceId* ~~for UL channel measurement~~*)* are higher layer configured in *SRS-ResourceSet*. A UE is not expected to update the SRS precoding information if the gap from the last symbol of the reception of the aperiodic NZP-CSI-RS resource and the first symbol of the aperiodic SRS transmission is less than 42 OFDM symbols.

----------End of TP ----------

Agreement

Adopt the following TP for Subclause 6.1.1.2 of TS38.214:

----------Start of TP ----------

- If the UE configured with aperiodic SRS associated with aperiodic NZP CSI-RS resource, the presence of the associated CSI-RS is indicated by the SRS request field if the value of the SRS request field is not '00' as in Table 7.3.1.1.2-24 of [5, TS 38.212]. The CSI-RS is located in the same slot as the SRS request field~~, while any of the tci-States for aperiodic CSI-RS shall not be configured with 'QCL-Type-D'~~. If the UE configured with aperiodic SRS associated with aperiodic NZP CSI-RS resource, any of the TCI states configured in the scheduled CC shall not be configured with 'QCL-TypeD'.

----------End of TP ----------

Agreement

Agree the TP to 6.1.1.2 of 38.214

----------Start of TP ----------

6.1.1.2 Non-Codebook based UL transmission

<unrelated part omitted>

The UE shall perform one-to-one mapping from the indicated SRI(s) to the indicated DM-RS ports(s) ~~in the~~given by DCI format 0_1 or *ConfiguredGrantConfig* according to subclause 6.1.2.3 in increasing order.

<unrelated part omitted>

----------End of TP ----------

Agreement

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Confirm the working assumption of TP to 38.214, Section 6.1.1.2:

----------Start of TP ----------

6.1.1.2 Non-Codebook based UL transmission

For non-codebook based transmission, the UE can determine its PUSCH precoder and transmission rank based on the wideband SRI ~~given by *SRS resource indicator* field from the DCI~~ when multiple SRS resources are configured, where the SRI is given by the SRS resource indicator in DCI according to subclause 7.3.1.1.2 of [TS 38.212], or the SRI is given by *srs-ResourceIndicator* according to subclause 6.1.2.3.

----------End of TP ----------

R1-1809740 Summary on Issues of PRB bundling for DL vivo

Agreement

Text proposal for 38.214 Section 3.3 and 5.1.2.3

----------Start of TP ----------

3.3 Abbreviations

< Unchanged parts are omitted >

PRG ~~Physical resource block group~~ Precoding resource block group

< Unchanged parts are omitted >

5.1.2.3 Physical resource block (PRB) bundling

< Unchanged parts are omitted >

If $P'_{BWP,i}$ is determined as "wideband", the UE is not expected to be scheduled with non-contiguous ~~resource allocation~~ PRBs and the UE may assume that the same precoding is applied to the allocated resource.

If $P'_{BWP,i}$ is determined as one of the values among {2, 4}, Precoding Resource Block Group (PRGs) partitions the bandwidth part i with $P'_{BWP,i}$ consecutive PRBs. Actual number of consecutive PRBs in each PRG could be one or more.

The first PRG size is given by $P'_{BWP,i} - N^{\text{start}}_{\text{BWP},i} \bmod P'_{BWP}$ and the last PRG size given by $(N^{start}_{BWP,i} + N^{size}_{BWP,i}) \bmod P'_{BWP,i}$ if $(N^{start}_{BWP,i} + N^{size}_{BWP,i}) \bmod P'_{BWP,i} \neq 0$, and the last PRG size is $P'_{BWP,i}$ if $(N^{start}_{BWP,i} + N^{size}_{BWP,i}) \bmod P'_{BWP,i} = 0$.

The UE may assume the same precoding is applied for any downlink contiguous allocation of PRBs in a PRG.

< Unchanged parts are omitted >

- is set to '1' and two values are configured for the first set of $P'_{BWP,i}$ values as 'n2-wideband' (corresponding to two $P'_{BWP,i}$ values 2 and wideband) or 'n4-wideband' (corresponding to two $P'_{BWP,i}$ values 4 and wideband), the UE shall use the value when receiving PDSCH scheduled by the same DCI as follows:

< Unchanged parts are omitted >

----------End of TP ----------

R1-1809896 Corrections for UL MIMO for single antenna port, DCI format, and antenna Ericsson, Nokia, LG Electronics

Agreement

Text proposal for 38.214:

----------Start of TP 1a ----------

6.1.1 Transmission schemes

Two transmission schemes are supported for PUSCH: codebook based transmission and non-codebook based transmission. The UE is configured with codebook based transmission when the higher layer parameter *txConfig* in *PUSCH-Config* is set to 'codebook', the UE is configured non-codebook based transmission when the higher layer parameter *txConfig* is set to 'nonCodebook'. If the higher layer parameter *txConfig* is not configured, the UE is not expected to be scheduled by DCI format 0_1. ~~the PUSCH transmission is based on one PUSCH antenna port, which is triggered by DCI format 0_0.~~ If PUSCH is scheduled by DCI format 0_0, the PUSCH transmission is based on a single antenna port.

----------End of TP 1a ----------

----------Start of TP 1b----------

6.1.1.1 Codebook based UL transmission

For codebook based transmission, PUSCH can be scheduled by DCI format 0_0, DCI format 0_1 or semi-statically configured to operate according to Subclause 6.1.2.3. If this ~~if~~ PUSCH is scheduled by DCI format 0_1, the UE determines its PUSCH transmission precoder based on SRI, TPMI and the transmission rank from the DCI, given by DCI fields of SRS resource indicator and Precoding information and number of layers in subclause 7.3.1.1.2 of [TS 38.212]., ~~where the~~ The TPMI is used to indicate the precoder to be applied over the antenna ports $\{0\ldots\nu\text{-}1\}$ and that corresponds to the SRS resource selected by the SRI when multiple SRS resources are configured, or if a single SRS resource is configured TPMI is used to indicate the precoder to be applied over the antenna ports $\{0\ldots\nu\text{-}1\}$ and that corresponds to the SRS resource. The transmission precoder is selected from the uplink codebook that has a number of antenna ports equal to higher layer parameter *nrofSRS-Ports* in SRS-Config, as defined in Subclause 6.3.1.5 of [4, TS 38.211]. When the UE is configured with the higher layer parameter *txConfig* set to 'codebook', the UE is configured with at least one SRS resource. The indicated SRI in slot n is associated with the most recent transmission of SRS resource identified by the SRI, where the SRS resource is prior to the PDCCH carrying the SRI before slot n.

----------End of TP 1b ----------

----------Start of TP 1c ----------

6.1.1.2 Non-Codebook based UL transmission

For non-codebook based transmission, PUSCH can be scheduled by DCI format 0_0, DCI format 0_1 or semi-statically configured to operate according to Subclause 6.1.2.3. ~~the~~ The UE can determine its PUSCH precoder and transmission rank based on the wideband SRI when multiple SRS resources are configured, where the SRI is given by the SRS resource indicator in DCI according to subclause 7.3.1.1.2 of [5, 38.212], or the SRI is given by *srs-ResourceIndicator* according to subclause 6.1.2.3. The UE shall use one or multiple SRS resources for SRS transmission, where the number of SRS resources which can be configured to the UE for simultaneously transmission in the same RBs is a UE capability. Only one SRS port for each SRS resource is configured. Only one SRS resource set can be configured with higher layer parameter *usage* in *SRS-ResourceSet* set to 'nonCodebook'. The maximum number of SRS resources that can be configured for non-codebook based uplink transmission is 4. The indicated SRI in slot n is associated with the most recent transmission of SRS resource identified by the SRI, where the SRS resource is prior to the PDCCH carrying the SRI before slot n.

----------End of TP 1c ----------

Agreement

Text proposal for TS38.211

----------Start of TP ----------

6.3.1.5 Precoding

The block of vectors $\left[y^{(0)}(i) \quad \ldots \quad y^{(\upsilon-1)}(i)\right]^T$, $i=0,1,\ldots,M_{\text{symb}}^{\text{layer}}-1$ shall be precoded according to

- $$\begin{bmatrix} z^{(p_0)}(i) \\ \vdots \\ z^{(p_{\rho-1})}(i) \end{bmatrix} = W \begin{bmatrix} y^{(0)}(i) \\ \vdots \\ y^{(\upsilon-1)}(i) \end{bmatrix}$$

where $i=0,1,\ldots,M_{\text{symb}}^{\text{ap}}-1$, $M_{\text{symb}}^{\text{ap}}=M_{\text{symb}}^{\text{layer}}$. The set of antenna ports $\{p_{0,\ldots},p_{\rho-1}\}$ shall be determined according to the procedure in [6, TS 38.214].

For non-codebook-based transmission, the precoding matrix W equals the identity matrix.

For codebook-based transmission, the precoding matrix W is given by $W=1$ for single-layer transmission on a single antenna port, otherwise by Tables 6.3.1.5-1 to 6.3.1.5-7 with the TPMI index obtained from the DCI scheduling the uplink transmission or the higher layer parameters according to the procedure in [6, TS 38.214].

<unrelated part omitted>

----------End of TP ----------

Agreement

Text proposal for TS38.212

----------Start of TP ----------

7.3.1.1.2 Format 0_1

<unrelated part omitted>

- Precoding information and number of layers – number of bits determined by the following:
  - 0 bits if the higher layer parameter *txConfig* = *nonCodeBook*;

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- 0 bits for 1 antenna port and if the higher layer parameter *txConfig* = *codebook*;
- 4, 5, or 6 bits according to Table 7.3.1.1.2-2 for 4 antenna ports, if *txConfig* = *codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;
- 2, 4, or 5 bits according to Table 7.3.1.1.2-3 for 4 antenna ports, if *txConfig* = *codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank*, and *codebookSubset*;
- 2 or 4 bits according to Table7.3.1.1.2-4 for 2 antenna ports, if *txConfig* = *codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank* and *codebookSubset*;
- 1 or 3 bits according to Table7.3.1.1.2-5 for 2 antenna ports, if *txConfig* = *codebook,* and according to the values of higher layer parameters *transformPrecoder*, *maxRank* and *codebookSubset*.

<unrelated part omitted>

----------End of TP ----------

Agreement

Text proposal for TS38.214

----------Start of TP ----------

6.1.1.1 Codebook based UL transmission

<unrelated part omitted>

~~F~~or codebook based transmission, the UE determines its codebook subsets based on TPMI and upon the reception of higher layer parameter *codebookSubset* in *PUSCH-Config* which may be configured with 'fullyAndPartialAndNonCoherent ~~fullAndPartialAndNonCoherent~~', or 'partialAndNonCoherent', or 'nonCoherent' depending on the UE capability. The maximum transmission rank may be configured by the higher parameter *maxRank* in *PUSCH-Config* .

A UE reporting its UE capability of 'partialAndNonCoherent' transmission shall not expect to be configured by *codebookSubset* with 'fullyAndPartialAndNonCoherent ~~fullAndPartialAndNonCoherent~~'.

A UE reporting its UE capability of 'nonCoherent ~~Non-Coherent~~' transmission shall not expect to be configured by *codebookSubset* with 'fullyAndPartialAndNonCoherent ~~fullAndPartialAndNonCoherent~~' or with 'partialAndNonCoherent'.

A UE shall not expect to be configured with the higher layer parameter *codebookSubset* set to 'partialAndNonCoherent' when higher layer parameter *nrofSRS-Ports* in an *SRS-ResourceSet* with *usage* set to 'codebook ~~codeBook~~' indicates that two SRS antenna ports are configured.

For codebook based transmission, the UE may be configured with a single *SRS-ResourceSet* set to 'codebook ~~codeBook~~' and only one SRS resource can be indicated based on the SRI from within the SRS resource set. The maximum number of configured SRS resources for codebook based transmission is 2. If aperiodic SRS is configured for a UE, the SRS request field in DCI triggers the transmission of aperiodidc SRS resources.

When multiple SRS resources are configured by *SRS-ResourceSet* with *usage* set to 'codebook ~~codeBook~~', the UE shall expect that higher layer parameters *nrofSRS-Ports* in *SRS-ResourceSet* in *SRS-ResourceSet* shall be configured with the same value for all these SRS resources.

----------End of TP ----------

R1-1809911 **Further discussions on non-codebook based uplink transmission** **Nokia, Nokia Shanghai Bell**

Agreement

Agree this TP to 6.2.1 of 38.214:

----------Start of TP ----------

6.2.1 UE sounding procedure

The UE can be configured with one or more Sounding Reference Symbol (SRS) resource sets as configured by the higher layer parameter *SRS-ResourceSet*. For each SRS resource set, a UE may be configured with $K \geq 1$ SRS resources (higher ~~later~~layer parameter *SRS-Resource*), where the maximum value of K is indicated by [*SRS_capability* [13, 38.306]]. The SRS resource set applicability is configured by the higher layer parameter ~~*SRS-SetUse*~~*usage* in *SRS-ResourceSet*. When the higher layer parameter *usage*~~*SRS-SetUse*~~ is set to 'BeamManagement', only one SRS resource in each of multiple SRS sets can be transmitted at a given time instant. The SRS resources in different SRS resource sets can be transmitted simultaneously.

For aperiodic SRS at least one state of the DCI field is used to select at least one out of the configured SRS resource set

…

----------End of TP ----------

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R1-1808146	Remaining issues on multi-antenna schemes	Huawei, HiSilicon
R1-1808194	Maintenance for Multi-antenna scheme	ZTE
R1-1808219	Remaining issues on multi-antenna scheme	vivo
R1-1808311	Corrections on Codebook based transmission	Fujitsu
R1-1808373	Issues on transmission schemes	CATT
R1-1808485	Text proposals on multi-antenna scheme	LG Electronics
R1-1808549	Maintenance for codebook and non-codebook based UL transmission	Lenovo, Motorola Mobility
R1-1808667	Remaining Issues on Multi-antenna Scheme	Intel Corporation
R1-1808799	Remaining issues on PRB bundling for DL	Spreadtrum Communications
R1-1808880	Text proposals for multi-antenna scheme	Guangdong OPPO Mobile Telecom
R1-1809052	Text Proposal on MIMO Codeword Mapping	AT&T
R1-1809195	Maintenance for Multi-antenna scheme	Ericsson
R1-1809235	Remaining issues on multi-antenna schemes	Nokia, Nokia Shanghai Bell
R1-1809421	Maintenance for multi-antenna scheme	Qualcomm Incorporated
R1-1809494	Corrections on transmission schemes	Samsung (rev. of R1-1808748)
R1-1809852	Correction on UL antenna port mapping	Nokia, Nokia Shanghai Bell

7.1.2.2 Maintenance for CSI acquisition

Including CSI measurement & reporting, CQI & MCS, etc.

Please use separate sections for each of the respective sub-topic to facilitate reviews and summary.

R1-1809771 Feature lead summary on CSI measurement ZTE

Agreement

Section 5.2.1.4.2 of TS 38.214:

----------Start of TP ----------

[Unchanged text are omitted]

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-CQI':

- the UE is configured with higher layer parameter *non-PMI-PortIndication* contained in a *CSI-ReportConfig,* where *r* ports are indicated in the order of layer ordering for rank *r* and each CSI-RS resource in the CSI resource setting is linked to the *CSI-ReportConfig* based on the order of the associated *NZP-CSI-RS-ResourceId* in the linked CSI resource setting for channel measurement given by higher layer parameter *resourcesForChannelMeasurement*. The higher layer parameter *non-PMI-PortIndication* contains a sequence $p_0^{(1)}, p_0^{(2)}, p_1^{(2)}, p_0^{(3)}, p_1^{(3)}, p_2^{(3)}, \ldots, p_0^{(R)}, p_1^{(R)}, \ldots, p_{R-1}^{(R)}$ of port indices, where $p_0^{(\nu)}, \ldots, p_{\nu-1}^{(\nu)}$ are the CSI-RS port indices associated with rank ν and $R \in \{1,2,\ldots,\min(8,P)\}$ where $P \in \{1,2,4,8\}$ is the number of ports in the CSI-RS resource.
- When calculating the CQI for a rank, the UE shall use the ports indicated for that rank for the selected CSI-RS resource. The precoder for the indicated ports shall be assumed to be the identity matrix scaled by $\frac{1}{\sqrt{\nu}}$.

----------End of TP ----------

Agreement

----------Start of TP for 38.214 Section 5.2.1.4.2----------

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-CQI':

- If the UE is configured with higher layer parameter *non-PMI-PortIndication* contained in a *CSI-ReportConfig,* ~~where~~ *r* ports are indicated in the order of layer ordering for rank *r* and each CSI-RS resource in the CSI resource setting is linked to the *CSI-ReportConfig* based on the order of the associated *NZP-CSI-RS-ResourceId* in the linked CSI resource setting for channel measurement given by higher layer parameter *resourcesForChannelMeasurement*. The configured higher layer parameter *non-PMI-PortIndication* contains a sequence $p_0^{(1)}, p_0^{(2)}, p_1^{(2)}, p_0^{(3)}, p_1^{(3)}, p_2^{(3)}, \ldots, p_0^{(R)}, p_1^{(R)}, \ldots, p_{R-1}^{(R)}$ of port indices, where $p_0^{(\nu)}, \ldots, p_{\nu-1}^{(\nu)}$ are the CSI-RS port indices associated with rank ν and $R \in \{1,2,\ldots,\min(8,P)\}$ where $P \in \{1,2,4,8\}$ is the number of ports in the CSI-RS resource.
- If the UE is not configured with higher layer parameter *non-PMI-PortIndication,* the UE assumes, for each CSI-RS resource in the CSI resource setting linked to the *CSI-ReportConfig,* that the CSI-RS port indices

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$p_0^{(\nu)},...,p_{\nu-1}^{(\nu)}=\{0,...,\nu-1\}$ are associated with ranks $\nu=1,2,...,\min(8,P)$ where $P\in\{1,2,4,8\}$ is the number of ports in the CSI-RS resource.

----------End of TP for 38.214 Section 5.2.1.4.2----------

Agreement

- One DCI 0_1 trigger is not allowed to trigger reports with the same report configuration ID. Multiple CSI reports with the same ID cannot be simultaneously triggered

Up to the RAN1 editor to implement the above agreement

Agreement

----------Start of TP for 38.214 ----------

< Start of the text proposal >

5.2.2.4 Channel State Information – Interference Measurement (CSI-IM)

< Unchanged parts are omitted>

The following parameters are configured via higher layer parameter *CSI-IM-Resource* for each CSI-IM resource configuration:

- *csi-IM-ResourceId* determines CSI-IM resource configuration identity
- *subcarrierLocation-p0* or *subcarrierLocation-p1* defines subcarrier occupancy of the CSI-IM resource within a slot for *csi-IM-ResourceElementPattern* set to 'pattern0' or 'pattern1', respectively.
- *symbolLocation-p0* or *symbolLocation~~subcarrierLocation~~-p1* defines OFDM symbol location of the CSI-IM resource within a slot for *csi-IM-ResourceElementPattern* set to 'pattern0' or 'pattern1', respectively.

< End of the text proposal >

----------End of TP for 38.214 ----------

Agreement

----------Start of TP for 38.214----------

5.2.1.2 Resource settings

~~E~~ach CSI Resource Setting *CSI-ResourceConfig* contains a configuration of S≥1 CSI Resource Sets (given by higher layer parameter *csi-RS-ResourceSetList*), with each CSI Resource Set consisting of CSI-RS resources (comprised of either NZP CSI-RS or CSI-IM*)* ~~and~~ or SS/PBCH Block resources used for L1-RSRP computation. Each CSI Resource Setting is located in the DL BWP identified by the higher layer parameter *bwp-id*, and all CSI Resource Settings linked to a CSI Report Setting have the same DL BWP.

---------- omitted ----------

The UE may assume that the NZP CSI-RS resource(s) for channel measurement and the CSI-IM~~/NZP CSI-RS~~ resource(s) for interference measurement configured for one CSI reporting are resource-wise QCLed with respect to 'QCL-TypeD'. When NZP CSI-RS resource(s) is used for interference measurement, the UE may assume that the NZP CSI-RS resource for channel measurement and the CSI-IM resource and/or NZP CSI-RS resource(s) for interference measurement configured for one CSI reporting are QCLed with respect to 'QCL-TypeD'.

----------End of TP for 38.214 ----------

Agreement

----------Start of TP for 38.214----------

5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS

---------- omitted ----------

If the UE is configured with a single carrier for uplink, the UE is not expected to transmit more than one aperiodic CSI report triggered by different DCIs on overlapping OFDM symbols.

----------End of TP for 38.214 ----------

Agreement

----------Start of TP for 38.214----------

5.2.1 Channel state information framework

The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI) and/or L1-RSRP.

~~F~~or CQI, PMI, CRI, SSBRI, LI, RI, L1-RSRP, a UE is configured by higher layers with N≥1 *CSI-ReportConfig* Reporting Settings, M≥1 *CSI-ResourceConfig* Resource Settings, and one or two list(s) of trigger states (given by the higher layer parameters ~~*aperiodicTriggerStateList*~~ *CSI-AperiodicTriggerStateList* and ~~*semiPersistentOnPUSCH-TriggerStateList*~~ *CSI-SemiPersistentOnPUSCH-TriggerStateList*). Each trigger state in ~~*aperiodicTriggerStateList*~~ *CSI-AperiodicTriggerStateList* contains a list of associated *CSI-ReportConfigs* indicating the Resource Set IDs for channel and optionally for interference. Each

trigger state in ~~*semiPersistentOnPUSCH-TriggerStateList*~~ *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig*.

----------End of TP for 38.214 ----------

R1-1809828 Summary of views on CSI reporting v4 Ericsson

Agreement

----------Start of TP for 38.214 section 5.2.1.4.1----------

For semi-persistent or periodic CSI, each *CSI-ReportConfig* is linked to periodic or semi-persistent Resource Setting(s):

- When one Resource Setting (given by higher layer parameter *resourcesForChannelMeasurement*) is configured, the Resource Setting is for channel measurement for L1-RSRP computation.
- When two Resource Settings are configured, the first Resource Setting (given by higher layer parameter *resourcesForChannelMeasurement*) is for channel measurement and the second Resource Setting (given by higher layer parameter *csi-IM-ResourcesForInterference*) is used for interference measurement performed on CSI-IM.

A UE is not expected to be configured with more than 1 CSI-RS resource in resource set for channel measurements for a *CSI-ReportConfig* with the higher layer parameter *codebookType* set to 'typeII' or to 'typeII-PortSelection'.

If interference measurement is performed on CSI-IM, each CSI-RS resource for channel measurement is resource-wise associated with a CSI-IM resource by the ordering of the CSI-RS resource and CSI-IM resource in the corresponding resource sets. The number of CSI-RS resources for channel measurement equals to the number of CSI-IM resources.

----------End of TP for 38.214 section 5.2.1.4.1----------

Agreement

Capture the following text proposal to section 5.2.1.5.1 of TS 38.214.

----------Start of TP ----------

For CSI-RS resource sets associated with Resource Settings configured with the higher layer parameter *resourceType* set to 'aperiodic', periodic', or semi-persistent', trigger states for Reporting Setting(s) (configured with the higher layer parameter *reportConfigType* set to 'aperiodic') and/or Resource Setting for channel and/or interference measurement on one or more component carriers are configured using the higher layer parameter *CSI-AperiodicTriggerStateList*. For aperiodic CSI report triggering, a single set of CSI triggering states are higher layer configured, wherein the CSI triggering states can be associated with any candidate DL BWP. A UE is not expected to receive more than one DCI with non-zero CSI request per slot. A UE is not expected to receive more than one aperiodic CSI report request for transmission in a given slot. A UE is not expected to be triggered with a CSI report for a non-active DL BWP. A trigger state is initiated using the *CSI request* field in DCI.

----------End of TP ----------

Agreement

----------Start of TP for 38.214----------

5.2.1.5.2 Semi-persistent CSI/Semi-persistent CSI-RS

For semi-persistent reporting on PUSCH, a set of ~~semi-persistent Reporting settings~~trigger states are higher layer configured by *CSI-SemiPersistentOnPUSCH-TriggerStateList,* where the CSI request field in DCI scrambled with SP-CSI-RNTI activates one of the ~~semi-persistent CSI reports~~trigger states.

~~and t~~For semi-persistent reporting on PUCCH, ~~T~~the PUCCH resource used for transmitting the CSI report are configured by *reportConfigType*.

Semi-persistent reporting on PUCCH is activated by an activation command [10, TS 38.321], which selects one of the semi-persistent Reporting Settings for use by the UE on the PUCCH. When the HARQ-ACK corresponding to the PDSCH carrying the activation command is transmitted in slot n, the indicated semi-persistent Reporting Setting should be applied starting from slot $n+3N_{slot}^{subframe,\mu}+1$. ~~If the field *reportConfigType* is not present, the UE shall report the CSI on PUSCH.~~

For a UE configured with CSI resource setting(s) where the higher layer parameter ~~*reportConfigType*~~ *resourceType* set to ~~'semiPersistentOnPUCCH'~~'semiPersistent' .

- when a UE receives an activation command [10, TS 38.321] for CSI-RS resource set(s) for channel measurement and CSI-IM/NZP CSI-RS resource set(s) for interference measurement associated with configured CSI resource setting(s), and when the HARQ-ACK corresponding to the PDSCH carrying the selection command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions (including QCL assumptions provided by a list of reference to *TCI-State's,* one per activated resource) on CSI-RS/CSI-IM transmission corresponding to the configured CSI-RS/CSI-IM resource configuration(s) shall be applied starting from slot $n+3N_{slot}^{subframe,\mu}+1$ If a *TCI-State* referred to in

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the list is configured with a reference to an RS associated with 'QCL-TypeD', that RS can be an SS/PBCH block, periodic or semi-persistent CSI-RS located in same or different CC/DL BWP.

- when a UE receives a deactivation command [10, TS 38.321] for activated CSI-RS/CSI-IM resource set(s) associated with configured CSI resource setting(s), and when the HARQ-ACK corresponding to the PDSCH carrying the selection command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and UE assumption on cessation of CSI-RS/CSI-IM transmission corresponding to the deactivated CSI-RS/CSI-IM resource set(s) shall apply starting from slot $n+3N_{slot}^{subframe,\mu}+1$ ~~If a *TCI State* referred to in the list is configured with a reference to an RS associated with 'QCL-TypeD', that RS can be an SS/PBCH block, periodic or semi-persistent CSI-RS located in same or different CC/DL BWP.~~

---------- omitted ----------

A UE validates, for semi-persistent CSI activation or release, a DL semi-persistent assignment PDCCH on a DCI only if the following conditions are met:

- the CRC parity bits of the DCI format are scrambled with a SP-CSI-RNTI provided by higher layer parameter *sp-csi-RNTI*
- ~~All~~ Special fields for the DCI format are set according to Table 5.2.1.5.2-1 or Table 5.2.1.5.2-2.

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of semi-persistent CSI transmission on PUSCH. If validation is not achieved, the UE considers the DCI format as having been detected with a non-matching CRC.

---------- omitted ----------

~~I~~f the UE has an active semi-persistent CSI-RS/CSI-IM resource configuration, or an active semi-persistent ZP CSI-RS resource set configuration, and has not received a deactivation command, the activated semi-persistent CSI-RS/CSI-IM resource ~~configuration~~ set or the activated semi-persistent ZP CSI-RS resource set configurations are considered to be active ~~in~~ when the corresponding DL BWP ~~which~~ is active ~~when the resource sets are activated~~, otherwise they are considered suspended.

If the UE is configured with carrier deactivation, the following ~~resources~~ configurations~~ed~~ in the carrier in activated state would also be deactivated and need re-activation configuration(s): semi-persistent CSI-RS/CSI-IM ~~RS~~ resource, semi-persistent CSI reporting on PUCCH, semi-persistent SRS, semi-persistent ZP CSI-RS resource set.

----------End of TP for 38.214----------

Agreement

- Refine the CPU occupation for A-CSI report based on P/SP CSI-RS as starting from the first symbol after the PDCCH triggering the report until the last symbol of the PUSCH carrying the report.

Conclusion

RAN1 editors to check and if necessary implement the following into the specification:

- Reports are assigned to CPUs on the symbol where CPU occupancy starts

Agreement

- Capture the following text proposal to section 5.2.1.6 of TS 38.214

----------Start of TP ----------

The UE indicates the number of supported simultaneous CSI calculations N_{CPU}. If a UE supports N_{CPU} simultaneous CSI calculations it is said to have N_{CPU} CSI processing units for processing CSI reports across all configured cells. If L CPUs are occupied for calculation of CSI reports in a given OFDM symbol, the UE has $N_{CPU}-L$ unoccupied CPUs. If a UE receives an aperiodic CSI request for N CSI reports, where each CSI report $n=0,\ldots,N-1$ ~~has $K_S^{(n)}$ CSI-RS resources in the CSI-RS resource set for channel measurement~~ corresponds to $O_{CPU}^{(n)}$ the UE is not required to update the $N-M$ requested CSI reports with lowest priority (according to Subclause 5.2.5), where $0 \le M \le N$ is the largest value such that $\sum_{n=0}^{M} ~~K_S^{(n)}~~ O_{CPU}^{(n)} \le N_{CPU}-L$ holds.

The UE is not required to update a periodic or semi-persistent CSI report if $N_{CPU}-L ~~\le K_S~~ < O_{CPU}$ on the earliest one of the first symbol of the latest CSI-RS/CSI-RS resource earlier than the corresponding CSI reference resource of the CSI report. Processing of a CSI report occupies a number of CPUs for a number of symbols as follows:

- $O_{CPU}=0$ for a CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'none' and *CSI-RS-ResourceSet* with high layer parameter *trs-Info* configured.

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- $O_{CPU} = 1$ for a~~A~~ CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'cri-RSRP', 'ssb-Index-RSRP', or 'none' (and *CSI-RS-ResourceSet* with high layer parameter *trs-Info* not configured) ~~occupies one CPU~~.
- $O_{CPU} = K_S$ for a~~A~~ CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'cri-RI-PMI-CQI', 'cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI', or 'cri-RI-LI-PMI-CQI', ~~'cri-RSRP' or 'none' occupies~~ K_S ~~CPUs~~, where K_S the number of CSI-RS resources in the CSI-.RS resource set for channel measurement.
- $O_{CPU} = N_{CPU}$ for a~~A~~ CSI report aperiodically triggered without transmitting a PUSCH with either transport block or HARQ-ACK or both when $L = 0$ CPUs are occupied, where the CSI corresponds to a single CSI with wideband frequency-granularity and to at most 4 CSI-RS ports in a single resource without CRI report and where *codebookType* is set to 'TypeI-SinglePanel' or where *reportQuantity* is set to 'cri-RI-CQI'~~, occupies~~ N_{CPU} ~~CPUs~~.

The CPU(s) are occupied for a number of OFDM symbols as follows:

- A periodic or semi-persistent CSI report used with periodic or semi-persistent CSI-RS occupies CPU(s) from the first symbol of the earliest one of ~~the for~~ each CSI-RS/CSI-IM resource for channel or interference measurement, respective latest CSI-RS/CSI-IM occasion no later than the corresponding CSI reference resource, if applicable, until the last symbol of the PUSCH/PUCCH carrying the report.
- An aperiodic CSI report used with periodic or semi-persistent CSI-RS occupies CPU(s) from the first symbol of the earliest one of each CSI-RS/CSI-IM resource for channel or interference measurement respective latest CSI-RS/CSI-IM occasions no later than the corresponding CSI reference resource until the last symbol of the PUSCH carrying the report.
- -- An aperiodic CSI report used with aperiodic CSI-RS occupies a CPU from the first symbol after the PDCCH triggering the CSI report until the last symbol of the PUSCH carrying the report.

----------End of TP ----------

Agreement

----------Start of TP to Section 5.2.2.1.1 of 38.214----------

The CSI reference resource for a serving cell is defined as follows:

- In the frequency domain, the CSI reference resource is defined by the group of downlink physical resource blocks corresponding to the band to which the derived CQI value relates.
- In the time domain, ~~for a UE configured with a single CSI resource set for the serving cell~~, the CSI reference resource for a CSI reporting in uplink slot n' is defined by a single downlink slot n-n_{CQI_ref},
  - where $n = \left\lfloor n' \cdot \frac{2^{\mu_{DL}}}{2^{\mu_{UL}}} \right\rfloor$ and μ_{DL} and μ_{UL} are the subcarrier spacing configurations for DL and UL, respectively
  - where for periodic and semi-persistent CSI reporting
    - if a single CSI-RS resource is configured for channel measurement n_{CQI_ref} is the smallest value greater than or equal to $4 \cdot 2^{\min(\mu_{DL},\mu_{UL})} 2^{\mu_{DL}}$, such that it corresponds to a valid downlink slot, or
    - if multiple CSI-RS resources are configured for channel measurement n_{CQI_ref} is the smallest value greater than or equal to $5 \cdot 2^{\min(\mu_{DL},\mu_{UL})} 2^{\mu_{DL}}$, such that it corresponds to a valid downlink slot.
  - where for aperiodic CSI reporting, if the UE is indicated by the DCI to report CSI in the same slot as the CSI request, n_{CQI_ref} is such that the reference resource is in the same valid downlink slot as the corresponding CSI request, otherwise n_{CQI_ref} is the smallest value greater than or equal to $\lfloor Z' / N_{symb}^{slot} \rfloor$, such that slot n-n_{CQI_ref} corresponds to a valid downlink slot, where Z' corresponds to the delay requirement as defined in Subclause 5.4.
  - when periodic or semi-persistent CSI-RS/CSI-IM is used for channel/interference measurements, the UE is not expected to measure channel/interference on the CSI-RS/CSI-IM whose last OFDM symbol is received up to Z' symbols before transmission time of the first OFDM symbol of the aperiodic CSI reporting.

----------End of TP to Section 5.2.2.1.1 of 38.214----------

Agreement

----------Start of TP to Section 5.2.2.2 of 38.214----------

5.2.2.2.1 Type I Single-Panel Codebook

< Unchanged part omitted >

For UE configured with higher layer parameter *codebookType* set to 'typeI-SinglePanel', t~~T~~he bitmap parameter *typeI-SinglePanel-ri-Restriction* forms the bit sequence $r_7,...,r_1,r_0$ where r_0 is the LSB and r_7 is the MSB. When r_i is zero, $i \in \{0,1,\ldots,7\}$, PMI and RI reporting are not allowed to correspond to any precoder associated with $\upsilon = i+1$ layers.

< Unchanged part omitted >

5.2.2.2.4 Type II Port Selection Codebook

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For 4 antenna ports {3000, 3001, …, 3003}, 8 antenna ports {3000, 3001, …, 3007}, 12 antenna ports {3000, 3001, …, ~~3007~~3011}, 16 antenna ports {3000, 3001, …, 3015}, 24 antenna ports {3000, 3001, …, 3023}, and 32 antenna ports {3000, 3001, …, 3031}, and the UE configured with higher layer parameter *codebookType* set to 'typeII-PortSelection'

----------End of TP to Section 5.2.2.2 of 38.214----------

Agreement

Adopt the text proposal for TS38.214 section 5.2.3(CSI reporting using PUSCH) which is provided in R1-1809828 section 2.7.3 (page 19~20).

Agreement

----------Start of TP ----------

5.2.4 CSI reporting using PUCCH

< Unchanged parts are omitted >

A UE is not expected to report CSI with a payload size larger than 115 bits when configured with PUCCH format 4.

For CSI reports transmitted on a PUCCH, if all CSI reports consist of one part, the UE may omit a portion of CSI reports. Omission of CSI is according to the priority order determined from the $\text{Pri}_{i,CSI}(y,k,c,s)$ value as defined in Subclause 5.2.5. CSI report is omitted beginning with the lowest priority level until the CSI report code rate is less or equal to r configured by higher layer parameter *maxCodeRate*.

If any of the CSI report consist of two parts, the UE may omit a portion of Part 2 CSI is omitted. Omission of Part 2 CSI is according to the priority order shown in Table 5.2.3-1. Part 2 CSI is omitted beginning with the lowest priority level until the Part 2 CSI code rate is less or equal to r configured by higher layer parameter *maxCodeRate*.

----------End of TP ----------

Agreement

----------Start of TP for 38.214----------

5.2.4 CSI reporting using PUCCH

A UE is semi-statically configured by higher layers to perform periodic CSI Reporting on the PUCCH. A UE can be configured by higher layers for multiple periodic CSI Reports corresponding to ~~one or more~~multiple higher layer configured CSI Reporting Setting~~s Indications~~, where the associated ~~CSI Measurement Links and~~ CSI Resource Settings are higher layer configured. Periodic CSI reporting on PUCCH formats 2, 3, 4 supports Type I CSI with wideband granularity.

A UE shall perform semi-persistent CSI reporting on the PUCCH applied starting from slot $n+3N_{slot}^{subframe,\mu}+1$ after the HARQ-ACK corresponding to the PDSCH carrying the selection command [10, TS 38.321] is transmitted in slot n. The selection command will contain one or more Reporting Settings ~~Indications~~ where the associated ~~CSI Measurement Links and~~ CSI Resource Settings are configured. Semi-persistent CSI reporting on the PUCCH supports Type I CSI. Semi-persistent CSI reporting on the PUCCH format 2 supports Type I CSI with wideband frequency granularity. Semi-persistent CSI reporting on PUCCH formats 3 or 4 supports Type I CSI with wideband and ~~S~~sub-band frequency granularities ~~CSI~~ and Type II CSI Part 1 ~~with wideband frequency granularity~~.

----------End of TP ----------

Agreement

Text proposal for TS38.214

----------Start of TP ----------

5.2.5 Priority rules for CSI reports

< Unchanged parts are omitted >

A first CSI report is said to have priority over second CSI report if the associated $\text{Pri}_{iCSI}(y,k,c,s)$ value is lower for the first report than for the second report.

Two CSI reports are said to collide if the time occupancy of the physical channels scheduled to carry the CSI reports overlap in at least one OFDM symbol and are transmitted on the same carrier. When a UE is configured to transmit two colliding CSI reports,

if y values are different between the two CSI reports, the following rules apply (for CSI reports transmitted on PUSCH, as described in Subclause 5.2.3; for CSI reports transmitted on PUCCH, as described in Subclause 5.2.4):

- The CSI report with higher $\text{Pri}_{iCSI}(y,k,c,s)$ value shall not be sent by the UE,

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otherwise, the two CSI reports are multiplexed or either is dropped based on the priority values, as described in Subclause 9.2.5.2 in 38.213.

If a semi-persistent CSI report to be carried on PUSCH collides with PUSCH data transmission, when the starting symbols between the two channels are aligned, the CSI report shall not be transmitted by the UE.

----------End of TP ----------

Agreement

- The values of (Z_1, Z_1') for CSI timing requirement 1 for 15kHz SCS is $(Z_1, Z_1') = (10, 8)$ symbols
  - Note: Huawei can accept this solution as a compromise for the purpose of progress

Agreement

----------Start of TP Section 5.4 of 38.214----------

When the *CSI request* field on a DCI triggers a CSI report(s) on PUSCH, the UE shall provide valid CSI report(s),

- if the first uplink symbol to carry the corresponding CSI report(s) including the effect of the timing advance, starts no earlier than at symbol Z_{ref}, and
- if the first uplink symbol to carry the corresponding CSI report(s) including the effect of the timing advance, starts no earlier than at symbol Z'_{ref},

where Z_{ref} is defined as the next uplink symbol with its CP starting ~~after~~ $\left((Z+d)(2048+144)\cdot\kappa 2^{-\mu}\right)\cdot T_C$ after the end of the last symbol of the PDCCH triggering the CSI report, and where Z'_{ref} is defined as the next uplink symbol with its CP starting ~~after~~ $\left((Z'+d)\cdot(2048+144)\cdot\kappa 2^{-\mu}\right)\cdot T_C$ after the end of the last symbol in time of the latest of: ~~the last symbol of~~ aperiodic CSI-RS resource for channel measurements, ~~the last symbol of~~ aperiodic CSI-IM used for interference measurements, and ~~the last symbol of~~ aperiodic NZP CSI-RS for interference measurement, when aperiodic CSI-RS is used for channel measurement for triggered CSI report *n*,

When the *CSI request* field on a DCI triggers a CSI report(s) on PUSCH, if the first uplink symbol to carry the corresponding CSI report(s) including the effect of the timing advance, starts ~~no~~ earlier than at symbol Z_{ref},

- the UE may ignore the scheduling DCI if no HARQ-ACK or transport block is multiplexed on the PUSCH, or
- the UE drops the CSI for the triggered CSI reports if either HARQ-ACK or transport block is multiplexed on the PUSCH,

When the *CSI request* field on a DCI triggers a CSI report(s) on PUSCH, if the first uplink symbol to carry the corresponding CSI report including the effect of the timing advance, starts ~~no~~ earlier than at symbol Z'_{ref} for report *n*,

- the UE may ignore the scheduling DCI if the number of triggered reports is one and no HARQ-ACK or transport block is multiplexed on the PUSCH
- Otherwise, the UE is not required to update the CSI for the triggered CSI report *n*.

Z and Z' are defined as:

$Z = \max_{m=0,\ldots,M-1}\left(Z(m)\right)$ and $Z' = \max_{m=0,\ldots,M-1}\left(Z'(m)\right)$, where M is the number of updated CSI report(s) according to Subclause 5.2.1.6, $(Z(m), Z'(m))$ corresponds to the *m*-th ~~requested~~ updated CSI report and is defined as

- (Z_1, Z_1') of the table 5.4-1 if the CSI is triggered without a PUSCH with either transport block or HARQ-ACK or both when $L = 0$ CPUs are occupied (according to Subclause 5.2.1.6) and the CSI to be transmitted is a single CSI and corresponds to wideband frequency-granularity where the CSI corresponds to at most 4 CSI-RS ports in a single resource without CRI report and where *CodebookType* is set to 'TypeI-SinglePanel' or where *reportQuantity* is set to 'cri-RI-CQI', or
- (Z_1, Z_1') of the table 5.4-2 if ~~the CSI is triggered without a PUSCH with either a transport block or HARQ-ACK or both and~~ the CSI to be transmitted corresponds to wideband frequency-granularity where the CSI corresponds to at most 4 CSI-RS ports in a single resource without CRI report and where *CodebookType* is set to 'TypeI-SinglePanel' or where *reportQuantity* is set to 'cri-RI-CQI', or
- If *reportQuantity* is set to 'cri-RSRP' or 'ssb-Index-RSRP', Z'_m is according to UE reported capability and Z_m is FFS, or
- (Z_2, Z_2') of table 5.4-2 otherwise.
- μ of table 5.4-1 and table 5.4-2 corresponds to the min (μ_{PDCCH}, $\mu_{CSI\text{-}RS}$, μ_{UL}) where the μ_{PDCCH} corresponds to the subcarrier spacing of the PDCCH with which the DCI was transmitted and μ_{UL} corresponds to the subcarrier spacing of the PUSCH with which the CSI report is to be transmitted and $\mu_{CSI\text{-}RS}$ corresponds to the minimum subcarrier spacing of the aperiodic CSI-RS triggered by the DCI
- $d = 0$ if the CSI is not multiplexed with a PUSCH with either a transport block or HARQ-ACK of both. If CSI is multiplexed with a PUSCH with either a transport block or HARQ-ACK of both, $d = 2$ for $\mu = 0,1$, $d = 3$ for $\mu = 2$ and $d = 4$ for $\mu = 3$

1. **Table 5.4-1: CSI computation delay requirement 1**

μ	Z_1 [symbols]	
	Z_1	Z'_1
0	[9 or 10]	[7 or 8]
1	13	11
2	25	21
3	43	36

2. **Table 5.4-2: CSI computation delay requirement 2**

μ	Z_1 [symbols]		Z_2 [symbols]	
	Z_1	Z'_1	Z_2	Z'_2
0	22	16	40	37
1	33	30	72	69
2	44	42	141	140
3	97	85	152	140

----------End of TP Section 5.4 of 38.214----------

Agreement

Text proposal for TS38.214

----------Start of TP ----------

6.1.2.1 Resource allocation in time domain

< Unchanged parts are omitted>

When the UE is scheduled to transmit a transport block and no CSI report, or the UE is scheduled to transmit a transport block and a CSI report(s) on PUSCH by a DCI, the *Time domain resource assignment* field value m of the DCI provides a row index $m+1$ to an allocated table. The determination of the used resource allocation table is defined in sub-clause 6.1.2.1.1. The indexed row defines the slot offset K_2, the start and length indicator *SLIV*, or directly the start symbol S and the allocation length L, and the PUSCH mapping type to be applied in the PUSCH transmission.

~~W~~When the UE is scheduled to transmit a PUSCH with no transport block and with a CSI report(s) by a *CSI request* field on a DCI, the *Time-domain resource assignment* field value m of the DCI provides a row index $m+1$ to an allocated table which ~~. The determination of the applied resource allocation table~~ is defined by the higher layer configured *pusch-TimeDomainResourceAllocationList* in *pusch-Config*~~in sub-clause 6.1.2.1.1~~. The indexed row defines the start and length indicator SLIV,~~ or directly the start symbol S and the allocation length L,~~ and the PUSCH mapping type to be applied in the PUSCH transmission and the K_2 value is determined as $K_2 = \max_j Y_j(m+1)$, where $Y_j, j = 0,\ldots,N_{Rep}-1$ are ~~based on~~ the corresponding list entries ~~$Y_j, j = 0,\ldots,N_{Rep}-1$~~ of the higher layer parameter ~~*reportSlotConfig*~~*reportSlotOffsetList* in *CSI-ReportConfig* for the N_{Rep} triggered CSI Reporting Settings and~~. The ith codepoint of K_2 is determined as~~ $K_2 = \max_j Y_j$ ~~where~~ $Y_j(m+1)$ is the ~~$(m+1)$-~~th entry ~~codepoint~~ of Y_j.

----------End of TP ----------

Agreement

----------Start of TP Section 6.3.1.1.2 of 38.212----------

6.3.1.1.2 CSI only

< Unchanged part omitted >

Table 6.3.1.1.2-7: Mapping order of CSI fields of one CSI report, *pmi-FormatIndicator=widebandPMI* and *cqi-FormatIndicator=widebandCQI*

CSI report number	CSI fields
CSI report #n	CRI as in Tables 6.3.1.1.2-3/4, if reported
	Rank Indicator as in Tables 6.3.1.1.2-3/4, if reported
	Layer Indicator as in Tables 6.3.1.1.2-3/4, if reported
	Zero padding bits O_p, if needed
	PMI wideband information fields X_1, from left to right as in Tables 6.3.1.1.2-1/2, if reported

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	PMI wideband information fields X_2, from left to right as in Tables 6.3.1.1.2-1/2 or codebook index for 2 antenna ports according to Subclause 5.2.2.2.1 in [6, TS 38.214], if reported
	Wideband CQI as in Tables 6.3.1.1.2-3/4/5, if reported

< Unchanged part omitted >

Table 6.3.1.1.2-10: Mapping order of CSI fields of one CSI report, CSI part 2 wideband, *pmi-FormatIndicator= subbandPMI* or *cqi-FormatIndicator=subbandCQI*

CSI report number	CSI fields
CSI report #n CSI part 2 wideband	Wideband CQI for the second TB as in Tables 6.3.1.1.2-3/4/5, if present and reported
	Layer Indicator as in Tables 6.3.1.1.2-3/4/5, if reported
	PMI wideband information fields X_1, from left to right as in Tables 6.3.1.1.2-1/2, if reported
	PMI wideband information fields X_2, from left to right as in Tables 6.3.1.1.2-1/2 or codebook index for 2 antenna ports according to Subclause 5.2.2.2.1 in [6, TS 38.214], if *pmi-FormatIndicator= widebandPMI* and if reported

Table 6.3.1.1.2-11: Mapping order of CSI fields of one CSI report, CSI part 2 subband, *pmi-FormatIndicator= subbandPMI* or *cqi-FormatIndicator=subbandCQI*

CSI report #n Part 2 subband	Subband differential CQI for the second TB of all even subbands with increasing order of subband number, as in Tables 6.3.1.1.2-3/4/5, if *cqi-FormatIndicator=subbandCQI* and if reported
	PMI subband information fields X_2 of all even subbands with increasing order of subband number, from left to right as in Tables 6.3.1.1.2-1/2 or codebook index for 2 antenna ports according to Subclause 5.2.2.2.1 in [6, TS 38.214] of all even subbands with increasing order of subband number, if *pmi-FormatIndicator= subbandPMI* and if reported
	Subband differential CQI for the second TB of all odd subbands with increasing order of subband number, as in Tables 6.3.1.1.2-3/4/5, if *cqi-FormatIndicator=subbandCQI* and if reported
	PMI subband information fields X_2 of all odd subbands with increasing order of subband number, from left to right as in Tables 6.3.1.1.2-1/2 or codebook index for 2 antenna ports according to Subclause 5.2.2.2.1 in [6, TS 38.214] of all odd subbands with increasing order of subband number, if *pmi-FormatIndicator= subbandPMI* and if reported

----------End of TP Section 6.3.1.1.2 of 38.212----------

----------Start of TP Section 6.3.2.1.2 of 38.212----------

6.3.2.1.2 CSI

< Unchanged part omitted >

Table 6.3.2.1.2-4: Mapping order of CSI fields of one CSI report, CSI part 2 wideband

CSI report number	CSI fields
CSI report #n CSI part 2 wideband	Wideband CQI for the second TB as in Tables 6.3.1.1.2-3/4/5, if present and reported
	Layer Indicator as in Tables 6.3.1.1.2-3/4/5, if reported
	PMI wideband information fields X_1, from left to right as in Tables 6.3.1.1.2-1/2 or 6.3.2.1.2-1/2, if reported
	PMI wideband information fields X_2, from left to right as in Tables 6.3.1.1.2-1/2 or 6.3.2.1.2-1/2 or codebook index for 2 antenna ports according to Subclause 5.2.2.2.1 in [6, TS 38.214], if *pmi-FormatIndicator= widebandPMI* and if reported

Table 6.3.2.1.2-5: Mapping order of CSI fields of one CSI report, CSI part 2 subband

CSI report #n Part 2 subband	Subband differential CQI for the second TB of all even subbands with increasing order of subband number, as in Tables 6.3.1.1.2-3/4/5, if *cqi-FormatIndicator=subbandCQI* and if reported

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	PMI subband information fields X_2 of all even subbands with increasing order of subband number, from left to right as in Tables 6.3.1.1.2-1/2 or 6.3.2.1.2-1/2 or codebook index for 2 antenna ports according to Subclause 5.2.2.2.1 in [6, TS 38.214] of all even subbands with increasing order of subband number, if *pmi-FormatIndicator= subbandPMI* and if reported
	Subband differential CQI for the second TB of all odd subbands with increasing order of subband number, as in Tables 6.3.1.1.2-3/4/5, if *cqi-FormatIndicator=subbandCQI* and if reported
	PMI subband information fields X_2 of all odd subbands with increasing order of subband number, from left to right as in Tables 6.3.1.1.2-1/2 or 6.3.2.1.2-1/2 or codebook index for 2 antenna ports according to Subclause 5.2.2.2.1 in [6, TS 38.214] of all odd subbands with increasing order of subband number, if *pmi-FormatIndicator= subbandPMI* and if reported

----------End of TP Section 6.3.2.1.2 of 38.212----------

Agreement

----------Start of TP for 38.212----------

Section 6.3.2.1.2

[Unchanged text are omitted]

The bitwidth for PMI of *codebookType=typeII* is provided in Tables 6.3.2.1.2-1, where the values of (N_1,N_2), (O_1,O_2), L, N_{PSK}, M_1, M_2, and $K^{(2)}$ are given by Subclause 5.2.2.2.3 in [6, TS 38.214].

Table 6.3.2.1.2-1: PMI of *codebookType= typeII*

	Information fields X_1 for wideband PMI						Information fields X_2 per subband PMI			
	$i_{1,1}$	$i_{1,2}$	$i_{1,3,1}$	$i_{1,4,1}$	$i_{1,3,2}$	$i_{1,4,2}$	$i_{2,1,1}$	$i_{2,1,2}$	$i_{2,2,1}$	$i_{2,2,2}$
Rank=1 SBAmp	$\lceil \log_2(O_1O_2) \rceil$	$\left\lceil \log_2\binom{N_1N_2}{L} \right\rceil$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	N/A	N/A	$(M_1-1)\cdot \log_2 N_{PSK}$	N/A	N/A	N/A
Rank=2 SBAmp	$\lceil \log_2(O_1O_2) \rceil$	$\left\lceil \log_2\binom{N_1N_2}{L} \right\rceil$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	$(M_1-1)\cdot \log_2 N_{PSK}$	$(M_2-1)\cdot \log_2 N_{PSK}$	N/A	N/A
Rank=1 SBAmp	$\lceil \log_2(O_1O_2) \rceil$	$\left\lceil \log_2\binom{N_1N_2}{L} \right\rceil$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	N/A	N/A	$\min(M_1,K^{(2)})\cdot \log_2 N_{PSK} - \log_2 N_{PSK} + 2\cdot(M_1-\min(M_1,K^{(2)}))$	N/A	$\min(M_1,K^{(2)})-1$	N/A
Rank=2 SBAmp	$\lceil \log_2(O_1O_2) \rceil$	$\left\lceil \log_2\binom{N_1N_2}{L} \right\rceil$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	$\min(M_1,K^{(2)})\cdot \log_2 N_{PSK} - \log_2 N_{PSK} + 2\cdot(M_1-\min(M_1,K^{(2)}))$	$\min(M_2,K^{(2)})\cdot \log_2 N_{PSK} - \log_2 N_{PSK} + 2\cdot(M_2-\min(M_2,K^{(2)}))$	$\min(M_1,K^{(2)})-1$	$\min(M_2,K^{(2)})-1$

The bitwidth for PMI of *codebookType= typeII-PortSelection* is provided in Tables 6.3.2.1.2-2, where the values of P_{CSI-RS}, d, L, N_{PSK}, M_1, M_2, and $K^{(2)}$ are given by Subclause 5.2.2.2.4 in [6, TS 38.214].

Table 6.3.2.1.2-2: PMI of *codebookType= typeII-PortSelection*

	Information fields X_1 for wideband PMI					Information fields X_2 per subband PMI			
	$i_{1,1}$	$i_{1,3,1}$	$i_{1,4,1}$	$i_{1,3,2}$	$i_{1,4,2}$	$i_{2,1,1}$	$i_{2,1,2}$	$i_{2,2,1}$	$i_{2,2,2}$
Rank=1 SBAmp	$\left\lfloor \log_2\left\lfloor \frac{P_{CSI-RS}}{2d} \right\rfloor \right\rfloor$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	N/A	N/A	$(M_1-1)\cdot \log_2 N_{PSK}$	N/A	N/A	N/A
Rank=2 SBAmp	$\left\lfloor \log_2\left\lfloor \frac{P_{CSI-RS}}{2d} \right\rfloor \right\rfloor$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	$(M_1-1)\cdot \log_2 N_{PSK}$	$(M_2-1)\cdot \log_2 N_{PSK}$	N/A	N/A

Rank=1 SBAmp	$\left\lceil \log_2 \left\lceil \frac{P_{CSI-RS}}{2d} \right\rceil \right\rceil$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	N/A	N/A	$\min(M_1, K^{(2)}) \cdot \log_2 N_{PSK} - \log_2 N_{PSK} + 2 \cdot (M_1 - \min(M_1, K^{(2)}))$	N/A	$\min(M_1, K^{(2)}) - 1$	N/A
Rank=2 SBAmp	$\left\lceil \log_2 \left\lceil \frac{P_{CSI-RS}}{2d} \right\rceil \right\rceil$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	$\lceil \log_2(2L) \rceil$	$3(2L-1)$	$\min(M_1, K^{(2)}) \cdot \log_2 N_{PSK} - \log_2 N_{PSK} + 2 \cdot (M_1 - \min(M_1, K^{(2)}))$	$\min(M_2, K^{(2)}) \cdot \log_2 N_{PSK} - \log_2 N_{PSK} + 2 \cdot (M_2 - \min(M_2, K^{(2)}))$	$\min(M_1, K^{(2)}) - 1$	$\min(M_2, K^{(2)}) - 1$

----------End of TP for 38.212----------

Agreement

----------Start of TP for 38.212----------

6.3.2.1.2 CSI

The bitwidth for PMI of *codebookType=typeI-SinglePanel* and *codebookType=typeI-MultiPanel* is specified in Subclause 6.3.2.1.1.

The bitwidth for RI/LI/CQI/CRI of *codebookType=typeI-SinglePanel* and *codebookType=typeI-MultiPanel* is specified in Subclause 6.3.2.1.1.

The bitwidth for PMI of *codebookType=typeII* is provided in Tables 6.3.2.1.2-1, where the values of (N_1, N_2), (O_1, O_2), L, N_{PSK}, M_1, M_2, and $K^{(2)}$ are given by Subclause 5.2.2.2.3 in [6, TS 38.214].

----------End of TP for 38.212----------

R1-1809741 **Summary of CQI/MCS AT&T**

R1-1809868 **Offline summary on CSI measurement ZTE**

Conclusion

From RAN1 point of view, the following is assumed

- To determine MAC-CE activation time, the end of transmission of ACK for the PDSCH carrying the MAC-CE shall be the end of the last slot of the PUCCH or PUSCH transmission carrying ACK for the transport block(s) associated with the PDSCH.
- In case of CBG-based PDSCH, the ACK for determining MAC-CE activation time refers to the last ACK for all CBGs, regardless which CBGs carry MAC-CE bits.

There is no RAN1 specification impact from the above understanding

Agreement

UE is not expected to be configured with more than 64 NZP CSI-RS resources in a resource setting for channel measurement linked to non-PMI feedback.

- There is no impact to RAN2 specifications

R1-1809912 **Comeback issues for CSI reporting Ericsson**

Agreement

----------Start of TP for 38.214----------

5.2.1.5.2 Semi-persistent CSI/Semi-persistent CSI-RS

For semi-persistent reporting on PUSCH, a set of semi-persistent Reporting settings are higher layer configured by *CSI-SemiPersistentOnPUSCH-TriggerStateList,* the CSI request field in DCI scrambled with SP-CSI-RNTI activates one of the semi-persistent CSI reports and the PUCCH resource used for transmitting the CSI report are configured by *reportConfigType*. A UE is not expected to receive a DCI scrambled with SP-CSI-RNTI activating one semi-persistent CSI report with the same CSI-ReportConfigId as in a semi-persistent CSI report which is activated by a previously received DCI scrambled with SP-CSI-RNTI.

----------End of TP for 38.214----------

Agreement

----------Start of TP for 38.214----------

5.2.1.5.2 Semi-persistent CSI/Semi-persistent CSI-RS

---------- omitted ----------

A codepoint of the CSI request field in the DCI is mapped to a SP-CSI triggering state according to the order of the CSI triggering state ID of the configured trigger states, with codepoint '0' mapped to the triggering state having the smallest triggering state ID. A UE validates, for semi-persistent CSI activation or release, a DL semi-persistent assignment PDCCH on a DCI only if the following conditions are met:

- the CRC parity bits of the DCI format are scrambled with a SP-CSI-RNTI provided by higher layer parameter *sp-csi-RNTI*
- ~~All~~ Special fields for the DCI format are set according to Table 5.2.1.5.2-1 or Table 5.2.1.5.2-2.

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of semi-persistent CSI transmission on PUSCH. If validation is not achieved, the UE considers the DCI format as having been detected with a non-matching CRC.

---------- omitted ----------

----------End of TP for 38.214----------

Agreement

----------Start of TP for 38.212----------

6.3.1.1.2 CSI only

---------- omitted ----------

The bitwidth for RI/LI/CQI/CRI of *codebookType=typeI-SinglePanel* is provided in Tables 6.3.1.1.2-3.

Table 6.3.1.1.2-3: RI, LI, CQI, and CRI of *codebookType=typeI-SinglePanel*

Field	Bitwidth				
	1 antenna port	2 antenna ports	4 antenna ports	>4 antenna ports	
				Rank1~4	Rank5~8
Rank Indicator	0	$\min(1,\lceil \log_2 n_{\text{RI}} \rceil)$	$\min(2,\lceil \log_2 n_{\text{RI}} \rceil)$	$\lceil \log_2 n_{\text{RI}} \rceil$	$\lceil \log_2 n_{\text{RI}} \rceil$
Layer Indicator	0	$\min(2,\lceil \log_2 \text{RI} \rceil)$ $\log_2(\text{RI})$	$\min(2,\lceil \log_2 \text{RI} \rceil)$	$\min(2,\lceil \log_2 \text{RI} \rceil)$	$\min(2,\lceil \log_2 \text{RI} \rceil)$
Wide-band CQI	4	4	4	4	8
Subband differential CQI	2	2	2	2	4
CRI	$\lceil \log_2(K_s^{\text{CSI-RS}}) \rceil$	$\lceil \log_2(K_s^{\text{CSI-RS}}) \rceil$	$\lceil \log_2(K_s^{\text{CSI-RS}}) \rceil$	$\lceil \log_2(K_s^{\text{CSI-RS}}) \rceil$	$\lceil \log_2(K_s^{\text{CSI-RS}}) \rceil$

~~If the higher layer parameter *nrofCQIsPerReport*=1,~~ n_{RI} ~~in Table 6.3.1.1.2-3 is the number of allowed rank indicator values in the 4 LSBs of the higher layer parameter *typeI-SinglePanel-ri-Restriction* according to Subclause 5.2.2.2.1 [6, TS 38.214]; otherwise~~ n_{RI} in Table 6.3.1.1.2-3 is the number of allowed rank indicator values according to Subclause 5.2.2.2.1 [6, TS 38.214]. The value of $K_s^{\text{CSI-RS}}$ is the number of CSI-RS resources in the corresponding resource set.

----------End of TP for 38.212----------

Agreement

Send an LS to RAN2 to convey that *nrofCQIsPerReport* is not necessary from RAN1 perspective

R1-1809955 **[Draft] LS on the number of CQI reports Intel**

Decision: The draft LS is endorsed and final LS is approved in R1-1809993

For the next RAN1 meeting:

- Discuss the following issues in RAN1#94bis:
  - CPU occupancy starting time for L1-RSRP reporting
  - Z timing requirement (from triggering PDCCH to start of PUSCH) for L1-RSRP reporting
  - Solution to avoid transmission of CSI for inactive/suspended BWP without changing the definition of valid downlink slot of the CSI reference resource.

R1-1809422 **Maintenance for CSI acquisition Qualcomm Incorporated**

Further revised in R1-1809501

R1-1808143 Remaining issues on CSI acquisition Huawei, HiSilicon

R1-1808220	Remaining issues on CSI acquisition	vivo
R1-1808263	Remaining issues in CSI acquisition	MediaTek Inc.
R1-1808362	Remaining issues on CSI reporting	NEC
R1-1808374	Issues on CSI acquisition	CATT
R1-1808486	Text proposals on CSI acquisition	LG Electronics
R1-1808550	Maintenance on CSI reporting	Lenovo, Motorola Mobility
R1-1808668	Remaining issues on CSI reporting	Intel Corporation
R1-1808749	Issues on CSI reporting	Samsung
R1-1808800	Remaining issues on CSI acquisition	Spreadtrum Communications
R1-1808885	Text proposals for CSI acquisition/reporting	Guangdong OPPO Mobile Telecom
R1-1809053	Text Proposal on Type 1 Codebook	AT&T
Withdrawn		
R1-1809137	Maintenance for CSI acquisition	NTT DOCOMO, INC.
R1-1809196	Maintenance for CSI acquisition	Ericsson
R1-1809236	Remaining issues on CSI acquisition	Nokia, Nokia Shanghai Bell
R1-1809518	Maintenance for CSI acquisition	ZTE (rev of R1-1808195)

7.1.2.3 Maintenance for beam management

Including measurement, reporting, beam failure recovery, etc.

Please use separate sections for each of the respective sub-topic to facilitate reviews and summary.

R1-1809805 Summary #1 on Remaing issues on Beam Failure Recovery MediaTek

Agreement

Concerning the questions in RAN2 LS (R1-1808166) on BFR

Question 1: After UE sending PRACH for contention-free BFR, does the UE continue monitoring PDCCH candidates in configured search spaces monitored before PRACH, in addition to the search space indicated by recoverySearchSpaceId?

- RAN1 repsonse: Yes, all configured search spaces before dedicated BFR PRACH transmission for BFR are monitored

Question 2: If the answer to Question 1 is "Yes", is the BFR RACH procedure considered successfully completed only if PDCCH is received in search space indicated by recoverySearchSpaceId?

- RAN1 repsonse: Yes, only when a PDCCH transmission addressed to C-RNTI is received on the search space indicated by higher layer parameter *recovoerySearchSpaceId*, i.e., SS-BFR, UE considers a contention-free BFR procedure is successfully terminated

Response LS to RAN2 is approved in R1-1809887

Agreement

Text proposal for TS38.213, section 6: Remove the following text

----------Start of TP ----------

< Unchanged parts are omitted >

~~If the UE is not provided a control resource set for a search space set provided *recoverySearchSpaceId* or if the UE is not provided *recoverySearchSpaceId*, the UE does not expect to receive a PDCCH order triggering a PRACH transmission.~~

< Unchanged parts are omitted >

----------End of TP ----------

Agreement

----------Start of TP TS38.213 Section 6----------

< Unchanged parts are omitted >

The UE expects the set $\bar{q}_0$ to include up to two RS indexes and, if there are two RS indexes in a TCI state, the set $\bar{q}_0$ includes ~~only~~ RS indexes with QCL-TypeD configuration for the corresponding TCI states.

< Unchanged parts are omitted >

----------End of TP TS38.213 Section 6----------

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R1-1809864 **Feature lead summary for beam management – Thursday Ericsson**

Agreement
NW may schedule an ap-CSI-RS with a shorter delay than a threshold, and the UE applies a default QCL assumption
- At least applies for CSI-RS for CSI acquisition
- All CSI-RS symbols in one resource set should be below the threshold or all CSI-RS symbols in one resource set should be above the threshold
- FFS: Default QCL assumption
- FFS: Exact threshold with reference to UE capability

Agreement
When *TCIpresentinDCI* is enabled, the TCI field in DCI in the scheduling CC points to the activated TCI states in the scheduled CC/BWP

Agreement
The indicated TCI should be based on the candidate TCI states in the slot with the scheduled PDSCH
- Applies for single slot PDSCH

Agreement
PUSCH on a cell cannot be scheduled by DCI format 0_0 without configured PUCCH resource on the same cell with spatial relation info in FR2.
- This does not preclude the deactivation DCI for configured grant on a SCell

Agreement
----------Start of TP for 38.214 Section 5.2.1.2----------
Each CSI Resource Setting *CSI-ResourceConfig* contains a configuration of a list of S≥1 CSI Resource Sets (given by higher layer parameter *csi-RS-ResourceSetList*), where the list is comprised of references to either or both of NZP CSI-RS resource set(s) and SS/PBCH block set(s) or the list is comprised of references to CSI-IM resource set(s). ~~with each CSI Resource Set consisting of CSI-RS resources (comprised of either NZP CSI-RS or CSI-IM) and SS/PBCH Block resources used for L1-RSRP computation.~~ Each CSI Resource Setting is located in the DL BWP identified by the higher layer parameter *bwp-Id*, and all CSI Resource Settings linked to a CSI Report Setting have the same DL BWP.
----------End of TP for 38.214 Section 5.2.1.2----------

Agreements
Increase the maximum number of configurable TCI states to 128 per CC
- Requires change to RAN2 specifications
- Support of up to 128 is UE optional

Send an LS to RAN

R1-1809908 **[DRAFT] LS on maximum number of TCI states Ericsson**
Decision: The draft LS is endorsed and final LS is approved in R1-1809888

For RAN1#94bis:
Companies are encouraged to check whether the existing radio resource control element *ControlResourceSet* could be used to configure TCI state for CORESET #0 or not

R1-1809926 **Summary #2 on Remaing issues on Beam Failure Recovery MediaTek**

Agreement
Downselect among the following two alternatives in RAN1#94bis

- Alt 1: K symbols after successfully receiving BFR gNB response, the PUCCH transmissions shall use the same spatial filter as the PRACH transmission until the UE receives an activation or reconfiguration of *PUCCH-Spatialrelationinfo* of at least one of configured PUCCH resources
  - Note: The latency of RRC or MAC CE configuration is included as part of time duration for applying the same spatial filter as the PRACH transmission
  - FFS: value of K
- Alt 4: K symbols after successfully receiving BFR gNB response, the transmissions of PUCCH resources for HARQ ACK/NACK feedback of a corresponding DL PDSCH scheduled from SearchSpace-BFR shall use the same spatial filter as the PRACH transmission until the UE receives a MAC-CE activation or reconfiguration of *PUCCH-Spatialrelationinfo* of at least one of configured PUCCH resources
  - FFS: value of K
  - Note: The latency of RRC or MAC CE configuration is included as part of time duration for applying the same spatial filter as the PRACH transmission

R1-1808145	Remaining issues on beam management and beam failure recovery	Huawei, HiSilicon
R1-1808196	Maintenance for beam management	ZTE
R1-1808221	Remaining issues on beam management	vivo
R1-1808264	Remaining issues for beam management and beam failure recovery	MediaTek Inc.
R1-1808289	Remaining issues on Beam Failure Recovery	China Telecommunications
R1-1808330	Remaining issues on beam management and beam failure recovery	Sony
R1-1808375	Issues on beam management	CATT
R1-1808487	Text proposals on BM and BFR	LG Electronics
R1-1808669	Remaining Issues on Beam Management	Intel Corporation
R1-1808750	Remaining Issues on multi-beam operation	Samsung
R1-1808830	Discussion on remaining issues for beam management	CMCC
R1-1808886	Text proposals for beam management	Guangdong OPPO Mobile Telecom
R1-1809077	Remaining issues on beam management	InterDigital, Inc.
R1-1809106	Remaining issues on beam management	Sharp
R1-1809116	Remaining issues on beam management	MTI
R1-1809138	Remaining issues on beam management	NTT DOCOMO, INC.
R1-1809197	Maintenance for beam management	Ericsson
R1-1809225	Remaining issues on beam management	ASUSTEK COMPUTER (SHANGHAI)
R1-1809237	Remaining issues on beam management	Nokia, Nokia Shanghai Bell
R1-1809711	Maintenance for beam management	Qualcomm Incorporated (rev of R1-1809423)
R1-1809759	Feature lead summary for beam management	Ericsson

7.1.2.4 Maintenance for Reference signals and QCL

Including CSI-RS, DM-RS, PT-RS, SRS, TRS, QCL, multiplexing of different types of RSs, etc.
Please use separate sections for each of the respective sub-topic to facilitate reviews and summary.

R1-1809743 Feature lead summary of remaining issues for RS multiplexing Huawei, HiSilicon

Agreement
Text change for section 5.1.6.1.2 of TS 38.214

----------Start of TP ----------

< Unchanged parts are omitted >

If the UE is configured with the CSI-RS resource in the same OFDM symbol(s) as an SS/PBCH block, the UE may assume that the CSI-RS and the SS/PBCH block are quasi co-located with 'QCL-TypeD' if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to be configured with the CSI-RS in ~~REs~~ PRBs that overlap with those of the SS/PBCH block, and the UE shall expect that the same subcarrier spacing is used for both the CSI-RS and the SS/PBCH block.

< Unchanged parts are omitted >

----------End of TP ----------

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R1-1809749 **Remaining issues on CSI-RS #1 Huawei, HiSi**

Agreement
Text proposal for Section 7.4.1.5.3 in 38.211:
----------Start of TP ----------
The time-domain locations $l_0 \in \{0,1,2,3,...,12,13\}$ and $l_1 \in \{2,3,...,12\}$ are provided by the higher-layer parameters *firstOFDMSymbolInTimeDomain* and *firstOFDMSymbolInTimeDomain2*, respectively, in the *CSI-RS-ResourceMapping* IE and defined relative to the start of a slot.
----------End of TP ----------

Agreement
Text proposal for Section 5.1.4.2 in 38.214:
----------Start of TP ----------
- ~~*ZP-CSI-RS-FreqBand* parameters enabling configuration of frequency occupancy of a ZP-CSI-RS resource within a BWP as defined in Subclause 7.4.1.5 of [4, TS 38.211]. If the configured bandwidth is larger than the corresponding BWP, UE shall assume that the actual CSI-RS bandwidth is equal to the BWP size.~~
----------End of TP ----------
Text proposal for Section 5.1.4.2 in 38.214:
----------Start of TP ----------
- ~~*resourceType* in *ZP-CSI-RS-ResourceSet* defines t~~The ZP-CSI-RS time domain behavior can be configured to ~~of ZP-CSI-RS resource configuration as described in Subclause 7.4.1.5 of [4, TS 38.211]. The *ZP-CSI-RS-ResourceConfigType* can be~~ periodic, semi-persistent or aperiodic by higher parameters within *PDSCH-config*. All the resources in a ZP CSI-RS resource set are configured with the same time domain behavior ~~*ZP-CSI-RS-ResourceConfigType* ~~('periodic', 'semi-persistent', 'aperiodic').
----------End of TP ----------
Text proposal for Section 5.1.4.2 in 38.214:
----------Start of TP ----------
For a UE configured with ~~the higher layer parameter *resourceType* set to 'semiPersistent ',~~ a list of *ZP-CSI-RS-ResourceSet(s)*, provided by higher layer parameter *sp-ZP-CSI-RS-ResourceSetsToAddModList*, is configured
----------End of TP ----------

Agreement
Text proposal for Section 3.2 in 38.211:
----------Start of TP ----------
n_f System frame number; see clause 4.3.1
----------End of TP ----------

Agreement
Text proposal for Section 5.1.6.1.2 in 38.214:
----------Start of TP ----------
If a UE is configured with a *NZP-CSI-RS-ResourceSet* configured with the higher layer parameter *repetition* set to 'on', the UE may assume that the CSI-RS resources, described in Subclause 5.2.2.3.1, within the *NZP-CSI-RS-ResourceSet* are transmitted with the same downlink spatial domain transmission filter, where the CSI-RS resources in the *NZP-CSI-RS-ResourceSet* are transmitted in different OFDM symbols. ~~The UE is not expected to receive different periodicity in *periodicityAndOffset* in every CSI-RS resource within the set.~~ If *repetition* is set to 'off', the UE shall not assume that the CSI-RS resources within the *NZP-CSI-RS-ResourceSet* are transmitted with the same downlink spatial domain transmission filter.
----------End of TP ----------

Agreement
The possible agreement in section 2.14 of R1-1809749 is agreed (text proposal for Section 5.1.6.1.2 in 38.214).
----------Start of TP ----------

Table 7.4.1.5.3-2: The sequences $w_f(k')$ and $w_t(l')$ for *cdm-Type* equal to 'no CDM'.

Index	$w_f(0)$ ~~$w_f(k')$~~	$w_t(0)$ ~~$w_t(l')$~~
0	1	1

Table 7.4.1.5.3-3: The sequences $w_f(k')$ and $w_t(l')$ for *cdm-Type* equal to 'FD-CDM2'.

Index	$[w_f(0) \quad w_f(1)]$ ~~$w_f(k')$~~	$w_t(0)$ ~~$w_t(l')$~~
0	$[+1 \quad +1]$	1
1	$[+1 \quad -1]$	1

Table 7.4.1.5.3-4: The sequences $w_f(k')$ and $w_t(l')$ for *cdm-Type* equal to 'CDM4'.

Index	$[w_f(0) \quad w_f(1)]$ ~~$w_f(k')$~~	$[w_t(0) \quad w_t(1)]$ ~~$w_t(l')$~~
0	$[+1 \quad +1]$	$[+1 \quad +1]$
1	$[+1 \quad -1]$	$[+1 \quad +1]$
2	$[+1 \quad +1]$	$[+1 \quad -1]$
3	$[+1 \quad -1]$	$[+1 \quad -1]$

Table 7.4.1.5.3-5: The sequences $w_f(k')$ and $w_t(l')$ for *cdm-Type* equal to 'CDM8'.

Index	$[w_f(0) \quad w_f(1)]$ ~~$w_f(k')$~~	$[w_t(0) \quad w_t(1) \quad w_t(2) \quad w_t(3)]$ ~~$w_t(l')$~~
0	$[+1 \quad +1]$	$[+1 \quad +1 \quad +1 \quad +1]$
1	$[+1 \quad -1]$	$[+1 \quad +1 \quad +1 \quad +1]$
2	$[+1 \quad +1]$	$[+1 \quad -1 \quad +1 \quad -1]$
3	$[+1 \quad -1]$	$[+1 \quad -1 \quad +1 \quad -1]$
4	$[+1 \quad +1]$	$[+1 \quad +1 \quad -1 \quad -1]$
5	$[+1 \quad -1]$	$[+1 \quad +1 \quad -1 \quad -1]$
6	$[+1 \quad +1]$	$[+1 \quad -1 \quad -1 \quad +1]$
7	$[+1 \quad -1]$	$[+1 \quad -1 \quad -1 \quad +1]$

----------End of TP ----------

R1-1809762 **Summary of DMRS Issues** **Qualcomm**

Agreement:
Text proposal for section 7.4.1.1.2 in 38.211

----------Start of TP ----------

7.4.1.1.2 Mapping to physical resources

The UE shall assume the PDSCH DM-RS being mapped to physical resources according to configuration type 1 or configuration type 2 as given by the higher-layer parameter *dmrs-Type*.

The UE shall assume the sequence $r(m)$ is scaled by a factor $\beta_{\text{PDSCH}}^{\text{DMRS}}$ to conform with the transmission power specified in [6, TS 38.214] and mapped to resource elements $(k,l)_{p,\mu}$ according to

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$$a_{k,l}^{(p,\mu)} = \beta_{\text{PDSCH}}^{\text{DMRS}} w_{\text{f}}(k') w_{\text{t}}(l') r(2n+k')$$

$$k = \begin{cases} 4n+2k'+\Delta & \text{Configuration type 1} \\ 6n+k'+\Delta & \text{Configuration type 2} \end{cases}$$

$$k' = 0,1$$

$$l = \bar{l} + l'$$

$$n = 0,1,\ldots$$

where $w_{\text{f}}(k')$, $w_{\text{t}}(l')$, and Δ, ~~and~~ λ are given by Tables 7.4.1.1.2-1 and 7.4.1.1.2-2 and the following conditions are fulfilled:

- the resource elements are within the common resource blocks allocated for PDSCH transmission

...

For PDSCH mapping type B

- if the PDSCH duration is 2, 4, or 7 OFDM symbols for normal cyclic prefix or 2, 4, 6 OFDM symbols for extended cyclic prefix, and the PDSCH allocation collides with resources reserved for a search space set associated with a CORESET, $\bar{l}$ shall be incremented such that the first DM-RS symbol occurs immediately after the CORESET and

----------End of TP ----------

Agreement

The following text proposal for 4.1 of 38.214 is agreed.

----------Start of TP ----------

4.1 Power allocation for downlink

For downlink DM-RS associated with PDSCH, the UE may assume the ratio of PDSCH EPRE to DM-RS EPRE (~~1/~~ β_{DMRS} [dB]) is given by Table 4.1-1 according to the number of DM-RS CDM groups without data as described in Subclause 5.1.6.2.

The DM-RS scaling factor β_{PDSCH}^{DMRS} specified in Subclause 7.4.1.1.2 of [4, TS 38.211] is given by $\beta_{PDSCH}^{DMRS} = 10^{\frac{\beta_{DMRS}}{20}}$.

Table 4.1-1: The ratio of PDSCH EPRE to DM-RS EPRE

Number of DM-RS CDM groups without data	DM-RS configuration type 1	DM-RS configuration type 2
1	0 dB	0 dB
2	-3 dB	-3 dB
3	-	-4.77 dB

----------End of TP ----------

Agreement

The following text proposal for 6.2.2 of 38.214 is agreed.

----------Start of TP ----------

6.2.2 UE DM-RS transmission procedure

For uplink DM-RS with PUSCH, the UE may assume the ratio of PUSCH EPRE to DM-RS EPRE (β_{DMRS} $1/\beta_{\text{DMRS}}$ [dB]) is given by Table 6.2.2-1 according to the number of DM-RS CDM groups without data. The DM-RS scaling factor β_{PUSCH}^{DMRS} specified in subclause 6.4.1.1.3 of [4, TS 38.211] is given by $\beta_{PUSCH}^{DMRS} = 10^{\frac{\beta_{DMRS}}{20}}$.

Table 6.2.2-1: The ratio of PUSCH EPRE to DM-RS EPRE

----------End of TP ----------

Agreement

The following text proposal for section 6.4.1.1.1.1 of 38.211 is agreed.

----------Start of TP ----------

6.4.1.1.1.1 Sequence generation when transform precoding is disabled

If transform precoding for PUSCH is not enabled, the sequence $r(n)$ shall be generated according to

$$r(n) = \frac{1}{\sqrt{2}}(1-2\cdot c(2n)) + j\frac{1}{\sqrt{2}}(1-2\cdot c(2n+1)).$$

where the pseudo-random sequence $c(i)$ is defined in clause 5.2.1. The pseudo-random sequence generator shall be initialized with

- $c_{\text{init}} = \left(2^{17}\left(N_{\text{symb}}^{\text{slot}} n_{\text{s,f}}^{\mu} + l + 1\right)\left(2N_{\text{ID}}^{n_{\text{SCID}}} + 1\right) + 2N_{\text{ID}}^{n_{\text{SCID}}} + n_{\text{SCID}}\right) \bmod 2^{31}$

where l is the OFDM symbol number within the slot, $n_{\text{s,f}}^{\mu}$ is the slot number within a frame, and

- $N_{\text{ID}}^{0}, N_{\text{ID}}^{1} \in \{0,1,\ldots,65535\}$ are given by the higher-layer parameters *scramblingID0* and *scramblingID1*, respectively, in the *DMRS-UplinkConfig* IE if provided and the PUSCH is scheduled by DCI format 0_1;
- $N_{\text{ID}}^{0} \in \{0,1,\ldots,65535\}$ is given by the higher-layer parameter *scramblingID0* in the *DMRS-UplinkConfig* IE if provided and the PUSCH is scheduled by DCI format 0_0 with the CRC scrambled by C-RNTI or CS-RNTI;
- $N_{\text{ID}}^{n_{\text{SCID}}} = N_{\text{ID}}^{\text{cell}}$ otherwise.

The quantity $n_{SCID} \in \{0,1\}$ is indicated by the DM-RS initialization field, if present, in the DCI associated with the PUSCH transmission if DCI format 0_1 in [4, TS 38.212] is used, otherwise $n_{SCID} = 0$.

----------End of TP ----------

R1-1809792 **Summary of DMRS Issues** **Qualcomm**

Agreement

----------Start of TP for 38.211----------

6.4.1.1.3 Precoding and mapping to physical resources

~~F~~or PUSCH mapping type A, the case *dmrs-AdditionalPosition* equal to ~~3~~ 'pos3' is only supported when *dmrs-TypeA-Position* is equal to ~~2~~ 'pos2'. For PUSCH mapping type A, duration of 4 symbols in Table 6.4.1.1.3-4 is only applicable for *dmrs-TypeA-Position*~~*dmrs-AdditionalPosition*~~ equals 'pos2'.

The time-domain index l' and the supported antenna ports $\tilde{p}_j$ are given by Tables 6.4.1.1.3-3 through 6.4.1.1.3-6:

- if the higher-layer parameter *maxLength* in *DMRS-UplinkConfig* is ~~equal to 1~~not configured and frequency hopping is disabled, the tables shall be used according to single-symbol DM-RS
- if the higher-layer parameter *maxLength* in *DMRS-UplinkConfig* is equal to ~~2~~ 'len2' and frequency hopping is disabled, the associated DCI determines whether single-symbol or double-symbol DM-RS shall be used
- if the higher-layer parameter *dmrs-AdditionalPosition* is ~~equal to or more than 1~~ not set to 'pos0' and frequency hopping is enabled according to clause 7.3.1.1.2 in [4, TS 38.212], Tables 6.4.1.1.3-6 and 6.4.1.1.3-7 shall be used assuming *dmrs-AdditionalPosition* is equal to ~~1~~'pos1' for each hop.

/********** Omitted part **********/

7.4.1.1.2 Mapping to physical resources

The reference point for l and the position l_0 of the first DM-RS symbol depends on the mapping type:

- for PDSCH mapping type A:
  - l is defined relative to the start of the slot
  - $l_0 = 3$ if the higher-layer parameter *dmrs-TypeA-Position* ~~equals~~ is equal to ~~3~~ 'pos3' and $l_0 = 2$ otherwise
- for PDSCH mapping type B:
  - l is defined relative to the start of the scheduled PDSCH resources
  - $l_0 = 0$

The position(s) of the DM-RS symbols is given by $\bar{l}$ and

- for PDSCH mapping type A, the duration is between the first OFDM symbol of the slot and the last OFDM symbol of the scheduled PDSCH resources in the slot
- for PDSCH mapping type B, the duration is the number of OFDM symbols of the scheduled PDSCH resources as signalled

and according to Tables 7.4.1.1.2-3 and 7.4.1.1.2-4. The case *dmrs-AdditionalPosition* equal to ~~3~~ 'pos3' is only supported when *dmrs-TypeA-Position* is equal to ~~2~~'pos2'. For PDSCH mapping type A, duration of 3 and 4 symbols in Tables 7.4.1.1.2-3 and 7.4.1.1.2-4 respectively is only applicable ~~for~~when *dmrs-TypeA-Position* is equal to~~s~~ ~~2~~'pos2'.

For PDSCH mapping type B

- if the PDSCH duration is 2, 4, or 7 OFDM symbols for normal cyclic prefix or 2, 4, 6 OFDM symbols for extended cyclic prefix, and the PDSCH allocation collides with resources reserved for a CORESET, $\bar{l}$ shall be incremented such that the first DM-RS symbol occurs immediately after the CORESETand
  - if the PDSCH duration is 4 symbols, the UE is not expected to receive a DM-RS symbol beyond the third symbol,
  - if the PDSCH duration is 7 symbols for normal cyclic prefix or 6 symbols for extended cyclic prefix,

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- the UE is not expected to receive the first DM-RS beyond the fourth symbol, and
- if one additional single-symbol DM-RS is configured, the UE only expects the additional DM-RS to be transmitted on the 5th or 6th symbol when the front-loaded DM-RS symbol is in the 1st or 2nd symbol, respectively, of the PDSCH duration, otherwise the UE should expect that the additional DM-RS is not transmitted.

- if the PDSCH duration is 2 or 4 OFDM symbols, only single-symbol DM-RS is supported.

The time-domain index l' and the supported antenna ports p are given by Table 7.4.1.1.2-5 where

- single-symbol DM-RS is used if the higher-layer parameter *maxLength* in the *DMRS-DownlinkConfig* IE is ~~equal to 1~~not configured,
- single-symbol or double-symbol DM-RS is determined by the associated DCI if the higher-layer parameter *maxLength* in the *DMRS-DownlinkConfig* IE is equal to ~~2.~~'len2'

In absence of CSI-RS configuration, and unless otherwise configured, the UE may assume PDSCH DM-RS and SS/PBCH block to be quasi co-located with respect to Doppler shift, Doppler spread, average delay, delay spread, and, when applicable, spatial Rx parameters. The UE may assume that the PDSCH DM-RS within the same CDM group are quasi co-located with respect to Doppler shift, Doppler spread, average delay, delay spread, and spatial Rx. The UE may assume that DMRS ports associated with a PDSCH are QCL with QCL Type A, Type D (when applicable) and average gain.

----------End of TP for 38.211----------

Agreement

----------Start of TP for 38.214----------

6.2.2 UE DM-RS transmission procedure

If frequency hopping is enabled:

- The UE shall assume *dmrs-AdditionalPosition* equal to 'pos1' and up to one additional DM-RS can be transmitted according to PUSCH duration.

~~A UE can be configured with one or two scrambling identity(s), i = 0,1 by higher layers for UE-specific reference signal generation as defined in Subclause 6.4.1.1 of [4, TS 38.211] to transmit PUSCH which are the same for both PUSCH mapping Type A and Type B.~~

For the UE-specific reference signals generation as defined in Subclause 6.4.1.1 of [4, TS 38.211], a UE can be configured by higher layers with one or two scrambling identity(s), $n_{ID}^{DMRS,i}$ i = 0,1 which are the same for both PUSCH mapping Type A and Type B.

When transmitting PUSCH scheduled by PDCCH format 0_1 with CRC scrambled by C-RNTI or CS-RNTI,

- the UE may be configured with higher layer parameter *dmrs-Type* in *DMRS-UplinkConfig*, and the configured DM-RS configuration type is used for transmitting PUSCH in as defined in Subclause 6.4.1.1 of [4, TS 38.211].
- the UE may be configured with the maximum number of front-loaded DM-RS symbols for PUSCH by higher layer parameter *maxLength* in *DMRS-UplinkConfig.*
  - if *maxLength* is not configured, single-symbol DM-RS can be scheduled for the UE by DCI, and the UE can be configured with a number of additional DM-RS for PUSCH by higher layer parameter *dmrs-AdditionalPosition,* which can be 'pos0', 'pos1' , 'pos2' or 'pos3'~~0, 1, 2 or 3~~.
  - if *maxLength* is configured, ~~both~~ either single-symbol DM-RS ~~and~~ or double symbol DM-RS can be scheduled for the UE by DCI, and the UE can be configured with a number of additional DM-RS for PUSCH by higher layer parameter *dmrs-AdditionalPosition,* which can be 'pos0' or 'pos1'.
  - and, the UE shall transmit a number of additional DM-RS as specified in Table 6.4.1.1.3-3 and Table 6.4.1.1.3-4 in - Subclause 6.4.1.1.3 of [4, TS 38.211].

----------End of TP for 38.214----------

Agreement

- Agree on the following text proposal for TS 38.211 v15.2.0 Section 6.4.1.1.1.3

----------Start of TP ----------

The position(s) of the DM-RS symbols is given by $\bar{l}$ and

- the signalled duration between the first OFDM symbol of the slot and the last OFDM symbol of the scheduled PUSCH resources in the slot for PUSCH mapping type A according to Tables 6.4.1.1.3-3 and 6.4.1.1.3-4 if ~~inter-slot frequency hopping is used or~~ intra-slot frequency hopping is not used, or
- the signalled duration of scheduled PUSCH resources for PUSCH mapping type B according to Tables 6.4.1.1.3-3 and 6.4.1.1.3-4 if ~~inter-slot frequency hopping is used or~~ intra-slot frequency hopping is not used, or
- the signalled duration per hop according to Table 6.4.1.1.3-6 if intra-slot frequency hopping is used.

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- if the higher-layer parameter *maxLength* in *DMRS-UplinkConfig* is ~~equal to 1~~not configured, the tables shall be used according to single-symbol DM-RS
- if the higher-layer parameter *maxLength* in *DMRS*-UplinkConfig is equal to ~~2~~ 'len2', the associated DCI determines whether single-symbol or double-symbol DM-RS shall be used
- if the higher-layer parameter *dmrs-AdditionalPosition* is ~~equal to or more than 1~~ not set to 'pos0' and intra-slot frequency hopping is enabled according to clause 7.3.1.1.2 in [4, TS 38.212] and by higher layer, Tables 6.4.1.1.3-6 shall be used assuming *dmrs-AdditionalPosition* is equal to ~~1~~'pos1' for each hop.

For PUSCH mapping type A, the case *dmrs-AdditionalPosition* equal to ~~3~~'pos3' is only supported when *dmrs-TypeA-Position* is equal to ~~2~~'pos2'. For PUSCH mapping type A, duration of 4 symbols in Table 6.4.1.1.3-4 is only applicable for *dmrs-AdditionalPosition* equals 'pos1'.

The time-domain index l' and the supported antenna ports $\tilde{p}_j$ are given by Tables 6.4.1.1.3-~~35. through 6.4.1.1.3-6:~~

- ~~if the higher-layer parameter *maxLength* in *DMRS-UplinkConfig* is equal to 1 and frequency hopping is disabled, the tables shall be used according to single-symbol DM-RS~~
- ~~if the higher-layer parameter *maxLength* in *DMRS-UplinkConfig* is equal to 2 and frequency hopping is disabled, the associated DCI determines whether single-symbol or double-symbol DM-RS shall be used~~
- ~~if the higher-layer parameter *dmrs-AdditionalPosition* is equal to or more than 1 and frequency hopping is enabled according to clause 7.3.1.1.2 in [4, TS 38.212], Tables 6.4.1.1.3-6 and 6.4.1.1.3-7 shall be used assuming *dmrs-AdditionalPosition* is 1 for each hop.~~

Table 6.4.1.1.3-3: PUSCH DM-RS positions within slot $\bar{l}$ for single-symbol DM-RS **and intra-slot frequency hopping disabled** ~~and frequency hopping disabled.~~

Duration in symbols	DM-RS positions $\bar{l}$							
	PUSCH mapping type A				PUSCH mapping type B			
	dmrs-AdditionalPosition				*dmrs-AdditionalPosition*			
	0	*1*	*2*	*3*	*0*	*1*	*2*	*3*
<4	-	-	-	-	l_0	l_0	l_0	l_0
4	l_0	l_0	l_0	l_0	l_0	l_0	l_0	l_0
5	l_0	l_0	l_0	l_0	l_0	$l_0, 4$	$l_0, 4$	$l_0, 4$
6	l_0	l_0	l_0	l_0	l_0	$l_0, 4$	$l_0, 4$	$l_0, 4$
7	l_0	l_0	l_0	l_0	l_0	$l_0, 4$	$l_0, 4$	$l_0, 4$
8	l_0	$l_0, 7$	$l_0, 7$	$l_0, 7$	l_0	$l_0, 6$	$l_0, 3, 6$	$l_0, 3, 6$
9	l_0	$l_0, 7$	$l_0, 7$	$l_0, 7$	l_0	$l_0, 6$	$l_0, 3, 6$	$l_0, 3, 6$
10	l_0	$l_0, 9$	$l_0, 6, 9$	$l_0, 6, 9$	l_0	$l_0, 8$	$l_0, 4, 8$	$l_0, 3, 6, 9$
11	l_0	$l_0, 9$	$l_0, 6, 9$	$l_0, 6, 9$	l_0	$l_0, 8$	$l_0, 4, 8$	$l_0, 3, 6, 9$
12	l_0	$l_0, 9$	$l_0, 6, 9$	$l_0, 5, 8, 11$	l_0	$l_0, 10$	$l_0, 5, 10$	$l_0, 3, 6, 9$
13	l_0	$l_0, 11$	$l_0, 7, 11$	$l_0, 5, 8, 11$	l_0	$l_0, 10$	$l_0, 5, 10$	$l_0, 3, 6, 9$
14	l_0	$l_0, 11$	$l_0, 7, 11$	$l_0, 5, 8, 11$	l_0	$l_0, 10$	$l_0, 5, 10$	$l_0, 3, 6, 9$

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Table 6.4.1.1.3-4: PUSCH DM-RS positions within slot $\bar{l}$ for double-symbol DM-RS **and intra-slot frequency hopping disabled** ~~and frequency hopping disabled.~~

Duration in symbols	DM-RS positions $\bar{l}$							
	PUSCH mapping type A				PUSCH mapping type B			
	dmrs-AdditionalPosition				*dmrs-AdditionalPosition*			
	0	*1*	*2*	*3*	*0*	*1*	*2*	*3*
<4	-	-			-	-		
4	l_0	l_0			-	-		
5	l_0	l_0			l_0	l_0		
6	l_0	l_0			l_0	l_0		
7	l_0	l_0			l_0	l_0		
8	l_0	l_0			l_0	l_0, 5		
9	l_0	l_0			l_0	l_0, 5		
10	l_0	l_0, 8			l_0	l_0, 7		
11	l_0	l_0, 8			l_0	l_0, 7		
12	l_0	l_0, 8			l_0	l_0, 9		
13	l_0	l_0, 10			l_0	l_0, 9		
14	l_0	l_0, 10			l_0	l_0, 9		

Table 6.4.1.1.3-6: PUSCH DM-RS positions within slot $\bar{l}$ for single-symbol DM-RS and intra-slot frequency hopping enabled.

Duration in symbols	DM-RS positions $\bar{l}$											
	PUSCH mapping type A								PUSCH mapping type B			
	$l_0 = 2$				$l_0 = 3$				$l_0 = 0$			
	dmrs-AdditionalPosition				dmrs-AdditionalPosition				dmrs-AdditionalPosition			
	0		1		0		1		0		1	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
≤3	-	-	-	-	-	-	-	-	0	0	0	0
4	2	0	2	0	3	0	3	0	0	0	0	0
5, 6	2	0	2	0, 4	3	0	3	0, 4	0	0	0, 4	0, 4
7	2	0	2, 6	0, 4	3	0	3	0, 4	0	0	0, 4	0, 4

----------End of TP ----------

Agreement

TP1 for section 7.4.1.1.1 in 38.211

7.4.1.1.1 Sequence generation

…

The quantity $n_{SCID} \in \{0,1\}$ is given by the DM-RS sequence initialization field~~, if present,~~ in the DCI associated with the PDSCH transmission if DCI format 1_1 in [4, TS 38.212] is used, otherwise $n_{SCID} = 0$.

TP2 for section 7.3.1.1.2 in 38.212

7.3.1.1.2 Format 0_1

...

- DMRS sequence initialization – 0 bit if the higher layer parameter *transformPrecoder=enabled*; 1 bit if the higher layer parameter *transformPrecoder=disabled* ~~and both *scramblingID0* and *scramblingID1* are configured in *DMRS-UplinkConfig*, for~~ n_{SCID} ~~selection defined in Subclause 6.4.1.1.1.1 of [4, TS 38.211]~~.

TP3 for section 7.3.1.2.2 in 38.212

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7.3.1.2.2 Format 1_1
...
- DMRS sequence initialization – 1 bit ~~if both *scramblingID0* and *scramblingID1* are configured in *DMRS-DownlinkConfig* for~~ n_{SCID} ~~selection defined in Subclause 7.4.1.1.1 of [4, TS 38.211]; 0 bit otherwise~~.

Agreement
Agree to the following text proposal for TS38.211, section 7.3.1.4
The set of antenna ports $\{p_{0,\ldots},p_{\rho-1}\}$ shall be determined according to the procedure in [~~64~~, TS 38.~~214~~212]

R1-1809777 **Feature lead summary of PT-RS Ericsson**

Agreement
Text proposal for TS38.214

----------Start of TP ----------

4.1 Power allocation for downlink

<<<<<<<<<<<<<<<<<<<<<<<<<omitted>>>>>>>>>>>>>>>>>>>

When the UE is scheduled with a PT-RS port~~s~~ associated with the PDSCH~~and when the PT-RS port is associated to~~ n_{DMRS}^{PTRS} ~~DM-RS ports,~~

- if the UE is configured with the higher layer parameter *epre-Ratio*, the ratio of PT-RS EPRE to PDSCH EPRE per layer per RE for PT-RS port (ρ_{PTRS}) is given by Table 4.1-2 according to the *epre-Ratio*, the PT-RS scaling factor β_{PTRS} specified in subclause 7.4.1.2.2 of [4, TS 38.211] is given by $\beta_{PTRS} = 10^{-\frac{\rho_{PTRS}}{20}}$.
- otherwise, the UE shall assume *epre-Ratio* is set to state '0' in Table 4.1-2 if not configured.

Table 4.1-2: PT-RS-to-PDSCH EPRE ratio per layer for PT-RS port ~~*i*~~ ($\alpha_{PTRS,i}$)

epre-Ratio	The number of PDSCH layers					
	1	2	3	4	5	6
0	0	3	4.77	6	7	7.78
1	0	0	0	0	0	0
2	reserved					
3	reserved					

<<<<<<<<<<<<<<<<<<<<<<<<<omitted>>>>>>>>>>>>>>>>>>>

When the UE is scheduled with PT-RS ports associated with the PDSCH and when the PT-RS port is associated to n_{DMRS}^{PTRS} DM-RS ports,

- if the UE is configured with the higher layer parameter *epre-Ratio*, the ratio of PT-RS EPRE to PDSCH EPRE per layer per RE for PT-RS port (ρ_{PTRS}) is given by Table 4.1-2 according to the *epre-Ratio*, the PT-RS scaling factor β_{PTRS} specified in subclause 7.4.1.2.2 of [4, TS 38.211] is given by $\beta_{PTRS} = 10^{-\frac{\rho_{PTRS}}{20}}$ $\beta_{PTRS} = 10^{\frac{\rho_{PTRS}}{20}}$.
- otherwise, the UE shall assume *epre-Ratio* is set to state '0' in Table 4.1-2 if not configured.

Table 4.1-2: PT-RS-to-PDSCH EPRE ratio per layer for PT-RS port *i* (ρ_{PTRS} $\alpha_{PTRS,i}$)

epre-Ratio	The number of PDSCH layers					
	1	2	3	4	5	6
0	0	3	4.77	6	7	7.78
1	0	0	0	0	0	0
2	reserved					
3	reserved					

----------End of TP ----------

Agreement
Text proposal for TS38.214

----------Start of TP ----------

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6.2.3.1 UE PT-RS transmission procedure when transform precoding is not enabled

<<<<<<<<<<<<<<<<<<<<<<<<omitted>>>>>>>>>>>>>>>>>>

The higher layer parameter *PTRS-UplinkConfig* provides the parameters *ptrs-MCSi*, *i*=1,2,3 and with values in 0-29 when MCS Table 5.1.3.1-1 is configured and 0-28 when MCS Table 5.1.3.1-2 is configured, respectively. *ptrs-MCS4* is not explicitly configured by higher layers but assumed 29 when MCS Table 5.1.3.1-1 is configured and 28 when MCS Table 5.1.3.1-2 is configured. The higher layer parameter *PTRS-UplinkConfig* provides the parameters N_{RBi} *i*=0,1 with values in range ~~0~~1-276.

----------End of TP ----------

Agreement Text proposal for TS38.212

----------Start of TP ----------

7.3.1.1.2 Format 0_1

< Unchanged parts are omitted >

Table 7.3.1.1.2-25: PTRS-DMRS association for UL PTRS port 0

Value	DMRS port
0	~~0~~ 1st scheduled DMRS port
1	~~1~~ 2nd scheduled DMRS port
2	~~2~~ 3rd scheduled DMRS port
3	~~3~~ 4th scheduled DMRS port

----------End of TP ----------

Agreement

Text proposal for TS38.214, section 6.2.3

"by DCI parameter *PTRS-DMRS association* as shown in DCI format 0_1 described in Subclause ~~6~~7.3.1~~.2.3~~ of [5, TS38.212]."

Agreement

Text proposal for TS38.214

----------Start of TP ----------

6.2.3 UE PT-RS transmission procedure

If a UE is not configured with the higher layer parameter *phaseTrackingRS* in *DMRS-UplinkConfig*, the UE shall not transmit PT-RS. The PTRS may only be present if RNTI equals C-RNTI, CS-RNTI, SP-CSI-RNTI or new-RNTI.

----------End of TP ----------

Agreement

The TP for section 5.1.6.3 and 6.2.3 in 38.214 as follows:

----------Start of TP ----------

5.1.6.3 PT-RS reception procedure

< Unchanged parts are omitted >

If a UE is configured with the higher layer parameter *phaseTrackingRS* in *DMRS-DownlinkConfig*,

- the higher layer parameters *timeDensity* and *frequencyDensity* in *PTRS-DownlinkConfig* indicate the threshold values *ptrs-MCSi*, *i*=1,2,3 and $N_{RB,i}$, *i*=0,1, as shown in Table 5.1.6.3-1 and Table 5.1.6.3-2, respectively.
- if either or both of the additional higher layer parameters *timeDensity* and *frequencyDensity* are configured, and the RNTI equals new-RNTI, C-RNTI or CS-RNTI, the UE shall assume the PT-RS antenna ports' presence and pattern are a function of the corresponding scheduled MCS of the corresponding codeword and scheduled bandwidth in corresponding bandwidth part as shown in Table 5.1.6.3-1, ~~and~~ Table 5.1.6.3-2~~,~~ and Table 5.1.6.3-3,
  <…>
- otherwise, if neither of the additional higher layer parameters *timeDensity* and *frequencyDensity* are configured and the RNTI equals new-RNTI, C-RNTI or CS-RNTI, the UE shall assume the PT-RS is present with $L_{PT\text{-}RS}$ = 1, $K_{PT\text{-}RS}$ = 2, and

< Unchanged parts are omitted >

The higher layer parameter *PTRS-DownlinkConfig* provides the parameters *ptrs-MCSi*, *i*=1,2,3 and with values in range 0-29 when MCS Table 5.1.3.1-1 or MCS Table 5.1.3.1-3 is used ~~configured~~ and 0-28 when MCS Table 5.1.3.1-2 is used ~~configured~~, respectively. *ptrs-MCS4* is not explicitly configured by higher layers but assumed 29 when MCS Table 5.1.3.1-1 or MCS Table 5.1.3.1-3 is used ~~configured~~ and 28 when MCS Table 5.1.3.1-2 is used ~~configured~~, respectively. The higher layer parameter *frequencyDensity* in *PTRS-DownlinkConfig* provides the parameters N_{RBi} *i*=0,1 with values in range 1-276.

< Unchanged parts are omitted >

When a UE is receiving PDSCH for retransmission, if the UE is scheduled with an MCS index greater than V, where V=28 for MCS Table 5.1.3.1-1 and Table 5.1.3.1-3, and V=27 for MCS Table 5.1.3.1-2 respectively,

< Unchanged parts are omitted >

6.2.3 UE PT-RS transmission procedure

If a UE is not configured with the higher layer parameter phaseTrackingRS in DMRS-UplinkConfig, the UE shall not transmit PT-RS. The PTRS may only be present if RNTI equals new-RNTI, C-RNTI, CS-RNTI, SP-CSI-RNTI.

6.2.3.1 UE PT-RS transmission procedure when transform precoding is not enabled

< Unchanged parts are omitted >

The higher layer parameter *PTRS-UplinkConfig* provides the parameters *ptrs-MCSi*, *i*=1,2,3 and with values in 0-29 when MCS Table 5.1.3.1-1 or Table 5.1.3.1-3 is used ~~configured~~, and 0-28 when MCS Table 5.1.3.1-2 is used ~~configured~~, respectively. *ptrs-MCS4* is not explicitly configured by higher layers but assumed 29 when MCS Table 5.1.3.1-1 or Table 5.1.3.1-3 is used ~~configured~~, and 28 when MCS Table 5.1.3.1-2 is used ~~configured~~. The higher layer parameter *PTRS-UplinkConfig* provides the parameters N_{RBi} *i*=0,1 with values in range 0-276.

< Unchanged parts are omitted >

----------End of TP ----------

Agreement

The TP for TS 38.214 v15.2.0 Section 5.1.6.3 as follows

----------Start of TP ----------

If a UE is configured with the higher layer parameter *phaseTrackingRS* in *DMRS-DownlinkConfig*,

- the higher layer parameters *timeDensity* and *frequencyDensity* in *PTRS-DownlinkConfig* indicate the threshold values *ptrs-MCSi*, *i*=1,2,3 and $N_{RB,i}$, *i*=0,1, as shown in Table 5.1.6.3-1 and Table 5.1.6.3-2, respectively.
- if either or both of the additional higher layer parameters *timeDensity* and *frequencyDensity* are configured, and the RNTI equals C-RNTI or CS-RNTI, the UE shall assume the PT-RS antenna ports' presence and pattern are a function of the corresponding scheduled MCS of the corresponding codeword and scheduled bandwidth in corresponding bandwidth part as shown in Table 5.1.6.3-1 and Table 5.1.6.3-2,
  - if the higher layer parameter *timeDensity* given by *PTRS-DownlinkConfig* is not configured, the UE shall assume $L_{PT\text{-}RS} = 1$.
  - if the higher layer parameter *frequencyDensity* given by *PTRS-DownlinkConfig* is not configured, the UE shall assume $K_{PT\text{-}RS} = 2$.
- otherwise, if neither of the additional higher layer parameters *timeDensity* and *frequencyDensity* are configured and the RNTI equals C-RNTI or CS-RNTI, the UE shall assume the PT-RS is present with $L_{PT\text{-}RS} = 1$, $K_{PT\text{-}RS} = 2$, and the UE shall assume PT-RS is not present when
- ~~The UE shall assume PT-RS is not present when,~~
  - the scheduled MCS from Table 5.1.3.1-1 is smaller than 10, or
  - the scheduled MCS from Table 5.1.3.1-2 is smaller than 5, or
  - the number of scheduled RBs is smaller than 3, or
- otherwise, if the RNTI equals RA-RNTI, SI-RNTI, or P-RNTI, the UE shall assume PT-RS is not present

----------End of TP ----------

R1-1809519 **Summary of SRSSony**

Agreement

Text proposal on SRS resource configuration in 38.214 version 15.2.0

< Start of the text proposal >

6.2 UE reference ~~symbol~~signal (RS) procedure

6.2.1 UE sounding procedure

The UE can be configured with one or more Sounding Reference ~~Symbol~~ Signal (SRS) resource sets as configured by the higher layer parameter *SRS-ResourceSet*. For each SRS resource set, a UE may be configured with $K \geq 1$ SRS resources (higher ~~later~~ layer parameter *SRS-Resource*), where the maximum value of K is indicated by [*SRS_capability* [13, 38.306]]. The SRS resource set applicability is configured by the higher layer parameter *SRS-SetUse*. When the higher layer parameter *SRS-SetUse* is set to 'BeamManagement', only one SRS resource in each of multiple SRS sets can be transmitted at a given time instant. The SRS resources in different SRS resource sets can be transmitted simultaneously.

For aperiodic SRS at least one state of the DCI field is used to select at least one out of the configured SRS resource sets.

< Unchanged parts are omitted >

The UE is not expected to be configured with different time domain behavior for SRS resources in the same SRS resource set. The UE is also not expected to be configured with different time domain behavior between SRS resource and associated SRS resources set.

The 2-bit SRS request field [5 TS38.212] in DCI format 0_1, 1_1 indicates the triggered SRS resource set given in Table 7.3.1.1.2-24 of [5, TS 38212]. The 2-bit SRS request field [5, TS38.212] in DCI format 2_3 indicates the triggered SRS resource set given in Subclause 11.4 of [6, TS 38.213].

< End of the text proposal >

Agreement

Text proposal on SRS rule in 38.214 version 15.2.0

< Start of the text proposal >

6.2.1 UE sounding procedure

< Unchanged parts are omitted >

In case of intra-band carrier aggregation, a UE is not expected to be configured with SRS and PUSCH/UL DM-RS/UL PT-RS/PUCCH ~~formats 1, 3 or 4~~ in the same symbol.

< End of the text proposal >

For further discussion in RAN1#94bis

Simultaneous SRS transmission on a different CC in intra-band or inter-band CA

Agreement

Text proposal on SRS rule in 38.214 version 15.2.0

< Start of the text proposal >

6.2.1 UE sounding procedure

< Unchanged parts are omitted >

The 2-bit SRS request field [5 TS38.212] in DCI format 0_1, 1_1 indicates the triggered SRS resource set given in Table 7.3.1.1.2-24 of [5, TS 38212]. The 2-bit SRS request field [5, TS38.212] in DCI format 2_3 indicates the triggered SRS resource set given in Subclause 11.4 of [6, TS 38.213].

For PUCCH formats 0 and 2, a UE shall not transmit SRS when semi-persistent and periodic SRS are configured in the same symbol(s) with PUCCH carrying only CSI report(s), or only L1-RSRP report(s) or if aperiodic SRS is configured and PUCCH consists of beam failure request. A UE shall not transmit SRS when semi-persistent or periodic SRS is configured or aperiodic SRS is triggered to be transmitted in the same symbol(s) with PUCCH carrying HARQ-ACK and/or SR. In the case that SRS is not transmitted due to overlap with PUCCH, only the SRS symbol(s) that overlap with PUCCH symbol(s) are dropped. PUCCH shall not be transmitted when aperiodic SRS is triggered to be transmitted to overlap in the same symbol with ~~semi-persistent or periodic~~ PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only.

< End of the text proposal >

Agreement

Text proposal on SRS in 38.214 version 15.2.0

----------Start of TP ----------

< Unchanged parts are omitted >

The UE may be configured by the higher layer parameter *resourceMapping* in *SRS-Resource* with an SRS resource occupying $N_s \in \{1,2,4\}$ adjacent symbols ~~a location~~ within the last 6 symbols of the slot, where all antenna ports of the SRS resources are mapped to each symbol of the resource.

< Unchanged parts are omitted >

6.2.1.1 UE SRS frequency hopping procedure

A ~~UE may be configured to transmit an SRS resource on~~ $N_s \in \{1,2,4\}$ ~~adjacent symbols within the last six symbols of a slot, where all antenna ports of the SRS resource are mapped to each symbol of the resource.~~ For a given SRS resource, the UE is configured with repetition factor R∈{1,2,4} by higher layer parameter *resourceMapping* in *SRS-Resource* where $R \le N_s$. When frequency hopping within an SRS resource in each slot is not configured ($R=N_s$), all antenna ports of the SRS resource in each slot are mapped in each of the N_s symbols to the same set of subcarriers in the same set of PRBs. When frequency hopping

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within as SRS resource in each slot is configured without repetition (*R=1*), according to the SRS hopping parameters B_{SRS}, C_{SRS} and b_{hop} defined in Subclause 6.4.1.4 of [4, TS 38.211], all antenna ports of the SRS resource in each slot are mapped to different sets of subcarriers in each OFDM symbol, where the same transmission comb value is assumed for different sets of subcarriers. When both frequency hopping and repetition within an SRS resource in each slot are configured (N_s*=4, R=2*), all antenna ports of the SRS resource in each slot are mapped to the same set of subcarriers within each pair of R adjacent OFDM symbols, and frequency hopping across the two pairs is according to the SRS hopping parameters B_{SRS}, C_{SRS} and b_{hop}.

< Unchanged parts are omitted >

6.2.1.3 UE sounding procedure between component carriers

< Unchanged parts are omitted >

For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, the UE shall not transmit a periodic/semi-persistent ~~type 0~~ SRS whenever periodic/semi-persistent SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *rf-RetuningTimeUL* and *rf-RetuningTimeDL)* on the carrier of the serving cell and PUSCH transmission carrying aperiodic CSI happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in the *SRS_capability* [13, TS 38.306].

----------End of TP ----------

Agreement

Text proposal for section 6.2.1.1 in 38.214

----------Start of TP ----------

6.2.1.1 UE SRS frequency hopping procedure

A UE may be configured to transmit an SRS resource on $N_s \in \{1,2,4\}$ adjacent symbols within the last six symbols of a slot, where all antenna ports of the SRS resource are mapped to each symbol of the resource. For a given SRS resource, the UE is configured with repetition factor R∈{1,2,4} by higher layer parameter *resourceMapping* in *SRS-Resource* where $R \le N_s$. When frequency hopping within an SRS resource in each slot is not configured ($R=N_s$), each of the~~all~~ antenna ports of the SRS resource in each slot ~~are~~is mapped in ~~each of~~all the N_s symbols to the same set of subcarriers in the same set of PRBs. When frequency hopping within a~~n~~s SRS resource in each slot is configured without repetition (*R=1*), according to the SRS hopping parameters B_{SRS}, C_{SRS} and b_{hop} defined in Subclause 6.4.1.4 of [4, TS 38.211], each of the~~all~~ antenna ports of the SRS resource in each slot ~~are~~is mapped to different sets of subcarriers in each OFDM symbol, where the same transmission comb value is assumed for different sets of subcarriers. When both frequency hopping and repetition within an SRS resource in each slot are configured (N_s*=4, R=2*), ~~all~~each of the antenna ports of the SRS resource in each slot ~~are~~is mapped to the same set of subcarriers within each pair of R adjacent OFDM symbols, and frequency hopping across the two pairs is according to the SRS hopping parameters B_{SRS}, C_{SRS} and b_{hop}.

A UE may be configured $N_s = 2$ *or* 4 adjacent symbol aperiodic SRS resource with intra-slot frequency hopping within a bandwidth part, where the full hopping bandwidth is sounded with an equal-size subband across N_s symbols when frequency hopping is configured with *R=1*. A UE may be configured $N_s = 4$ adjacent symbols aperiodic SRS resource with intra-slot frequency hopping within a bandwidth part, where the full hopping bandwidth is sounded with an equal-size subband across two pairs of *R* adjacent OFDM symbols, when frequency hopping is configured with *R=2*. ~~All~~Each of the antenna ports of the SRS resource is~~are~~ mapped to the same set of subcarriers within each pair of R adjacent OFDM symbols of the resource.

A UE may be configured $N_s = 1$ symbol periodic or semi-persistent SRS resource with inter-slot hopping within a bandwidth part, where the SRS resource occupies the same symbol location in each slot. A UE may be configured $N_s = 2$ *or* 4 symbol periodic or semi-persistent SRS resource with intra-slot and inter-slot hopping within a bandwidth part, where the N-symbol SRS resource occupies the same symbol location(s) in each slot. For N_s*=4*, when frequency hopping is configured with *R=2*, intra-slot and inter-slot hopping is supported with each of the ~~all~~ antenna ports of the SRS resource mapped to different sets of subcarriers across two pairs of *R* adjacent OFDM symbol(s) of the resource in each slot. Each of the~~All~~ antenna ports of the SRS resource is~~are~~ mapped to the same set of subcarriers within each pair of *R* adjacent OFDM symbols of the resource in each slot. For $N_s = R$, when frequency hopping is configured, inter-slot frequency hopping is supported with ~~all~~each of the antenna ports of the SRS resource mapped to the same set of subcarriers in *R* adjacent OFDM symbol(s) of the resource in each slot

----------End of TP ----------

Agreement

Text proposal on SRS resource configuration in 38.211 version 15.2.0

----------Start of TP ----------

6.4.1.4 Sounding reference signal

< Unchanged parts are omitted >

The frequency-domain starting position $k_0^{(p_i)}$ is defined by

- $$k_0^{(p_i)} = \bar{k}_0^{(p_i)} + \sum_{b=0}^{B_{\text{SRS}}} K_{\text{TC}} M_{\text{sc},b}^{\text{SRS}} n_b$$

where

- $$\bar{k}_0^{(p_i)} = n_{\text{shift}} N_{\text{sc}}^{\text{RB}} + k_{\text{TC}}^{(p_i)}$$
- $$k_{\text{TC}}^{(p_i)} = \begin{cases} \left(\bar{k}_{\text{TC}} + K_{\text{TC}}/2\right) \bmod K_{\text{TC}} & \text{if } n_{\text{SRS}}^{\text{cs}} \in \left\{n_{\text{SRS}}^{\text{cs,max}}/2, \ldots, n_{\text{SRS}}^{\text{cs,max}} - 1\right\} \text{ and } N_{\text{ap}}^{\text{SRS}} = 4 \text{ and} \\ \bar{k}_{\text{TC}} & \text{otherwise} \end{cases}$$

The frequency domain shift value n_{shift} adjusts the SRS allocation ~~to align~~ with respect to the common resource block grid ~~in multiples of four~~ and is contained in the higher-layer parameter *freqDomainShift* in the *SRS-Config* IE. The transmission comb offset $\bar{k}_{\text{TC}} \in \{0,1,\ldots,K_{\text{TC}}-1\}$ is contained in the higher-layer parameter ~~*transmisisonComb*~~ *transmissionComb* in the *SRS-Config* IE and n_{b} is a frequency position index.

----------End of TP ----------

Agreement

Text proposal for TS 38.214 V15.2.0 (2018-06)

----------Start of TP ----------

6.2.1 UE sounding procedure

< Unchanged parts are omitted >

For PUCCH formats 0 and 2, a UE shall not transmit SRS when semi-persistent and periodic SRS are configured in the same symbol(s) with PUCCH carrying only CSI report(s), or only L1-RSRP report(s) ~~or if aperiodic SRS is configured and PUCCH consists of beam failure request~~. A UE shall not transmit SRS when semi-persistent or periodic SRS is configured or aperiodic SRS is triggered to be transmitted in the same symbol(s) with PUCCH carrying HARQ-ACK and/or SR. In the case that SRS is not transmitted due to overlap with PUCCH, only the SRS symbol(s) that overlap with PUCCH symbol(s) are dropped. PUCCH shall not be transmitted when aperiodic SRS is triggered to be transmitted to overlap in the same symbol with semi-persistent or periodic PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only.

< Unchanged parts are omitted >

----------End of TP ----------

Agreement

Text proposal for TS 38.211

----------Start of TP ----------

6.4.1.4.1 SRS resource

An SRS resource is configured by the *SRS-Resource* IE and consists of

- $N_{\text{ap}}^{\text{SRS}} \in \{1,2,4\}$ antenna ports $\{p_i\}_{i=0}^{N_{\text{ap}}^{\text{SRS}}-1}$, $p_i \in \{1000,1001,\ldots\}$ where $p_i = i + 1000$, and where the number of antenna ports is given by the higher layer parameter ~~*nrofSRS-Ports*~~
- $N_{\text{symb}}^{\text{SRS}} \in \{1,2,4\}$ consecutive OFDM symbols given by the field *nrofSymbols* contained in the higher layer parameter *resourceMapping*
- l_0, the starting position in the time domain given by $l_0 = N_{\text{symb}}^{\text{slot}} - 1 - l_{\text{offset}}$ where the offset $l_{\text{offset}} \in \{0,1,\ldots,5\}$ counts symbols backwards from the end of the slot and is given by the field *startPosition* contained in the higher layer parameter *resourceMapping* and $l_{\text{offset}} \geq N_{\text{symb}}^{\text{SRS}} - 1$
- k_0, the frequency-domain starting position of the sounding reference signal

----------End of TP ----------

Agreement

Text proposal for 38.214 section 6.2.1 and section 6.2.1.3.

----------Start of TP ----------

6.2.1 UE sounding procedure

The UE can be configured with one or more Sounding Reference Symbol (SRS) resource sets as configured by the higher layer parameter *SRS-ResourceSet*. For each SRS resource set, a UE may be configured with $K \geq 1$ SRS resources (higher ~~later~~layer parameter *SRS-Resource*), where the maximum value of K is indicated by [*SRS_capability* [13, 38.306]]. The SRS resource set applicability is configured by the higher layer parameter ~~*SRS-SetUse*~~*usage*. When the higher layer parameter ~~*SRS-SetUse*~~*usage* is set to 'BeamManagement', only one SRS resource in each of multiple SRS sets can be transmitted at a given time instant. The SRS resources in different SRS resource sets can be transmitted simultaneously.

For aperiodic SRS at least one state of the DCI field is used to select at least one out of the configured SRS resource set(s).

The following SRS parameters are semi-statically configurable by higher layer parameter *SRS-Resource*.

- *srs-ResourceId* determines SRS resource configuration identify.
- Number of SRS ports as defined by the higher layer parameter *nrofSRS-Ports* and described in Subclause 6.4.1.4 of [4, TS 38.211].
- Time domain 85eriodic of SRS resource configuration as indicated by the higher layer parameter ~~*SRS-*~~ *resourceType*, which can be periodic, semi-persistent, aperiodic SRS transmission as defined in Subclause 6.4.1.4 of [4, TS 38.211].
- Slot level periodicity and slot level offset as defined by the higher layer parameters *periodicityAndOffset-p* or *periodicityAndOffset-sp* for an SRS resource of type periodic or semi-persistent. The UE shall not expect to be configured with SRS resources in the same SRS resource set *SRS-ResourceSet* with different slot level periodicities. For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to 'aperiodic', a slot level offset is defined by the higher layer parameter *slotOffset*.
- Number of OFDM symbols in the SRS resource, starting OFDM symbol of the SRS resource within a slot including repetition factor R as defined by the higher layer parameter *resourceMapping* and described in Subclause 6.4.1.4 of [4, TS 38.211].
- SRS bandwidth B_{SRS} and C_{SRS}, as defined by the higher layer parameter *freqHopping* and described in Subclause 6.4.1.4 of [4, TS 38.211].
- Frequency hopping bandwidth, b_{hop}, as defined by the higher layer parameter *freqHopping* and described in Subclause 6.4.1.4 of [4, TS 38.211].
- Defining frequency domain position and configurable shift to align SRS allocation to 4 PRB grid, as defined by the higher layer parameters *freqDomainPosition* and *freqDomainShift, respectively,* and described in Subclause 6.4.1.4 of [4, TS 38.211].
- Cyclic shift, as defined by the higher layer parameter *cyclicShift-n2* or *cyclicShift-n4* for transmission comb value 2 and 4, respectively, and described in Subclause 6.4.1.4 of [4, TS 38.211].
- Transmission comb value as defined by the higher layer parameter *transmissionComb* described in Subclause 6.4.1.4 of [4, TS 38.211].
- Transmission comb offset as defined by the higher layer parameter *combOffset-n2* or *combOffset-n4* for transmission comb value 2 or 4, respectively, and described in Subclause 6.4.1.4 of [4, TS 38.211].
- SRS sequence ID as defined by the higher layer parameter *sequenceId* in Subclause 6.4.1.4 of [4].
- The configuration of the spatial relation between a reference RS and the target SRS, where the higher layer parameter *spatialRelationInfo*, if configured, contains the ID of the reference RS. The reference RS can be an SS/PBCH block, CSI-RS or an SRS configured on the same or different component carrier and/or bandwidth part as the target SRS.

The UE may be configured by the higher layer parameter *resourceMapping* in *SRS-Resource* with an SRS resource occupying a location within the last 6 symbols of the slot.

When PUSCH and SRS are transmitted in the same slot, the UE may be configured to transmit SRS after the transmission of the PUSCH and the corresponding DM-RS.

For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* is set to 'periodic':

- if the UE is configured with the higher layer parameter *spatialRelationInfo* containing the ID of a reference 'ssb-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* contains the ID of a reference 'csi-RS-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* containing the ID of a reference 'srs', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS.

For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* is set to 'semi-persistent':

- when a UE receives an activation command [10, TS 38.321] for an SRS resource, and when the HARQ-ACK corresponding to the PDSCH carrying the selection command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on SRS transmission corresponding to the configured SRS resource set shall be applied

starting from slot $n+3N_{slot}^{subframe,\mu}+1$. The activation command also contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the activated SRS resource set. Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource, or SRS resource configured on the same or different component carrier and/or bandwidth part as the SRS resource(s) in the SRS resource set.

- if an SRS resource in the activated resource set is configured with the higher layer parameter *spatialRelationInfo*, the UE shall assume that the ID of the reference signal in the activation command overrides the one configured in *spatialRelationInfo.*
- when a UE receives a deactivation command [10, TS 38.321] for an activated SRS resource set, and when the HARQ-ACK corresponding to the PDSCH carrying the selection command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and UE assumption on cessation of SRS transmission corresponding to the deactivated SRS resource set shall apply starting from slot $n+3N_{slot}^{subframe,\mu}+1$.
- if the UE is configured with the higher layer parameter *spatialRelationInfo* containing the ID of a reference 'ssb-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* contains the ID of a reference 'csi-RS-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* contains the ID of a reference 'srs', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS.

If the UE has an active semi-persistent SRS resource configuration and has not received a deactivation command, the semi-persistent SRS configuration is considered to be active in the UL BWP which is active ~~when SRS resource configuration is activated~~, otherwise it is considered suspended.

For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* is set to 'aperiodic':

- the UE receives a configuration of SRS resource sets,
- the UE receives a downlink DCI, a group common DCI, or an uplink DCI based command where a codepoint of the DCI may trigger one or more SRS resource set(s). The minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is N_2 + 42.
- if the UE is configured with the higher layer parameter *spatialRelationInfo* containing the ID of a reference 'ssb-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* contains the ID of a reference 'csi-RS-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, or of the latest reference aperiodic CSI-RS. If the higher layer parameter *spatialRelationInfo* contains the ID of a reference 'srs', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS or of the reference aperiodic SRS.

The 2-bit SRS request field [5 TS38.212] in DCI format 0_1, 1_1 indicates the triggered SRS resource set given in Table 7.3.1.1.2-24 of [5, TS 38212]. The 2-bit SRS request field [5, TS38.212] in DCI format 2_3 indicates the triggered SRS resource set given in Subclause ~~11.4~~7.3 of [~~5~~6, TS 38.21~~2~~3].

For PUCCH formats 0 and 2, a UE shall not transmit SRS when semi-persistent and periodic SRS are configured in the same symbol(s) with PUCCH carrying only CSI report(s), or only L1-RSRP report(s) or if aperiodic SRS is configured and PUCCH consists of beam failure request. A UE shall not transmit SRS when semi-persistent or periodic SRS is configured or aperiodic SRS is triggered to be transmitted in the same symbol(s) with PUCCH carrying HARQ-ACK and/or SR. In the case that SRS is not transmitted due to overlap with PUCCH, only the SRS symbol(s) that overlap with PUCCH symbol(s) are dropped. PUCCH shall not be transmitted when aperiodic SRS is triggered to be transmitted to overlap in the same symbol with semi-persistent or periodic PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only.

A UE is not expected to be configured with aperiodic SRS and PUCCH formats 0 or 2 with aperiodic CSI report in the same symbol.

In case of intra-band carrier aggregation, a UE is not expected to be configured with SRS and PUSCH/UL DM-RS/UL PT-RS/PUCCH formats 1, 3 or 4 in the same symbol.

In case of intra-band carrier aggregation, AaUE shall not transmit simultaneously SRS resource(s) and PRACH.

When the UE is configured with the higher layer parameter *usage* in *SRS-ResourceSet* set to 'antennaSwitching,' and a guard period of Y symbols is configured according to Subclause 6.2.1.2, the UE shall use the same priority rules as defined above during the guard period as if SRS was configured.

----------End of TP ----------

----------Start of TP ----------

6.2.1.3 UE sounding procedure between component carriers

For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, the UE shall not transmit SRS whenever SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *rf-RetuningTimeUL* and *rf-RetuningTimeDL)* on the carrier of the serving cell and PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/CRI and/or PRACH happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in the *SRS_capability* [13, TS 38.306].
For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, the UE shall not transmit a periodic/semi-persistent ~~type 0~~ SRS whenever periodic/semi-persistent SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *rf-RetuningTimeUL* and *rf-RetuningTimeDL)* on the carrier of the serving cell and PUSCH transmission carrying aperiodic CSI happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in the *SRS_capability* [13, TS 38.306].
For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, the UE shall drop PUCCH/PUSCH transmission carrying periodic CSI comprising only CQI/PMI, and/or SRS transmission on another serving cell configured for PUSCH/PUCCH transmission whenever the transmission and SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *rf-RetuningTimeUL* and *rf-RetuningTimeDL)* on the serving cell happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in the *SRS_capability* [13, TS 38.306].
For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, the UE shall drop PUSCH transmission carrying aperiodic CSI comprising only CQI/PMI whenever the transmission and aperiodic SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133]) as defined by higher layer parameters *rf-RetuningTimeUL* and *rf-RetuningTimeDL)* on the carrier of the serving cell happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in the *SRS_capability* [13, TS 38.306].
For an aperiodic SRS triggered in DCI format 2_3 and if the UE is configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeA', and given by *SRS-CarrierSwitching,* without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells in the indicated set of serving cells configured by higher layers, where the UE in each serving cell transmits the configured one or two SRS resource set(s) with higher layer parameter ~~*SRS-SetUse*~~*usage* set to 'antenna switching' and higher layer parameter *resourceType* in *SRS-ResourceSet* set to 'aperiodic'.
For an aperiodic SRS triggered in DCI format 2_3 and if the UE is configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeB' without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells with aperiodic SRS triggered in the DCI, and the UE in each serving cell transmits the configured one or two SRS resource set(s) with higher layer parameter ~~*SRS-SetUse*~~*usage* set to 'antenna switching' and higher layer parameter *resourceType* in *SRS-ResourceSet* set to 'aperiodic'.
A UE can be configured with SRS resource(s) on a carrier c_1 with slot formats comprised of DL and UL symbols and not configured for PUSCH/PUCCH transmission. For carrier c_1, the UE is configured with higher layer parameter *srs-SwitchFromServCellIndex* and *srs-SwitchFromCarrier* the switching from carrier c_2 which is configured for PUSCH/PUCCH transmission. During SRS transmission on carrier c_1 (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *rf-RetuningTimeUL* and *rf-RetuningTimeDL*), the UE temporarily suspends the uplink transmission on carrier c_2.
If the UE is not configured for PUSCH/PUCCH transmission on carrier c_1 with slot formats comprised of DL and UL symbols, and if the UE is not capable of simultaneous reception and transmission on carrier c_1 and serving cell c_2, the UE is not expected to be configured or indicated with SRS resource(s) such that SRS transmission on carrier c_1 (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *rf-RetuningTimeUL* and *rf-RetuningTimeDL*) would collide with the REs corresponding to the SS/PBCH blocks configured for the UE or the slots belonging to a control resource set indicated by [*SystemInformationBlockType0*] or [*SystemInformationBlockType1*] on serving cell c_2.
For n-th ($n \geq 1$) aperiodic SRS transmission on a cell c, upon detection of a positive SRS request on a grant, the UE shall commence this SRS transmission on the configured symbol and slot provided

- it is no earlier than the summation of
  - the maximum time duration between the two durations spanned by N OFDM symbols of the numerology of cell c and the cell carrying the grant respectively, and

- the UL or DL RF retuning time [11, TS 38.133] as defined by higher layer parameters *rf-RetuningTimeUL* and *rf-RetuningTimeDL,*
- it does not collide with any previous SRS transmissions, or interruption due to UL or DL RF retuning time.

Otherwise, *n*-th SRS transmission is dropped, where N is the reported capability as the minimum time interval in unit of symbols, between the DCI triggering and aperiodic SRS transmission.

In case of inter-band carrier aggregation, a UE can simultaneously transmit SRS and PUCCH/PUSCH across component carriers in different bands subject to the UE's capability.

In case of inter-band carrier aggregation, a UE can simultaneously transmit PRACH and SRS/PUCCH/PUSCH across component carriers in different bands subject to UE's capability.

----------End of TP ----------

Agreement

Text proposal for 6.2.1 in TS38.214

----------Start of TP ----------

The UE may be configured by the higher layer parameter *resourceMapping* in *SRS-Resource* with an SRS resource occupying a location within the last 6 symbols of the slot.

When PUSCH and SRS are transmitted in the same slot, the UE ~~may~~ can only be configured to transmit SRS after the transmission of the PUSCH and the corresponding DM-RS.

----------End of TP ----------

Agreement

Text proposal for 6.2.1 in TS38.214

----------Start of TP ----------

/********** Omitted part **********/

For PUCCH formats 0 and 2, a UE shall not transmit SRS when semi-persistent and periodic SRS are configured in the same symbol(s) with PUCCH carrying only CSI report(s), or only L1-RSRP report(s) or if aperiodic SRS is configured and PUCCH consists of beam failure request. A UE shall not transmit SRS when semi-persistent or periodic SRS is configured or aperiodic SRS is triggered to be transmitted in the same symbol(s) with PUCCH carrying HARQ-ACK and/or SR. In the case that SRS is not transmitted due to overlap with PUCCH, only the SRS symbol(s) that overlap with PUCCH symbol(s) are dropped. PUCCH shall not be transmitted when aperiodic SRS is triggered to be transmitted to overlap in the same symbol with semi-persistent or periodic PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only.

~~A UE is not expected to be configured with aperiodic SRS and PUCCH formats 0 or 2 with aperiodic CSI report in the same symbol.~~

In case of intra-band carrier aggregation, a UE is not expected to be configured with SRS and PUSCH/UL DM-RS/UL PT-RS/PUCCH formats 1, 3 or 4 in the same symbol.

In case of intra-band carrier aggregation, a~~AaUE~~ UE shall not transmit simultaneously SRS resource(s) and PRACH.

When the UE is configured with the higher layer parameter *usage* in *SRS-ResourceSet* set to 'antennaSwitching,' and a guard period of Y symbols is configured according to Subclause 6.2.1.2, the UE shall use the same priority rules as defined above during the guard period as if SRS was configured.

----------End of TP ----------

R1-1809757 **Summary #1 for TRS** **MediaTek**

Agreement

Text proposal for TS38.214

----------Start of TP ----------

5.1.6.1.1 CSI-RS for tracking

----------omitted part----------

For a *NZP-CSI-RS-ResourceSet* configured with the higher layer parameter *trs-Info*, the UE shall assume the antenna port with the same port index of the configured NZP CSI-RS resources in the *NZP-CSI-RS-ResourceSet* is the same. For frequency range 1, the UE may be configured with one or more NZP-CSI-RS set(s), where a *NZP-CSI-RS-ResourceSet* consists of four periodic NZP CSI-RS resources in two consecutive slots with two periodic NZP CSI-RS resources in each slot. For frequency range 2 the UE may be configured with one or more NZP-CSI-RS set(s), where a *NZP-CSI-RS-ResourceSet* consists of two periodic CSI-RS resources in one slot or with a *NZP-CSI-RS-ResourceSet* of four periodic NZP CSI-RS resources in two consecutive slots with two periodic NZP CSI-RS resources in each slot.

A UE configured with *NZP-CSI-RS-ResourceSet(s)* configured with higher layer parameter *trs-Info* may have the CSI-RS resources configured as:

- Periodic, with the CSI-RS resources in the *NZP-CSI-RS-ResourceSet* configured with same periodicity, bandwidth and subcarrier location
- Periodic CSI-RS resource in one set and aperiodic CSI-RS resources in a second set, with the aperiodic CSI-RS and periodic CSI-RS resource having the same bandwidth (with same RB location) and the aperiodic CSI-RS being 'QCL-Type-A' and 'QCL-TypeD', where applicable, with the periodic CSI-RS resources. The UE does not expect that the scheduling offset between the triggering DCI and the first symbol of the aperiodic CSI-RS resources is smaller than the UE reported *ThresholdSched-Offset*. The UE shall expect that the periodic CSI-RS resource set and aperiodic CSI-RS resource set are configured with the same number of CSI-RS resources. For the aperiodic CSI-RS resource set if triggered, and if the associated periodic CSI-RS resource set is configured with four periodic CSI-RS resources with two consecutive slots with two periodic CSI-RS resources in each slot, the higher layer parameter *aperiodicTriggeringOffset* indicates the triggering offset for the first slot for the first two CSI-RS resources in the set.

----------End of TP ----------

Conclusion

No consensus on the support of semi-persistent TRS in Rel-15

Agreement

Text proposal for TS38.214

----------Start of TP ----------

5.1.6.1.1 CSI-RS for tracking

< Unchanged parts are omitted >

Each CSI-RS resource, defined in Subclause 7.4.1.5.3 of [4, TS 38.211], is configured by the higher layer parameter *NZP-CSI-RS-Resource* with the following restrictions:

- the periodicity and slot offset, as given by the higher layer parameter *periodicityAndOffset* configured by *NZP-CSI-RS-Resource*, is one of $2^{\mu} X_p$ slots where X_p =10, 20, 40, or 80 ~~ms~~ and where μ is defined in Subclause 4.3 of [4, TS 38.211].

----------End of TP ----------

Agreement

Text proposal for TS38.214

----------Start of TP ----------

5.1.6.1.1 CSI-RS for tracking

Periodic CSI-RS resource in one set and aperiodic CSI-RS resources in a second set, with the aperiodic CSI-RS and periodic CSI-RS resource having the same bandwidth (with same RB location) and the aperiodic CSI-RS being 'QCL-Type-A' and 'QCL-TypeD', where applicable, with the periodic CSI-RS resources. For frequency range 2, The UE does not expect that the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources is smaller than the UE reported *ThresholdSched-Offset*

----------End of TP ----------

R1-1809758 **Feature lead summary on QCL Nokia**

Agreement

The following text proposal is agreed

----------Start of TP ----------

---- *Unchanged parts omitted,* ***section 5.1.5 of 38.214*** ----

For a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* and without the higher layer parameter *repetition*, the UE shall expect that a *TCI-State* indicates one of the following quasi co-location type(s):

- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with the same CSI-RS resource, or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with an SS/PBCH block, or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or

- 'QCL-TypeB' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* when 'QCL-TypeD' is not applicable.

---- *Unchanged parts omitted,* ***section 5.1.5 of 38.214*** ----

----------End of TP ----------

Agreement

TP in Section 5.1.5 of 38.214 for the determination of QCL assumption before RRC configuration

----------Start of TP ----------

5.1.5 Antenna ports quasi co-location

< Unchanged parts are omitted >

For both the cases when *tci-PresentInDCI* is set to 'enabled' and *tci-PresentInDCI* is not configured in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *Threshold-Sched-Offset*, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the lowest *CORESET-ID* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE. If none of configured TCI states contains 'QCL-TypeD', the UE shall obtain the other QCL assumptions from the indicated TCI states for its scheduled PDSCH irrespective of the time offset between the reception of the DL DCI and the corresponding PDSCH.

----------End of TP ----------

Agreement

Text proposal for TS38.214

----------Start of TP ----------

5.2.1.4.3 L1-RSRP Reporting

For L1-RSRP computation

- the UE may be configured with CSI-RS resources, SS/PBCH Block resources or both CSI-RS and SS/PBCH block resources, when resource-wise quasi co-located with 'QCL-Type ~~A~~ C' and 'QCL-TypeD' when applicable.

----------End of TP ----------

R1-1809842 **Remaining issues on CSI-RS #2 Huawei, HiSilicon**

Agreement

Text proposal for Section 5.2.2.3.1 in 38.214:

< Start of text proposal >

- *repetition* in *NZP-CSI-RS-ResourceSet* is associated with a CSI-RS resource set and defines whether UE can assume the CSI-RS resources within the NZP-CSI-RS ResourceSet are transmitted with the same downlink spatial domain transmission filter or not ~~a repetition in conjunction with spatial domain transmission filter is on/off at gNB side can be assumed at the UE side~~ as described in Subclause 5.1.6.1.2. and can be configured only when the higher layer parameter *reportQuantity* associated with all the reporting settings linked with the CSI-RS resource set is set to 'cri-RSRP' or 'none'.
- *qcl-InfoPeriodicCSI-RS* contains a reference to a *TCI-State* indicating QCL source RS(s) and QCL type(s). If the *TCI-State* is configured with a reference to an RS with 'QCL-TypeD' association, that RS may be an SS/PBCH block located in the same or different CC/DL BWP or a CSI-RS resource configured as periodic located in the same or different CC/DL BWP.
- *trs-Info* in *NZP-CSI-RS-ResourceSet* is associated with a CSI-RS resource set and for which the UE can assume that the antenna port with the same port index of the configured NZP CSI-RS resources in the *NZP-CSI-RS-ResourceSet* is the same as described in Subclause 5.1.6.1.1 and can be configured when reporting setting is ~~un~~ not configured or ~~configured only~~ when the higher layer parameter *reportQuantity* associated with all the reporting settings linked with the CSI-RS resource set is ~~unconfigured or~~ set to 'none'.

< End of text proposal >

Agreement

- For multi-slot and single-slot PDSCH scheduling, the triggered aperiodic ZP CSI-RS is applied to all the slot(s) of the scheduled PDSCH.

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Agreement
- UE does not perform rate matching nor assumes puncturing on PDSCH REs overlapped with the REs for the triggered aperiodic NZP CSI-RS resource
- UE does not rate match PDSCH around the overlapped aperiodic ZP-CSI-RS resource scheduled by a DL DCI other than the one which scheduled this PDSCH

For further discussion until the next RAN1 meeting:
UE is not expected to be configured with NZP-CSI-RS resource(s) without functionality
- FFS on whether specification change is needed

For reference the following is provided for consideration until the next RAN1 meeting
A configured NZP-CSIRS resource falls under at least one of the cases below:
1) a NZP-CSI-RS resource is included in a configured NZP-CSI-RS resource set with a configured field "repetition" or "trs-info"
2) a NZP-CSI-RS resource is included in a configured NZP-CSI-RS resource set which is included by a configured CSI-ResourceConfig included in a configured CSI-ReportConfig
3) a NZP-CSI-RS resource is included in a configured "RadioLinkMonitoringRS" IE
4) a NZP-CSI-RS resource is included in a configured PUSCH-PathlossReferenceRS
5) a NZP-CSI-RS resource is included in a configured PUCCH-PathlossReferenceRS
6) a NZP-CSI-RS resource is included in a configured SRS-ResourceSet
7) a NZP-CSI-RS resource is included in a configured "SRS-SpatialRelationInfo"

R1-1809891 **Summary of DMRS Issues** **Qualcomm**

Agreement
DMRS of the PDSCH cannot be outside the scheduled OFDM symbols of the PDSCH

Agreement
TP: 38.211, v 15.2.0 Section 7.4.1.1.2
----------Start of TP ----------
For PDSCH mapping type B
- if the PDSCH duration is 2, 4, or 7 OFDM symbols for normal cyclic prefix or 2, 4, 6 OFDM symbols for extended cyclic prefix, and the PDSCH allocation collides with resources reserved for a CORESET, $\bar{l}$ shall be incremented such that the first DM-RS symbol occurs immediately after the CORESET and
  - if the PDSCH duration is 2 symbols, the UE is not expected to receive a DM-RS symbol beyond the second symbol,
  - if the PDSCH duration is 4 symbols, the UE is not expected to receive a DM-RS symbol beyond the third symbol,
  - if the PDSCH duration is 7 symbols for normal cyclic prefix or 6 symbols for extended cyclic prefix,
- the UE is not expected to receive the first DM-RS beyond the fourth symbol, and
- if one additional single-symbol DM-RS is configured, the UE only expects the additional DM-RS to be transmitted on the 5th or 6th symbol when the front-loaded DM-RS symbol is in the 1st or 2nd symbol, respectively, of the PDSCH duration, otherwise the UE should expect that the additional DM-RS is not transmitted.
- if the PDSCH duration is 2 or 4 OFDM symbols, only single-symbol DM-RS is supported.

----------End of TP ----------

R1-1809897 **Feature lead summary 2 of PT-RS** **Ericsson**

Agreement
TP for 38.214
----------Start of TP ----------
6.2.3.1 UE PT-RS transmission procedure when transform precoding is not enabled
<Unrelated part omitted>
~~For PT-RS, the transmit power of PT-RS is derived from ρ_{PTRS}^{PUSCH}, which is the power ratio between power of PUSCH and power of PT-RS per port.~~

When the UE is scheduled with Q_P={1,2} PT-RS port(s) in uplink and the number of scheduled layers is n_{layer}^{PUSCH},

- If the UE is configured with higher layer parameter *ptrs-Power*, the PUSCH to PT-RS power ratio per layer per RE ρ_{PTRS}^{PUSCH} is given by $\rho_{PTRS}^{PUSCH} = -\alpha_{PTRS}^{PUSCH}[dB]$, where α_{PTRS}^{PUSCH} is shown in the Table 6.2.3.1-3 according to the higher layer parameter *ptrs-Power*, the PT-RS scaling factor β_{PTRS} specified in subclause 6.4.1.2.2.1 of [4, TS 38.211] is given by $\beta_{PTRS} = 10^{\frac{\rho_{PTRS}^{PUSCH}}{20}}$ and also on the *Precoding Information and Number of Layers* ~~TPMI~~ field in DCI.
- The UE shall assume *ptrs-Power* in *PTRS-UplinkConfig* is set to state "00" in Table 6.2.3.1-3 if not configured or in case of non-codebook based PUSCH.

----------End of TP ----------

R1-1809814 **Summary of SRSSony**

Agreement

- For SRS for CB PUSCH and antenna switching on FR1, the minimal time internal between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is N2 symbols
  - Support of zero slot offset for aperiodic SRS triggering is UE capability
  - The time interval in units of OFDM symbols is counted based on the minimum subcarrier spacing between PDCCH and SRS

Above agreement does not change the switching time for SUL/UL
Above agreement only affects UE capability signalling from RAN2 perspective

Agreement
SRS dropping rule for same carrier
Aperiodic SRS resources > Semi-persistent SRS resources > Periodic SRS

- FFS: Whether Dropped SRS resource shall be at resource level or symbol level

Agreement

----------Start of TP for 38.214----------

- If the UE receives the DCI triggering aperiodic SRS in slot n, the UE transmits aperiodic SRS in each of the triggered SRS resource set(s) in slot $\left\lfloor n \cdot \frac{2^{\mu_{SRS}}}{2^{\mu_{PDCCH}}} \right\rfloor + k$ where k is configured via higher layer parameter *slotoffset* for each triggered SRS resources set and is based on the subcarrier spacing of the triggered SRS transmission, μ_{SRS} and μ_{PDCCH} are the subcarrier spacing configurations for triggered SRS and PDCCH carrying the triggering command ~~respectively.~~
- if the UE is configured with the higher layer parameter *spatialRelationInfo* containing the ID of a reference 'ssb-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* contains the ID of a reference 'csi-RS-Index', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, or of the latest reference aperiodic CSI-RS. If the higher layer parameter *spatialRelationInfo* contains the ID of a reference 'srs', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS or of the reference aperiodic SRS.

----------End of TP for 38.214----------

Agreement
Send LS to RAN2 and RAN4:

- From UE implementation perspective, RAN1 recommends RF retuning time(s) should be per band per band combination to signal retuning/interruption time from the band to other bands in the band combination.

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- To avoid performance loss, a single value (the maximum among all band combinations) for all band combinations is not recommended.

R1-1809931 **[Draft] reply LS on UE power class and UE capability on SRS carrier switch** **Huawei**
Decision: The draft LS is endorsed and final LS is approved in R1-1809889.

R1-1808144	Remaining issues on reference signals and QCL	Huawei, HiSilicon
R1-1808197	Maintenance for Reference signals and QCL	ZTE
R1-1808222	Remaining issues on reference signals and QCL	vivo
R1-1808312	Corrections on SRS antenna ports	Fujitsu
R1-1808376	Issues on reference signals	CATT
R1-1808488	Text proposals on reference signals	LG Electronics
R1-1808670	Corrections to reference signals and QCL	Intel Corporation
R1-1808751	Corrections on reference signals and QCL	Samsung
R1-1808801	Remaining issues on Reference signals	Spreadtrum Communications
R1-1808831	Discussion on remaining issues on SRS	CMCC
R1-1808881	Text proposals for RS and QCL	Guangdong OPPO Mobile Telecom
R1-1809054	Text Proposal on Reference Signal	AT&T
Withdrawn		
R1-1809107	Remaining issues on SRS	Sharp
R1-1809139	Maintenance for Reference signals and QCL	NTT DOCOMO, INC.
R1-1809198	Maintenance for RS and QCL	Ericsson
R1-1809238	Remaining issues on reference signals and QCL	Nokia, Nokia Shanghai Bell
R1-1809504	Maintenance for RS	Qualcomm Incorporated (rev of R1-1809424)

7.1.2.5 Other

Including handling simultaneous transmission and reception of different channels and reference signals

R1-1809820 **Summary of simultaneous Rx and Tx** **Intel**

Agreement
RAN1 expects that UE behavior for receiving the following combinations will be clarified in RAN4
- SSB-RRM/SSB-RLM/SSB-BFD/SSB-L1-RSRP in combination with PDSCH/PDCCH
- (CSI-RS RLM, CSI-RS RRM, CSIRS-BFD) in combination with (SSB SSB-RRM/SSB-RLM/SSB-BFD/SSB-L1-RSRP)
- (CSIRS-RRM, CSIRS-L1-RSRP-Rep-OFF) in combination with PDSCH
- Immediate RAN1 actions are not needed. RAN1 may discuss if needed following RAN4 decisions.

Send an LS to RAN4 (Bishwarup to draft LS)

Agreement
Send an LS to RAN4 with the following questions:

Question #1:
RAN1 requests RAN4 to clarify UE behaviour, if necessary, when a channel or RS in group 1 overlaps with a channel or RS in group 2 on the same OFDM symbol in the same serving cell or in different serving cells in the case of CA in FR2.

Case	Channels/RS in group 1	Channels/RS in group 2
1	SSB for L3 measurements, SSB for RLM, SSB for BFD, SSB for L1-RSRP measurements	CSI-RS for RLM, CSI-RS for L3 measurements, CSIRS for BFD, CSI-RS for L1-RSRP
2	CSIRS for L3 measurements, CSIRS with repetition=OFF for L1-RSRP measurements	PDSCH
3	CSIRS for L3 measurements, CSIRS with repetition=OFF for L1-RSRP measurements	PDCCH
4	CSI-RS for RLM, CSI-RS for L3 measurements, CSIRS for BFD, CSI-RS for L1-RSRP measurements	CSI-RS for RLM, CSI-RS for L3 measurements, CSIRS for BFD, CSI-RS for L1-RSRP measurements

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Question #2:
If scheduling restriction due to Rx beamforming is applied on certain symbols, is the NW allowed to schedule PDSCH that spans a time duration containing these symbols but with configured rate matching resources used for protecting the symbols such that the UE does not receive PDSCH on symbols with scheduling restriction applied?

R1-1809881 **draft LS on UE behaviour on reception of channels or RS in the same OFDM symbol** **Intel**
Decision: The draft LS is endorsed and final LS is approved in R1-1809890.

R1-1809882 **Guidance on simultaneous reception of channels or RS** **Intel**
Companies are encouraged to check the tdoc for discussions on simultaneous TX/RX in future RAN1 meetings

R1-1808142	Remaining issues on simultaneous reception or transmission over CCs and BWPs	Huawei, HiSilicon
R1-1808198	Simultaneous transmission and reception of channels/signals	ZTE
R1-1808199	Enhancements on multi-beam operation	ZTE
R1-1808201	Enhancements on Type II CSI feedback for MU-MIMO	ZTE
R1-1808202	Enhancements on multi-TRP transmission/reception	ZTE
R1-1808223	Remaining issues on simultaneous reception of DL/UL physical channels and RSs	vivo
R1-1808265	Discussions on simultaneous reception and transmission across CCs	MediaTek Inc.
R1-1808377	Discussion on simultaneous transmission and reception of different channels/signals	CATT
R1-1808489	Remaining issues on simultaneous Tx/Rx	LG Electronics
R1-1808671	Simultaneous Tx and Rx of channels and RS	Intel Corporation
R1-1808752	Simultaneous transmission and reception of physical channels and reference signals	Samsung
R1-1808832	Discussion on beam failure recovery	CMCC
R1-1809140	Simultaneous Tx/Rx of UL/DL physical channels and reference signals	NTT DOCOMO, INC.
R1-1809199	On simultaneous transmission and reception in FR2	Ericsson
R1-1809239	Correction on UL Antenna Port Indexing	Nokia, Nokia Shanghai Bell
R1-1809240	On simultaneous transmission and reception of multiplexed channels	Nokia, Nokia Shanghai Bell
R1-1809425	Details on simultaneous reception of PHY channels and RS in FR2	Qualcomm Incorporated

7.1.3 Maintenance for Scheduling/HARQ aspects

7.1.3.1 Maintenance for physical downlink control channel

Including PDCCH structure, search space, GC-PDCCH, DCI contents and formats, etc.

R1-1809766 **Offline summary for PDCCH structure and search space** **NTT DOCOMO**
Decision: The document is noted.

Conclusion:
- It is understood that the parameter "duration" in the search space configuration is applicable to any CSS configurations.

Agreements:
- PDCCH BD/CCE counting is only based on the configured PDCCH decoding candidates (i.e., irrespective of whether or not a PDCCH decoding candidate is dropped, e.g., due to collision with other channels/signals)
  - Check further offline on potential spec impact

Proposals:
- Send an LS to RAN2 regarding:
  - Whether RAN1's understanding of the limitation of RAN2 signalling of # of decoding candidates configured for the cross-carrier scheduled carriers is correct or not
    - If so, indicate RAN1's original intention and the limitations of the current RAN2 signalling (to give some example(s)), and ask RAN2 for possible update of the signalling to reflect RAN1's intention, if feasible (in terms of ASN.1 impact)
      - If not feasible, RAN1 will discuss further on how to handle

- Also discuss further offline same vs. different numerologies

Wednesday session

R1-1809855 Offline summary for PDCCH structure and search space NTT DOCOMO

Decision: The document is noted.

Conclusion:

- No new RRC signaling for TCI-state configuration for the CORESET#0 is introduced.
- No new MAC-CE for TCI-state indication for the CORESET#0 is introduced.
- FFS: Whether the existing RRC configuration and/or existing MAC-CE field can be used to configure/indicate dedicated TCI-state or SSB index for the CORESET#0
- FFS: Whether/how to support BFR for the CORESET#0

Agreements:

- From RAN1 perspective, the parameters *monitoringPeriodicity* and *nrofPDCCH-Candidates* under *dci-Format2-3* in the RRC IE *SearchSpace* have no use. It is up to RAN2 to delete or disable these two parameters
  - Note: No RAN1 spec impact is expected
- Send LS to RAN2 about the agreements – R1-1809856

R1-1809856 Draft LS on DCI format 2_3 NTT DOCOMO

Friday decision: The draft LS is endorsed and final LS is approved in R1-1809966.

Agreements: RAN1#93 agreements are updated as follows (to cover Case 5):

- For self-scheduling with same numerology or for cross-carrier scheduling with the same numerology for all the DL serving cells, and the number of DL-CCs is more than 4 and with up to T DL-CCs where the UE reports BD capability of y < T, the limit of BDs/CCEs per CC per slot is
  - The total number of BDs/CCEs across CCs is based on UE BD capability. It can be split across CCs, subject to the non-CA limit on each CC.
  - For SCell, NW ensures no overbooking based on non-CA case occurs. For cross-carrier scheduling, BDs/CCEs overlapped across DL serving cells are independently counted (i.e., counted per serving cell).

Proposals:

- For a UE monitors multiple search spaces associated with different CORESETs,
  - if the monitoring occasions of the search spaces are overlapped in time [or are separated less than Threshold-Sched-Offset in time], the UE may assume that the DM-RS of PDCCHs in the search spaces are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the lowest CORESET-ID among the CORESETs associated with the search spaces.

Agreement:

- Adopt following TP for TS 38.213 Section 10.

===== start of TP =====
If the UE is configured with a SCG, the UE shall apply the procedures described in this clause for both MCG and SCG except for PDCCH monitoring for Type0/0A/2-PDCCH common search spaces, in which case the UE is not required to apply the procedures in this clause for SCG.
===== end of TP =====

Agreements:

- Adopt following TP for TS38.211 Subclause 7.4.1.3.2.

===== start of TP =====
The reference point for k is

- subcarrier 0 of the lowest-numbered resource block in the CORESET if the CORESET is configured by the PBCH or by the *controlResourceSetZero* in the *PDCCH-ConfigCommon* ~~SIB1~~,
- subcarrier 0 in common resource block 0 otherwise

===== end of TP =====

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Agreements:
- To adopt the following TP to 38.213:

===== start of TP =====
10 UE procedure for receiving control information
[…]
If consistent control information is not detected in a PDCCH, the PDCCH is discarded.
[…]
===== end of TP =====

Agreement:
- The TP at the end of Section 3.5 in R1-1809855 is endorsed

Conclusion:
- At least for self-scheduling and for cross-carrier scheduling with the same numerology for all the DL serving cells, total number of CCEs or BDs corresponding to the remaining PDCCH candidates after PDCCH candidates are dropped based on the non-CA limit for the PCell (PSCell) and the configured PDCCH candidates for SCells is guaranteed by network to be no more than the CA limit.

Agreements:
- To adopt the following TP to TS 38.213 Section 10 (subject to Edtior's refining of wording):

===== start of TP =====
If the higher layer parameter *monitoringSymbolsWithinSlot* indicates to a UE ~~only one PDCCH monitoring occasion within a slot~~ to monitor PDCCH of all search space sets on a span of up to 3 consecutive OFDM symbols at the same position in every slot, the UE does not expect to be configured with a PDCCH subcarrier spacing other than 15 kHz ~~for the corresponding search space set s if the control resource set associated with the search space~~ if the span includes at least one symbol after the third symbol ~~in any~~ of the slot.
===== end of TP =====

Proposals:
- Adopt following TP for TS 38.213 Section 10.

If a UE is provided one or more search space sets by corresponding one or more higher layer parameters *searchSpaceZero, searchSpaceSIB1*, *searchSpaceOtherSystemInformation*, *pagingSearchSpace*, *ra-SearchSpace*, and the UE is provided with a C-RNTI or a CS-RNTI, the UE monitors PDCCH candidates for DCI format 0_0 and DCI format 1_0 with the C-RNTI or the CS-RNTI in the one or more search space sets whenever a DCI format associated with SI-RNTI, RA-RNTI, or P-RNTI, is monitored.

Friday session

Agreements:
- Send LS to RAN2:
  - RAN1 is discussing how the UE knows the number of PDCCH candidates for each scheduled cell in case of cross-carrier scheduling. RAN1's understanding is that:
    - Without ASN.1 signaling change with possible field description updates:
      - Search space with ID#*s* configuration configured on a BWP of a scheduled cell is used to determine the number of PDCCH candidate(s) for each aggregation level monitored in a search space with ID#*s* of a BWP of the scheduling cell for the BWP of the scheduled cell
    - Otherwise, RAN1 would like to know whether it is possible to realize previous RAN1 conclusion by modifying the ASN.1, e.g., update of *crossCarrierSchedulingConfig*, *PDCCH-Config*, *SearchSpace*, etc.
      - If not possible, RAN1 will discuss further on how to handle.
- In the LS, will include the previous RAN1 conclusion accordingly.

R1-1809968 Draft LS on cross-carrier scheduling NTT DOCOMO

Friday decision: The draft LS is endorsed and final LS is approved in R1-1810009.

Conclusion:

- The following is RAN1's common understanding (no spec impact):
  - For initial DL BWP of the PCell, PDCCH-ConfigCommon is provided by SIB1, and for other DL BWPs, PDCCH-ConfigCommon is provided by dedicated RRC signaling. For a SCell, PDCCH-ConfigCommon for any DL BWP is provided by dedicated RRC signalling. Then, PDCCH-ConfigCommon other than the initial DL BWP can be different from the PDCCH-ConfigCommon provided by SIB1. However, PDCCH-ConfigCommon has a description "The IE *PDCCH-ConfigCommon* is used to configure cell specific PDCCH parameters provided in SIB as well as during handover and PSCell/SCell addition". RAN1 view is that the PDCCH-ConfigCommon can be provided by dedicated RRC signalling also for each DL BWP of any cell including the PCell.
  - searchSpaceSIB1, searchSpaceOtherSystemInformation, paging-SeachSpace, and ra-SeachSpace can be associated with controlResourceSetZero or commonControlResourceSet in the PDCCH-ConfigCommon, or can be associated with controlResourceSet configured in the PDCCH-Config. However, the current description of commonControlResourceSet does not allow association to the searchSpaceSIB1, searchSpaceOtherSystemInformation, and paging-SeachSpace. Moreover, it is not clear whether searchSpaceSIB1, searchSpaceOtherSystemInformation, paging-SeachSpace, and ra-SeachSpace can be associate with controlResourceSet in the PDCCH-Config. RAN1's understanding is that these are possible.
  - After RRC connection setup, UE monitors common search space(s) based on the search space configuration(s) provided by PDCCH-ConfigCommon (which are Type0/0A/1/2-PDCCH common search spaces) and by PDCCH-Config (which is Type3 PDCCH-common search space).
  - If a UE is configured to monitor DCI format 0_0/1_0 in a CSS in the SearchSpace of the PDCCH-Config on the PCell, the UE monitors all the RNTIs that UE is configured to monitor, based on the SearchSpace configuration.

Send an LS to RAN2 regarding the first and the second sub-bullets above.

R1-1809969 Draft LS on higher layer configuration for search space monitoringNTT DOCOMO

Friday decision: The draft LS is endorsed with the update "review if the above", and final LS is approved in R1-1810010.

R1-1809970 Draft reply LS on PDCCH common search space configurations NTT DOCOMO

Friday decision: The draft LS is endorsed (by accepting all change marks), and final LS is approved in R1-1809971.

Agreements:

- To adopt the following TP to Section 11.1 of 38.213:

===== start of TP =====

- If the UE is configured by higher layers to receive a PDCCH, or a PDSCH, or a CSI-RS in the set of symbols of the slot, the UE receives the PDCCH, the PDSCH, or the CSI-RS if
  - the UE does not detect a DCI format 0_0, DCI format 0_1, DCI format 1_0, DCI format 1_1, or DCI format 2_3 that indicates to the UE to transmit a PUSCH, a PUCCH, a PRACH, or a SRS in at least one symbol of the set of symbols of the slot, or
  - ~~the UE detects a DCI format 0_0, DCI format 0_1, DCI format 1_0, DCI format 1_1, or DCI format 2_3 that indicates to the UE to transmit a PUSCH, a PUCCH, a PRACH, or a SRS in the set of symbols of the slot and a number of symbols between a last symbol of a control resource set where the UE detects the DCI format 0_0, DCI format 0_1, DCI format 1_0, DCI format 1_1, or DCI format 2_3 and a first symbol in the set of symbols is smaller than the PUSCH preparation time N_2 for the corresponding PUSCH timing capability [6, TS 38.214].~~

  Otherwise, the UE does not receive the PDCCH, or the PDSCH, or the CSI-RS in the set of symbols of the slot.
- If the UE is configured by higher layers to transmit a periodic SRS, or a PUCCH, or a PUSCH, or a PRACH in the set of symbols in the slot, the UE transmits the periodic SRS, or the PUCCH, or the PUSCH, or the PRACH in a symbol in the set of symbols of the slot if
  - the UE does not detect a DCI format 1_0, DCI format 1_1, or DCI format 0_1 that indicates to the UE to receive PDSCH or CSI-RS in the set of symbols in the slot, or
  - the UE detects a DCI format 1_0, DCI format 1_1, or DCI format 0_1 that indicates to the UE to receive PDSCH or CSI-RS in at least one symbol in the set of symbols in the slot and a number of symbols between a last symbol of a control resource set where the UE detects the DCI format 1_0, ~~or~~ DCI format 1_1, or DCI format 0_1 and ~~a first~~the symbol ~~in the set of symbols~~ is smaller than the PUSCH preparation time N_2 for the corresponding PUSCH timing capability.

  Otherwise, the UE does not transmit the periodic SRS, or the PUCCH, or the PUSCH, or the PRACH in the ~~set of~~ symbol~~s of the slot~~.

===== end of TP =====

R1-1809769 Summary of GC-PDCCH carrying SFI Qualcomm

Decision: The document is noted.

Agreement:

- In 38.213 Section 11.1.1, change log2(maxSFIindex) to $\mathbf{max}\left(\lceil \mathbf{log_2(maxSFIindex+1)} \rceil, \mathbf{1}\right)$ when computing the SFI field length.

Conclusion:

- On search space configuration of DCI format 2_0, currently 38.331 says

```
dci-Format2-0                           SEQUENCE {
        nrofCandidates-SFI                      SEQUENCE {
        aggregationLevel1                       ENUMERATED {n1, n2}
                    OPTIONAL,   -- Need R
        aggregationLevel2                       ENUMERATED {n1, n2}
                    OPTIONAL,   -- Need R
        aggregationLevel4                       ENUMERATED {n1, n2}
                    OPTIONAL,   -- Need R
        aggregationLevel8                       ENUMERATED {n1, n2}
                    OPTIONAL,   -- Need R
        aggregationLevel16                      ENUMERATED {n1, n2}
                    OPTIONAL    -- Need R
        },
        ...
                }
```

- RAN1 agreement is only support one AL. The 38.331 seems to allow multiple, which conflicts with the RAN1 agreement
- Send LS to RAN2 to update nrofCandidates-SFI accordingly. Draft LS in R1-1809761.

R1-1809761 **[draft] LS on search space configuration for DCI format 2_0** **Qualcomm**

Decision: The draft LS is endorsed (by updating "change ~~the~~ 38.331"). Final LS is approved in R1-1809774.

Wednesday session

R1-1809835 **Summary of contributions for GC-PDCCH carrying SFI** **Qualcomm**

Decision: The document is noted.

Agreements: Update the #92bis agreement as follows:

For cancellation of RRC configured transmission or reception by SFI or DCI, the cancellation is for a unit of transmission/reception if any OFDM symbol within the unit is cancelled by SFI.

- For RRC configured CSI-RS resource set, the cancellation unit is the CSI-RS resource set
- For RRC configured PDSCH and PUSCH with slot aggregation, the cancellation unit is the whole PDSCH or PUSCH within a slot
- For RRC configured PDSCH, PUCCH, and PUSCH without slot aggregation, the cancellation unit is the whole PDSCH, PUCCH, and PUSCH
- For RRC configured SRS transmission, the cancellation unit is OFDM symbol

Agreements:

- To adopt the following TP:

========== start of Text Proposal in Section 11.1 in TS 38.213==========

[…]

A UE expects $\mu_{\text{ref},2} = \mu_{\text{ref}}$.

A value $P_2 = 0.625$ msec is valid only for $\mu_{\text{ref},2} = 3$. A value $P_2 = 1.25$ msec is valid only for $\mu_{\text{ref},2} = 2$ or $\mu_{\text{ref},2} = 3$. A value $P_2 = 2.5$ msec is valid only for $\mu_{\text{ref},2} = 1$, or $\mu_{\text{ref},2} = 2$, or $\mu_{\text{ref},2} = 3$.

A slot configuration period of $P + P_2$ ~~slots~~ msec includes first $S = P \cdot 2^{\mu_{\text{ref}}}$ slots and second $S_2 = P_2 \cdot 2^{\mu_{\text{ref}}}$ $S_2 = P_2 \cdot 2^{\mu_{ref,2}}$ slots. From the S_2 slots, a first $d_{\text{slots},2}$ slots include only downlink symbols and a last $u_{\text{slots},2}$ include ~~only uplink~~ symbols. The $d_{\text{sym},2}$ symbols after the first $d_{\text{slots},2}$ slots are downlink symbols. The $u_{\text{sym},2}$ symbols before the last $u_{\text{slots},2}$ slots are uplink symbols. The remaining $\left(S_2 - d_{\text{slots},2} - u_{\text{slots},2}\right) \cdot N_{\text{symb}}^{\text{slot}} - d_{\text{sym},2} - u_{\text{sym},2}$ are flexible symbols.

[…]

For unpaired spectrum operation for a UE on a serving cell, the UE is provided by higher layer parameter *subcarrierSpacing* a reference subcarrier spacing configuration of μ_{SFI} for each slot format in a combination of slot formats indicated by

a SFI-index field value in DCI format 2_0. The UE expects that for a reference subcarrier spacing configuration of μ_{SFI} and for an active DL BWP ~~and~~ or an active UL BWP ~~pair~~ with subcarrier spacing configuration of μ, it is $\mu \geq \mu_{SFI}$. Each slot format in the combination of slot formats indicated by the SFI-index field value in DCI format 2_0 is applicable to $2^{(\mu-\mu_{SFI})}$ consecutive slots in the active DL BWP ~~and~~ or the active UL BWP ~~pair~~ where the first slot starts at a same time as a first slot for the reference subcarrier spacing configuration of μ_{SFI} and each downlink or flexible or uplink symbol for the reference subcarrier spacing configuration of μ_{SFI} corresponds to $2^{(\mu-\mu_{SFI})}$ consecutive downlink or flexible or uplink symbols for the subcarrier spacing configuration μ.

[…]

If a UE is configured by higher layers to transmit periodic SRS, or PUCCH, or PUSCH, or PRACH in a set of symbols of a slot and the UE detects a DCI format 2_0 with a slot format value other than 255 that indicates a slot format with a subset of symbols from the set of symbols as downlink or flexible, or the UE detects a DCI format 1_0, DCI format 1_1, or DCI format 0_1 indicating to the UE to receive CSI-RS or PDSCH in at least one symbol in the set of symbols, then

- the UE does not expect to cancel the transmission in symbols from the subset of symbols that occur, relative to a last symbol of a control resource set where the UE detects the DCI format 2_0, or the DCI format 1_0, or the DCI format 1_1, or the DCI format 0_1 after a number of symbols that is smaller than the PUSCH preparation time N_2 for the corresponding PUSCH timing capability [6, TS 38.214];
- the UE cancels the PUCCH, or PUSCH, or PRACH transmission in the remaining symbols of the slot and cancels the periodic SRS transmission in the subset of symbols of the slot.

A PUSCH preparation time N_2 throughout Subclause 11.1.1 is defined with respect to the subcarrier spacing of the PDCCH providing DCI format 2_0.

========== end of Text Proposal in Section 11.1 in TS 38.213==========

Agreements:

- To adopt the following TP:

========== Start of Text Proposal in Section 11.1 in TS 38.213 ==========

< ----------omitted---------- >

For a set of symbols of a slot, a UE does not expect to detect a DCI format 2_0 with an SFI-index field value indicating the set of symbols in the slot as downlink and to detect a DCI format 0_0, DCI format 0_1, DCI format 1_0, DCI format 1_1, ~~or~~ DCI format 2_3 , or UL grant carried by RAR, indicating to the UE to transmit PUSCH, PUCCH, PRACH, or SRS, in the set of symbols of the slot.

< ----------omitted---------->

For a set of symbols of a slot indicated to a UE as flexible by higher layer parameters *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationCommon2*, and *tdd-UL-DL-ConfigDedicated*, when provided to the UE, or when higher layer parameters *tdd-UL-DL-ConfigurationCommon*, *tdd-UL-DL-ConfigurationCommon2*, and *tdd-UL-DL-ConfigDedicated* are not provided to the UE, and if the UE detects a DCI format2_0 providing a format for the slot using a slot format value other than 255

< ----------omitted---------- >

- If an SFI-index field value in DCI format 2_0 indicates the set of symbols of the slot as flexible and the UE detects a DCI format 0_0, DCI format 0_1, DCI format 1_0, DCI format 1_1, ~~or~~ DCI format 2_3 , or UL grant carried by RAR, indicating to the UE to transmit PUSCH, PUCCH, PRACH, or SRS in the set of symbols of the slot the UE transmits the PUSCH, PUCCH, PRACH, or SRS in the set of symbols of the slot.
- If an SFI-index field value in DCI format 2_0 indicates the set of symbols of the slot as flexible, and the UE does not detect a DCI format 1_0, DCI format 1_1, or DCI format 0_1indicating to the UE to receive PDSCH or CSI-RS, or the UE does not detect a DCI format 0_0, DCI format 0_1, DCI format 1_0, DCI format 1_1, ~~or~~ DCI format 2_3 , or UL grant carried by RAR indicating to the UE to transmit PUSCH, PUCCH, PRACH, or SRS in the set of symbols of the slot, the UE does not transmit or receive in the set of symbols of the slot.

< ----------omitted---------- >

- A UE does not expect to detect an SFI-index field value in DCI format 2_0 indicating the set of symbols of the slot as downlink and also detect a DCI format 0_0, DCI format 0_1, DCI format 1_0, DCI format 1_1, ~~or~~ DCI format 2_3 , or UL grant carried by RAR indicating to the UE to transmit SRS, PUSCH, PUCCH, or PRACH, in one or more symbols from the set of symbols of the slot.

========== end of Text Proposal in Section 11.1 in TS 38.213 ==========

R1-1809701 **Summary of 7.1.3.1 (DCI contents and formats) Ericsson**
Decision: The document is noted.

Agreement:
- To adopt the following TP for DCI format 1-1 in 38.212:

===== start of TP =====
VRB-to-PRB mapping – 0 or 1 bit:
- 0 bit if only resource allocation type 0 is configured or if interleaved VRB-to-PRB mapping is not configured by higher layers;
- 1 bit according to Table 7.3.1.1.2-33 otherwise, only applicable to resource allocation type 1, as defined in Subclause 7.3.1.6 of [4, TS 38.211].

===== end of TP =====

Agreements:
- In TS 38.212:
  - Replace "transformPrecoder = enabled" by "transform precoder is enabled"
  - Replace "transformPrecoder = disabled" by "transform precoder is disabled"

Agreement:
- In 38.212, change the heading of Table 7.3.1.2.1-1 from "PUSCH frequency hopping" to "Short Message indicator"

Agreements:
- To adopt the following TP in Section 6.1.2.2.2 of 38.214

===== start of TP =====
In uplink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved virtual resource blocks within the active carrier bandwidth part of size N_{BWP}^{size} PRBs except for the case when DCI format 0_0 is decoded in any common search space ~~the Type0-PDCCH common search space in CORESET 0~~ in which case the initial bandwidth part of size N_{BWP}^{size} shall be used.

===== end of TP =====

Tuesday session
R1-1809797 **[DRAFT] Response LS on additional TDD configuration periodicities Nokia, Nokia Shanghai Bell**
Decision: The draft LS is endorsed and final LS is approved in R1-1809812.

Friday session
R1-1809983 **On offline discussion on DCI Ericsson**
Decision: The document is noted.

Agreement:
- Capture the following conclusion in 38.213 (with the clarification that "DCI" refers to "consistent DCI")
  - *7) Processing no more than one DCI with each RNTI in each of Type 0 CSS, Type 0A CSS, Type 1 CSS, Type 2 CSS, Type 3 CSS excluding unicast DCI per slot*

R1-1808069 Remaining issues on DL control Huawei, HiSilicon
R1-1809490 Remaining issues on NR DL Control ZTE (revision of R1-1808206)
R1-1808224 Remaining issues on PDCCH vivo
R1-1808262 Remaining issues in physical downlink control channel MediaTek Inc.
R1-1808378 Corrections to NR PDCCH CATT

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R1-1808490	Remaining issues on downlink control channel	LG Electronics
R1-1808614	NR TDD Configurations for LTE-NR co-existence	Apple Inc.
R1-1808672	Outstanding aspects on NR PDCCH	Intel Corporation
Withdrawn		
R1-1808753	Remaining Issues on PDCCH and Search Space Design	Samsung
R1-1808796	Remaining issues on PDCCH	Spreadtrum Communications
R1-1808833	Discussion on remaining issues for PDCCH and search space	CMCC
R1-1808869	Maintenance for physical downlink control channel	Panasonic Corporation
R1-1808952	On remaining details of DL control	Nokia, Nokia Shanghai Bell
R1-1809108	Remaining issues on DCI format	Sharp
R1-1809141	Maintenance for physical downlink control channel	NTT DOCOMO, INC.
R1-1809246	Remaining issues on downlink control channel	ASUSTEK COMPUTER (SHANGHAI)
R1-1809405	Maintenance issues of physical downlink control channel	Ericsson
R1-1809426	Maintenance for physical downlink control channel	Qualcomm Incorporated

7.1.3.2 Maintenance for physical uplink control channel

Including short/long PUCCH, UCI multiplexing, resource allocation, etc.

R1-1809751 **Summary of Maintenance Issues on Short PUCCH and UCI Multiplexing** **Ericsson**

Decision: The document is noted.

Agreements:

- To adopt the following TP (Section 6.3.2.2.1 of 38.211)

===== start of TP =====

where n_{ID} is given by the higher-layer parameter *hoppingId*, if the higher-layer parameter *hoppingId* is configured; otherwise, $n_{ID} = N_{ID}^{cell}$.

- if *pucch-GroupHopping* equals 'enable'

$$f_{\mathrm{gh}} = \left(\sum_{m=0}^{7} 2^m c\left(8\left(2n_{\mathrm{s,f}}^{\mu} + n_{\mathrm{hop}}\right) + m\right)\right) \bmod 30$$

$$f_{\mathrm{ss}} = n_{\mathrm{ID}} \bmod 30$$

$$v = 0$$

where the pseudo-random sequence $c(i)$ is defined by clause 5.2.1 and shall be initialized at the beginning of each radio frame with $c_{\mathrm{init}} = \lfloor n_{\mathrm{ID}}/30 \rfloor$ where n_{ID} is given by the higher-layer parameter *hoppingId*, if the higher-layer parameter *hoppingId* is configured; otherwise, $n_{ID} = N_{ID}^{cell}$.

- if *pucch-GroupHopping* equals 'disable'

$$f_{\mathrm{gh}} = 0$$

$$f_{\mathrm{ss}} = n_{\mathrm{ID}} \bmod 30$$

$$v = c\left(2n_{\mathrm{s,f}}^{\mu} + n_{\mathrm{hop}}\right)$$

where the pseudo-random sequence $c(i)$ is defined by clause 5.2.1 and shall be initialized at the beginning of each radio frame with $c_{\mathrm{init}} = 2^5\lfloor n_{\mathrm{ID}}/30 \rfloor + (n_{\mathrm{ID}} \bmod 30)$ where n_{ID} is given by the higher-layer parameter *hoppingId*, if the higher-layer parameter *hoppingId* is configured; otherwise, $n_{ID} = N_{ID}^{cell}$.

===== end of TP =====

Agreements:

- To adopt the following TP (Section 6.3.2.2.2 of 38.211)

===== start of TP =====

where the pseudo-random sequence $c(i)$ is defined by subclause 5.2.1. The pseudo-random sequence generator shall be initialized with $c_{\mathrm{init}} = n_{\mathrm{ID}}$, where n_{ID} is given by the higher-layer parameter *hoppingId*, if the higher-layer parameter *hoppingId* is configured; otherwise, $n_{ID} = N_{ID}^{cell}$.

===== end of TP =====

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Agreement:
- In Subclause 6.4.1.3.2 of TS 38.211, replace $r(m)$ with $r_l(m)$

R1-1809739 **Review Summary for Al 7.1.3.2 related to long PUCCH** **Huawei**
Decision: The document is noted.

Agreements:
For SP-CSI on configured PUSCH without UL-SCH colliding with a PUSCH with UL-SCH with overlapped symbols in time,
- If the timeline requirement for handling overlapped UCI over PUSCH is satisfied, drop SP-CSI and transmit PUSCH
- Otherwise, it is an error case. It is up to UE implementation to handle the error case.

Agreement:
- UE is not expected to be indicated 'UL-SCH indicator' = "0" and 'CSI request' = "zero(s)" (not triggered) in DCI format 0-1.

Wednesday
Conclusion (from offline consensus):
- It is clarified that NR Rel-15 supports multiple groups of overlapping PUCCH/PUSCH channels in a slot.

Thursday
R1-1809802 **Review Summary for Al 7.1.3.2 related to long PUCCH** **Huawei**
Decision: The document is noted.

Agreements:
When multi-slot PUCCH with repetition overlap with multi-slot PUCCH with repetition in time within the same PUCCH group
- The UE is not expected to have two overlapped multi-slot PUCCH transmissions with the same starting slot carrying UCI with the same proirity
- For UCI with the same priority, the PUCCH that starts in an earlier slot is transmitted.
- For UCI with different priority, the UCI PUCCH with higher priority is transmitted in overlapping slots if timeline requirement is met.
- Priority is defined as follows: HARQ-ACK > SR > CSI with higher priority >CSI with lower priority
- In overlapping slots, the de-prioritized UCI is dropped without any postponing of the transmission
- There is no impact on the transmission of the de-priortized UCI in the remaining non-overlapping slots
- FFS: multi-slot PUCCH with repetition overlap with single-slot PUCCH in time

Agreements:
- Pseudo-code in 9.2.5 of TS38.213 is applicable to overlapping PUCCH resources semi-statically configured
  - Note: timeline requirement for UCI multiplexing is not applied if none of these PUCCH resources correspond to DL SPS HARQ-ACK

Agreements:
- When a UE is not configured with multi-CSI-PUCCH report,
  - When SR occasion and/or DL SPS HARQ-ACK and two non-overlapping CSI PUCCH resources contained in Resource A and Set X (as defined in RAN1 #93 meeting) decided by the pseudo code (as in 9.2.5 of TS38.213) in a slot
    - DL SPS HARQ-ACK/SR is multiplexed on the CSI PUCCH resource with higher priority, and CSI on the CSI PUCCH resource with lower priority is dropped
      - In case of presence of DL SPS HARQ-ACK, multiplexing occurs if the corresponding timeline requirement is met, otherwise, it is considered as an error case

R1-1809806 **Summary of offline discussions on UCI multiplexing** **Ericsson**
Decision: The document is noted.

Proposals:

- Multiplex DL SPS AN/SR on CSI resource subject to timeline constraints as follows:
  - When HARQ-ACK for SPS PDSCH overlaps with configured PUCCH resource(s) for CSI and/or SR and/or configured PUSCH in a slot, the timeline for UCI multiplexing is defined such that
    - the earliest symbol among these PUCCHs/PUSCH starts no earlier than N1+X symbols after the last symbol of the corresponding SPS-PDSCH(s).
      - X is defined as agreed in RAN1#93.

Agreements:

- When grant-based PUSCH overlaps with configured PUCCH resource(s) for CSI and/or SR in a slot, the timeline requirement for UCI multiplexing on PUCCH or PUSCH is satisfied if the earliest symbol among these PUCCHs/PUSCH starts no earlier than N2+Y symbols after the last symbol of the DCI scheduling PUSCH.
  - Y is defined as agreed in RAN1#93.

Agreements:

- When PUSCH without corresponding DCI overlaps with configured PUCCH resource(s) for CSI and/or SR in a slot,
  - The timeline requirement for UCI multiplexing is not applicable
  - The pseudo-code in 9.2.5 of TS38.213 is applicable to resolve overlapping among PUCCH resources (if any)
  - After resolving overlapping among PUCCH resources (if any), the PUCCH UCI is multiplexed on the PUSCH without corresponding DCI if overlapping occurs.
  - Note: this does not apply to PUSCH as part of the activation

R1-1809927 Summary of PUCCH maintenance Qualcomm

Decision: The document is noted.

Agreements:

- The TP as in proposal 7 of R1-1809927 is endorsed (38.212)
- The TP as in proposal 8a of R1-1809927 is endorsed (38.212)
- The TP as in Section 2.3.3 of R1-1809927 is endorsed (38.213)

R1-1809827 Offline summary on maintenance for R15 NR PUCCH resource allocation OPPO

Decision: The document is noted.

Agreements:

- To adopt the following TP to 9.2.1 of 38.213

===== start of TP =====

If a UE does not have dedicated PUCCH resource configuration, provided by higher layer parameter *PUCCH-ResourceSet* in *PUCCH-Config*, a PUCCH resource set is provided by higher layer parameter *pucch-ResourceCommon* in *SystemInformationBlockType1* through an index to a row of Table 9.2.1-1 for transmission of HARQ-ACK information on PUCCH in an initial active UL BWP of $N_{\text{BWP}}^{\text{size}}$ PRBs provided by *SystemInformationBlockType1*. The PUCCH resource set is provided by higher layer parameter *PUCCH-Resource-Common* and includes sixteen resources, each corresponding to a PUCCH format, a first symbol, a duration, a PRB offset $RB_{\text{BWP}}^{\text{offset}}$, and a cyclic shift index set for a PUCCH transmission. An orthogonal cover code with index 0 is used for a PUCCH resource with PUCCH format 1 in Table 9.2.1-1. The UE transmits a PUCCH using frequency hopping. The UE transmits the PUCCH using the same spatial domain transmission filter as for the Msg3 PUSCH transmission.

===== end of TP =====

Proposals:

- To adopt the following TP to 9.2.1 of 38.213

If the UE provides HARQ-ACK information in a PUCCH transmission in response to detecting a DCI format 1_0 or DCI format 1_1, the UE determines a PUCCH resource with index r_{PUCCH}, $0 \le r_{\text{PUCCH}} \le 15$, as $r_{\text{PUCCH}} = \left\lfloor \frac{2 \cdot n_{\text{CCE},0}}{N_{\text{CCE},0}} \right\rfloor + 2 \cdot \Delta_{\text{PRI}}$, where

$N_{CCE,0}$ is a number of CCEs in a control resource set of a PDCCH reception conveying the DCI format 1_0 or DCI format 1_1, as described in Subclause 10.1, $n_{CCE,0}$ is the index of a first CCE for the PDCCH reception, and Δ_{PRI} is a value of the PUCCH resource indicator field in the DCI format 1_0 or DCI format 1_1.

Agreements:
- To adopt the following TP to 9.2.1 of 38.213

===== start of TP =====
A UE can be configured up to four sets of PUCCH resources by higher layer parameter *PUCCH-ResourceSet*. A PUCCH resource set is associated with a PUCCH resource set index provided by higher layer parameter *pucch-ResourceSetId*, with a set of PUCCH resource indexes provided by higher layer parameter *resourceList* that provides a set of *pucch-ResourceId* used in the PUCCH resource set, and with a maximum number of UCI information bits the UE can transmit using a PUCCH resource in the PUCCH resource set provided by higher layer parameter *maxPayloadMinus1*. For the first PUCCH resource set, the maximum number of UCI information bits is fixed to two. ~~For the PUCCH resource set with the largest index, other than the first one, the maximum number of UCI information bits is 1706.~~ A maximum number of PUCCH resource indexes for a set of PUCCH resources is provided by higher layer parameter *maxNrofPUCCH-ResourcesPerSet*. The maximum number of PUCCH resources in the first PUCCH resource set is 32 and the maximum number of PUCCH resources in the other sets of PUCCH resources is 8.
===== end of TP =====

Agreements:
- To adopt the following TP to 9.2.1 of 38.213

===== start of TP =====
- the UE determines the PRB index of the PUCCH transmission in the first hop as $RB_{BWP}^{offset} + \lfloor r_{PUCCH} / N_{CS} \rfloor$ and the PRB index of the PUCCH transmission in the second hop as $N_{BWP}^{size} - 1 - RB_{BWP}^{offset} - \lfloor r_{PUCCH} / N_{CS} \rfloor$, where N_{CS} is the total number of initial cyclic shift indexes in the set of initial cyclic shift indexes ~~set~~
- the UE determines the initial cyclic shift index in the set of initial cyclic shift indexes as $r_{PUCCH} \bmod N_{CS}$

===== end of TP =====

Friday session

R1-1809932 **Summary of Maintenance Issues on Short PUCCH** **Ericsson**

Decision: The document is noted.

Agreements:
- When HARQ-ACK corresponding to SPS PDSCH without scheduling DCI overlaps only with configured PUCCH resource(s) for CSI and/or SR and/or PUSCH resources with configured grant in a slot,
  - The timeline requirement for UCI multiplexing is satisfied if the earliest symbol among these PUCCH(s)/PUSCH(s) starts no earlier than N1+X symbols after the last symbol of the corresponding SPS-PDSCH(s).
    - X is defined as agreed in RAN1#93.
  - The pseudo-code in 9.2.5 of TS38.213 is applicable to resolve overlapping among PUCCH resources (if any)
  - After resolving overlapping among PUCCH resources (if any), the PUCCH UCI is multiplexed on the overlapping PUSCH resource with configured grant (if any).
  - Note: this does not apply to PUSCH or SPS PDSCH as part of the activation

Agreements:
- The TP in section 3.1 of R1-1809932 for 38.211, subclause 6.3.2.2.2 and 6.4.1.3.2.1, is endorsed
- The TP in section 3.2 of R1-1809932 for 38.211, subclause 6.3.2.5.1, is endorsed

Agreement:
- To adopt the following TP to 6.4.1.3.2.1 of 38.211:

===== start of TP =====
…….

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is given by the higher-layer parameter *scramblingID0* in the *DMRS-UplinkConfig* IE if provided and by N_{ID}^{cell} otherwise. If a UE is provided both *dmrs-UplinkForPUSCH-MappingTypeA* and *dmrs-UplinkForPUSCH-MappingTypeB, scramblingID0* is provided by *dmrs-UplinkForPUSCH-MappingTypeB.*
===== end of TP =====

R1-1809994 Summary of maintenance issues on frequency hopping Ericsson
Decision: The document is noted. further revised in **R1-1810011.**

Agreement:
- The two TPs in R1-1810011 are endorsed (38.211)

R1-1809976 Summary of PUCCH maintenance Qualcomm
Decision: The document is noted. Further revised in R1-1810003.

Agreements:
- For the determination of the number of PRBs in 38.213 section 9.2.5.1 and 9.2.5.2, O_{CRC}=11if the number of UCI bits is larger than or equal to 360; otherwise O_{CRC} is the number of CRC bits calculated based on the number of UCI bits, as determined in 38.212.

R1-1809517 Summary of RAN1#94 Tdocs on maintenance for R15 NR PUCCH resource allocation OPPO
R1-1809707 Specification Update on UL Control Incorporating Proposals in RAN1#94 Samsung

R1-1808103 Remaining issues for physical uplink control channel Huawei, HiSilicon
R1-1808207 Remaining issues on NR PUCCH ZTE
R1-1808225 Remaining issues on PUCCH vivo
R1-1808260 Remaining issues of PUCCH MediaTek Inc.
R1-1808313 Corrections on Subclause 9.2 UCI reporting in PUCCH in TS 38.213 Fujitsu
R1-1808363 Remaining issues on PUCCH NEC
R1-1809713 Corrections to UCI feedback procedures CATT (revision of R1-1808379)
R1-1808491 Correction on PUCCH and UCI multiplexing for NR LG Electronics
R1-1808620 Remaining issues on physical uplink control channel Panasonic Corporation
R1-1808673 Remaining details on NR PUCCH Intel Corporation
R1-1808754 Remaining Issues on PUCCH Samsung
R1-1808802 Remaining issues on UCI multiplexing Spreadtrum Communications
R1-1808812 Remaining issues about PUCCH ETRI
R1-1808893 Remaining issues for UL control Guangdong OPPO Mobile Telecom
R1-1808966 Remaining details on NR Physical UL Control Channel Nokia, Nokia Shanghai Bell
R1-1809513 Remaining issues on PUCCH Sharp (revision of R1-1809109)
R1-1809142 Maintenance for physical uplink control channel NTT DOCOMO, INC.
R1-1809321 Remaining issues on PUCCH WILUS Inc.
R1-1809406 Maintenance issues of physical uplink control channel Ericsson
R1-1809427 CRs for PUCCH Qualcomm Incorporated

7.1.3.3 Maintenance for DL/UL data scheduling and HARQ procedure

Including DL/UL resource allocation, DL/UL scheduling and HARQ management, CBG, UL data transmission procedure, soft-buffer management, multiplexing data with different tx durations, etc.

R1-1809702 Summary of 7.1.3.3 (resource allocation) Ericsson
Decision: The document is noted.

Proposal: Conclude whether interleaved VRB-to-PRB mapping is necessary for SIB1 prior to discussing which of the (potentially mutually incompatible) specification changes to adopt.

Interleaved VRB-to-PRB mapping is necessary for SIB1

Yes: Huawei, CATT
No: Ericsson

R1-1808105 **Remaining issues on data scheduling and HARQ Huawei, HiSilicon**

- Observation 1: Compared with non-interleaved VRB-to-PRB mapping, when the bandwidth of initial DL BWP is 24/48/96 RBs, 0.7/1.4/2.3 dB gain for SIBx (x ≥ 1) transmission is achieved by interleaved VRB-to-PRB mapping.
- Proposal 1: NR supports VRB-to-PRB interleaving for SIBx transmission.

Decision: The document is noted.

Agreements:

- To adopt the following TP to Section 4.3.2 of 38.211

===== start of TP =====

A UE not capable of full-duplex communication is not expected to transmit in the uplink earlier than $N_{\text{Rx-Tx}}T_c$ after the end of the last received downlink symbol in the same cell where $N_{\text{Rx-Tx}}$ is given by ~~[TS 38.101]~~ Table 4.3.2-3.

A UE not capable of full-duplex communication is not expected to receive in the downlink earlier than $N_{\text{Tx-Rx}}T_c$ after the end of the last transmitted uplink symbol in the same cell where $N_{\text{Tx-Rx}}$ is given by Table 4.3.2-3.

Table 4.3.2-3: Transition time $N_{\text{Rx-Tx}}$ and $N_{\text{Tx-Rx}}$.

Transition time	FR1	FR2
$N_{\text{Rx-Tx}}$	25600	13792
$N_{\text{Tx-Rx}}$	25600	13792

===== end of TP =====

Proposals:

- To adopt the following TP to section 5.1.2.2.2 of 38.214:

In downlink resource allocation of type 1, the resource block assignment information indicates to a scheduled UE a set of contiguously allocated non-interleaved or interleaved virtual resource blocks within the active bandwidth part of size N_{BWP}^{size} PRBs except for the case when DCI format 1_0 is decoded in any common search space ~~in CORESET 0~~ in which case the ~~initial bandwidth part of~~ size of the BWP $N_{\text{BWP},0}^{size}$ shall be used.

Agreements:

- To adopt the following TP to Section 8.3 of 38.213:

===== start of TP =====

The Msg3 PUSCH frequency resource allocation field is interpreted as follows:

- if $N^{size}_{BWP} \leq 180$
  - Truncate the Msg3 PUSCH frequency resource allocation to its b least significant bits, where $b = \lceil \log_2(N^{size}_{BWP}(N^{size}_{BWP}+1)/2) \rceil$, and interpret the truncated frequency resource allocation according to the rules for DCI format 0_0
- else
  - Insert b most significant bits with value set to '0' after the N_{UL_hop} hopping bits in the Msg3 PUSCH frequency resource allocation, where the number of hopping bits N_{UL_hop} is zero when the frequency hopping flag is not set to 1, and is defined in Table 8.3-1 when the hopping flag bit is set to1, and $b = (\lceil \log_2(N^{size}_{BWP}(N^{size}_{BWP}+1)/2) \rceil - 14)$, and interpret the expanded frequency resource allocation according to the rules for DCI format 0_0
- end if

===== end of TP =====

Agreements:

- Adopt the TP below for 38.214, Section 5.1.3.2:

===== start of TP =====

- the TBS is assumed to be as determined from the DCI transported in the latest PDCCH for the same transport block using $0 \leq I_{MCS} \leq 28$. If there is no PDCCH for the same transport block using $0 \leq I_{MCS} \leq 28$, and if the initial PDSCH for the same transport block is semi-persistently scheduled, the TBS shall be determined from the most recent semi-persistent scheduling assignment PDCCH.

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The UE is not expected to receive a PDSCH assigned by a PDCCH with CRC scrambled by SI-RNTI with a TBS exceeding 2976 bits.

For the PDSCH assigned by a PDCCH with DCI format 1_0 with CRC scrambled by P-RNTI, or RA-RNTI, TBS determination follows the steps 1-4 with the following modification in step 2: a scaling $N_{info} = S \cdot N_{RE} \cdot R \cdot Q_m \cdot \upsilon$ is applied in the calculation of Ninfo, where the scaling factor is determined based on the TB scaling field in the DCI as in Table 5.1.3.2-3.

===== end of TP =====

Agreements:

- To adopt the following TP to 7.4.1.1.2 of 38.211:

===== start of TP =====

The reference point for k is

- ~~for PDSCH transmission carrying SIB1,~~ subcarrier 0 of the lowest-numbered common resource block in ~~the~~ CORESET 0 ~~configured by the PBCH~~ if the corresponding PDCCH is associated with CORESET 0 and Type0-PDCCH common search space and is addressed to SI-RNTI,
- otherwise, subcarrier 0 in common resource block 0

===== end of TP =====

Agreements:

- To adopt the following TP of 8.2 of 38.213:

===== start of TP =====

~~If higher layer parameter *pusch-AllocationList* is provided by *pusch-ConfigCommon*, a value of the Msg3 PUSCH time resource allocation field indicates an entry to a table provided by *pusch-AllocationList*, otherwise a value of the Msg3 PUSCH time resource allocation field indicates an entry to default time resource allocation table [6, 38.214].~~

===== end of TP =====

Proposals:

- To adopt the following TP of 5.1.2.1 of 38.214:

If a bandwidth part indicator field is not configured in the scheduling DCI, the slot and symbol indexing for downlink type 0 and type 1 resource allocation is determined within the UE's active bandwidth part. If a bandwidth part indicator field is configured in the scheduling DCI, the slot and symbol indexing for downlink type 0 and type 1 resource allocation is determined within the UE's bandwidth part indicated by bandwidth part indicator field value in the DCI.

When the UE is configured with *aggregationF*actorDL > 1, the same symbol allocation is applied across the *aggregationFactorDL* consecutive slots. The UE may expect that the TB is repeated within each symbol allocation among each of the *aggregationFactorDL* consecutive slots and the PDSCH is limited to a single transmission layer. The redundancy version to be applied on the nth transmission occasion of the TB is determined according to table 5.1.2.1-2.

Wednesday session

R1-1809839 **Outcome of offline discussion on 7.1.3.3 (resource allocation)** **Ericsson**

Decision: The document is noted.

Agreement:

- The UE counts the number of DCI sizes across slots based on RRC configuration for PDCCH, without taking into account PDCCH candidate dropping by overbooking handling.

Agreements:

- The TPs in Section 2 of R1-1809839 are endorsed

Thursday session

R1-1809928 **Outcome of offline discussion on 7.1.3.3 (resource allocation) – part II** **Ericsson**

Decision: The document is noted.

Agreements:

- Adopt the text proposal in Section 2 of R1-1809928 for 38.211
- Remove the bracket in 38.212 around the VRB-to-PRB bit

Agreements:
For OSI and paging:

- if PDSCH-ConfigCommon has provided a table
  - Use this table
- else
  - the same table (A, B, or C) as used by SIB1

Adopt the TP below for 38.214

Table 5.1.2.1.1-1: Applicable PDSCH time domain resource allocation

RNTI	PDCCH search space	SS/PBCH block and CORESET multiplexing pattern	*pdsch-ConfigCommon* includes *pdsch-TimeDomainAllocationList*	*pdsch-Config* includes *pdsch-TimeDomainAllocationList*	PDSCH time domain resource allocation to apply
SI-RNTI	Type0 common	1	-	-	Default A for normal CP
		2	-	-	Default B
		3	-	-	Default C
SI-RNTI	Type0A common	1	No	-	Default A
		2	No	-	Default B
		3	No	-	Default C
		1,2,3	Yes	-	*pdsch-TimeDomainAllocationList* provided in *pdschConfigCommon*
RA-RNTI, TC-RNTI~~,~~	Type1 common	1, 2, 3	No	-	Default A
		1, 2, 3	Yes	-	*pdsch-TimeDomainAllocationList* provided in *pdschConfigCommon*
P-RNTI	Type2 common	1	No	-	Default A
		2	No	-	Default B
		3	No	-	Default C
		1,2,3	Yes	-	*pdsch-TimeDomainAllocationList* provided in *pdschConfigCommon*
C-RNTI, CS-RNTI	Any common search space associated with CORESET#0	1, 2, 3	No	-	Default A
		1, 2, 3	Yes	-	*pdsch-TimeDomainAllocationList* provided in *pdschConfigCommon*
C-RNTI, CS-RNTI	Any common search space not associated with CORESET#0 UE specific search space	1,2,3	No	No	Default A
		1,2,3	Yes	No	*pdsch-TimeDomainAllocationList* provided in *pdsch-ConfigCommon*
		1,2,3	No/Yes	Yes	*pdsch-TimeDomainAllocationList* provided in *pdsch-Config*

Friday session

R1-1809977 **Outcome of offline session on data rates and TB size limitation** **Ericsson**

Decision: The document is noted.

Working assumption:

A UE is not required to handle overlapped PDSCH/PUSCH transmissions not fulfilling the following condition at all points in time:

$$\sum_{j=0}^{N-1}\{C'_j \times K_{r,j}/D_j\} \le DataRate$$

- Note: the summation may need to be refined – e.g., considering summation over R code blocks indexed by r
- C_j' is the number of scheduled code blocks of the transport block in the j-th PDSCH/PUSCH (from 38.212)

- $K_{r,j}$ is the number of bits in r-th code block of the j-th PDSCH/PUSCH
- D_j is the duration of the j-th PDSCH/PUSCH (= #symbols * symbol duration)
- *DataRate* is computed by the approximate date rate given by Subcluase 4.1.2 in [13, TS 38.306] based on the following:
  - Applying per frequency range per CG only
    - ~~N is the number of configured NR carriers of the frequency range of the CG~~
- The PDSCHs/PUSCHs for j = 0 to N-1 overlapping or partially overlapping PDSCH/PUSCH transmission
- FFS In addition to limiting the number of information bits as above, constraints on the number of coded bits may be needed.
- Symbol duration $Ts^{\mu} = 10^{-3}/(N_{symb}^{slot} \times 2^{\mu})$, where μ is the numerology for the PDSCH/PUSCH and N_{symb}^{slot} is the number of symbols per slot

R1-1809997 **Summary of offline discussion on LBRM** **Ericsson**
Discussion: Some companies can not agree as it may change the behaviour in RAN2 spec.
Decision: The document is noted.

Agreement:
- The proposals in R1-1809997 is taken as a working assumption

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R1-1809776 **Summary for DL/UL data scheduling maintenance** **Qualcomm**
Decision: The document is noted.

Agreements:
The following agreement is extended to include RRC_INACTIVE. Text proposals for 38.214 and 38.202 should also be adopted to capture additional related specification details and corrections.
- For UE behavior in RRC_IDLE and RRC_INACTIVE, if PDSCHs among SI-RNTI PDSCH, P-RNTI PDSCH, and RA-RNTI/TC-RNTI PDSCH are overlapped with at least one symbol for a given UE from the primary cell
  - NR supports UE to decode up to two PDSCH simultaneously in Pcell, but not more than two (if more than two are received, the decoding prioritization is up to UE implementation)
  - Note: the above assumes that all the PDSCHs to be decoded by the UE have non-overlapped PRBs

Agreements:
- If a first DCI has indicated a first PUCCH resource for HARQ-ACK bits associated to the PDSCH scheduled by this DCI
  - If due to a second DCI, additional HARQ-ACK bits are to be multiplexed on the same slot as the first PUCCH resource, the UE is not expected to multiplex additional HARQ-ACK bits if the last symbol of second DCI is not earlier than N OFDM symbols before first symbol of the first PUCCH resource, where for UE Capability #1 the N values are:
    - 15 kHz case: 8
    - 30 kHz case: 10
    - 60 kHz case: 17
    - 120 kHz case: 20
    - FFS values to be used for Capability #2 (e.g., 3, 4.5, and 9 for 15kHz, 30kHz, and 60kHz respectively)

Agreement:
- For Capability #2, the processing time for UCI multiplexing should be extended by d symbols using the same values and conditions as used for Capability #1.

Agreements:
- The processing requirement for HARQ-ACK in response to DL SPS release is N OFDM symbols from last symbol of the corresponding PDCCH for UE Capability #2:
  - 15 kHz case: 5

- 30 kHz case: 5.5
- 60 kHz case (FR1 only): 11

Thursday session

R1-1809894 **Summary for DL/UL data scheduling maintenance** **Qualcomm**

Decision: The document is noted.

Agreements:

- Confirm the working assumption for N1 with Capability #2 and the following change
  - (working assumption) For PDSCH mapping type B with 4 or 2 symbols
    - N1 processing time is increased by 'd' symbols relative to the case of PDSCH with 7 symbols, where 'd' is the amount of time-domain overlap in symbols between the scheduling PDCCH and the scheduled PDSCH
      - ~~FFS: handling of 3-symbol CORESET where first 2 symbols of CORESET are overlapped with a 2-symbol PDSCH~~
      - For a DCI received in a 3-symbol CORESET where first 2 symbols of CORESET are overlapped with 2-symbol PDSCH scheduled by this DCI, then d=3

Agreements:

- For a UE indicating Capability #2 N1 with maximum scheduled RB allocation of 136 RBs
  - The UE may skip decoding a number of PDSCHs with last symbol within 10 symbols before the start of a PDSCH that is scheduled to follow Capability #2, if any of those PDSCHs are scheduled with more than 136 RBs with 30kHz SCS and following Capability #1 processing time.

Agreements:

- To adopt the following TP to 5.1 of 38.214

===== start of TP =====

On a frequency range 1 cell, the UE shall be able to decode a PDSCH scheduled with C-RNTI or CS-RNTI and, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI that partially or fully overlap in time in non-overlapping PRBs, unless the PDSCH scheduled with C-RNTI or CS-RNTI requires Capability #2 processing time according to subclause 5.3 in which case the UE may skip decoding of the scheduled PDSCH with C-RNTI or CS-RNTI.

On a frequency range 2 cell, the UE is not expected to decode a PDSCH scheduled with C-RNTI or CS-RNTI if in the same cell, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI partially or fully overlap in time in non-overlapping PRBs.

The UE is expected to decode a PDSCH scheduled with C-RNTI or CS-RNTI during a process of autonomous SI acquisition.

===== end of TP =====

Agreements:

- Send LS to RAN2 to requesting them to make [0..15] applicable for K1 – draft LS in R1-1809930 (Joseph, QC)
  - Note that from 38.331 vf2, RAN2 already has [0…15] as values.

```
dl-DataToUL-ACK                     SEQUENCE (SIZE (1..8)) OF INTEGER (0..15)
                    OPTIONAL,   -- Need M
```

- But in the field description below, the range is limited. Removing this limitation in the field description will enable the requested change.

PUCCH-Config field descriptions
dl-DataToUL-ACK
List of timing for given PDSCH to the DL ACK. ~~In this version of the specification only the values [0..8] are applicable.~~ Corresponds to L1 parameter 'Slot-timing-value-K1' (see TS 38.213, section FFS_Section).

Friday session

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R1-1809930 [DRAFT] LS on K1 Slot Offset Qualcomm
Decision: The draft LS is endorsed and final LS is approved in R1-1809982.

Observation:
The following are noted by RAN1 as already supported in 38.331
- The scheduling parameters K0 and K2 may be configured from the set of values {0,1,2,3,…,32}

Working assumption:
- The UE is not required to store more than 16 scheduling DCI for PDSCH on a given cell, among all scheduling DCI received prior and up to the current slot
  - FFS the applicability to broadcast PDSCH or not
  - FFS the applicability to activation/deactivation DCI
- The UE is not required to store more than 16 scheduling DCI for PUSCH on a given cell, among all scheduling DCI received prior and up to the current slot

R1-1809953 UE Processing Time and UCI Multiplexing TPs for 38.213 and 38.214 Qualcomm
Decision: The document is noted. Companies are encouraged to check R1-1809953.

R1-1809767 Offline summary for UL data transmission procedure NTT DOCOMO
Decision: The document is noted.

Proposals:
- To adopt the following TP to 8.3 of 38.213:

An UL BWP, as described in Subclause 12 and in [4, TS 38.211], for Msg3 PUSCH transmission is indicated by higher layers. When determining the frequency domain resource allocation for Msg3 PUSCH transmission within the active UL BWP, the initial UL BWP shall be used, if the active BWP and the initial BWP have the same and the active BWP includes all the PRBs of the initial BWP, or the active BWP is the initial BWP. Otherwise the active UL BWP shall be used.

Proposals:
- For MSG3 transmission and retransmission, when transform precoding is enabled, UE ignores the previously configured UE-specific parameters by dedicated signalling (for sequence hopping and mcs-tableTransformProcoder) but only applies cell-specific parameters. Sequence hopping should be considered as disabled for DMRS sequence generation, MCS table for transform precoder applies the value 64QAM. Further, groupHoppingEnabledTransformPrecoding in PUSCH-ConfigCommon should be interpreted as follows: (1) absent: both group hopping and sequence hopping disabled; (2) enabled: group hopping enabled, sequence hopping disabled; (3) disabled: group hopping disabled, sequence hopping disabled
- For PUSCH transmission including configured grant, if transform precoding is enabled, it follows the same default configuration as MSG3 transform precoding if dedicated signalling parameters are absent. Sequence hopping should be considered as disabled for DMRS sequence generation, MCS table for transform precoder applies the value 64QAM

In RAN2, there is an on-going discussion on how the default assumptions/values for L1 parameters are captured in the specs. They may ask us to check/capture the default assumptions/values. Once above is agreed, the agreements captured in the same way as other L1 parameters.

Thursday session
R1-1809898 Corrections on UL data transmission procedure NTT DOCOMO
Decision: The document is noted.

Agreements:
- To adopt the following TP to 8.3 of 38.213

===== start of TP =====

An UL BWP, as described in Subclause 12 and in [4, TS 38.211], for Msg3 PUSCH transmission is indicated by higher layers.

When determining the frequency domain resource allocation for Msg3 PUSCH transmission within the active UL BWP, the initial UL BWP shall be used, if the active UL BWP and the initial UL BWP have the same SCS and the same CP length and the active UL BWP includes all the PRBs of the initial UL BWP, or the active UL BWP is the initial UL BWP.

Otherwise the RB numbering for the scheduled PUSCH starts from starting RB of the active UL BWP and the maximum number of RBs possible for resource allocation is given by the size of the initial UL BWP.

===== end of TP =====

Agreements:

- For MSG3 transmission and retransmission, when transform precoding is enabled, UE ignores the previously configured UE-specific parameters by dedicated signalling (for sequence hopping) but only applies cell-specific parameters. Sequence hopping should be considered as disabled for DMRS sequence generation. Further, groupHoppingEnabledTransformPrecoding in PUSCH-ConfigCommon should be interpreted as follows: (1) absent: both group hopping and sequence hopping disabled; (2) enabled: group hopping enabled, sequence hopping disabled.
- For PUSCH transmission including configured grant, if transform precoding is enabled, it follows the same default configuration as MSG3 transform precoding if dedicated signalling parameters are absent. Sequence hopping should be considered as disabled for DMRS sequence generation.

Agreements:

- The TP in Section 2.3 in R1-1809898 is endorsed (38.214)
- The TP in Section 2.4 in R1-1809898 is endorsed (38.213)

- For a scheduled retransmission of a TB previously transmitted on a configured PUSCH, the UE follows
- Option 1: the set of parameters provided in *configuredGrantConfig IE* that are common to both Type1 and Type2 configured grant – i.e. except those provided specifically for Type1 in *rrc-ConfiguredUplinkGrant IE*. For all other parameters not provided in *configuredGrantConfig*, including those in *rrc-ConfiguredUplinkGrant*, the UE follows the transmission configuration provided by the *PUSCH-Config IE*.
  - Pros: simple and no additional issues.
  - Cons: May lose some scheduling flexibility
- Option 2: the set of transmission parameters provided by the *PUSCH-Config IE*.
  - Pros: May have some scheduling flexibility
  - Cons:
    - ambiguity on the DCI scrambled by CS-RNTI is used for (de)activation or re-transmission

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R1-1809765 **Summary on CBG based retransmission LG Electronics**
Decision: The document is noted.

R1-1809734 **Summary of 7.1.3.3 (Soft Buffer Management) Ericsson**
Decision: The document is noted.

R1-1809763 **Summary of multiplexing data with different tx durations vivo**
Decision: The document is noted.

Agreements:

- To adopt the following TP of 11.2 of 38.213 (Section 3 of R1-1809763):

===== start of TP =====

11.2 Interrupted transmission indication

< Unchanged parts are omitted >

If a UE detects a DCI format 2_1 for a serving cell from the configured set of serving cells, the UE may assume that no transmission to the UE is present in PRBs and in symbols that are indicated by DCI format 2_1, from a set of PRBs and a set of symbols of the last monitoring period~~, that are indicated by the DCI format 2_1~~. The indication by the DCI format 2_1 is not applicable to receptions of SS/PBCH blocks.
The set of PRBs is equal to the active DL BWP as defined in Subclause 12 and includes B_{INT} PRBs.
If a UE detects a DCI format 2_1 in a PDCCH transmitted in a control resource set in a slot, the set of symbols ~~indicated by a field in DCI format 2_1 includes~~ is the last $N_{\mathrm{symb}}^{\mathrm{slot}} \cdot T_{\mathrm{INT}} \cdot 2^{\mu - \mu_{INT}}$ symbols prior to the first symbol of the control resource set in the slot where T_{INT} is the PDCCH monitoring periodicity provided by the value of higher layer parameter *monitoringSlotPeriodicityAndOffset*, as described in Subclause 10.1, $N_{\mathrm{symb}}^{\mathrm{slot}}$ is the number of symbols per slot, μ is the subcarrier spacing configuration for a serving cell with mapping to a respective field in the DCI format 2_1, μ_{INT} is the subcarrier spacing configuration of the DL BWP where the UE receives the PDCCH conveying the DCI format 2_1. If the UE is configured with higher layer parameters *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL- ConfigurationCommon2*, symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL- ConfigurationCommon2* are excluded from the last $N_{\mathrm{symb}}^{\mathrm{slot}} \cdot T_{\mathrm{INT}} \cdot 2^{\mu - \mu_{INT}}$ symbols prior to the first symbol of the control resource set in the slot. The resulting set of symbols includes a number of symbols that is denoted as N_{INT}.

The UE does not expect to be provided values of μ, μ_{INT}, and T_{INT} resulting to a value of $N_{\mathrm{symb}}^{\mathrm{slot}} \cdot T_{\mathrm{INT}} \cdot 2^{\mu - \mu_{INT}}$ that is not an integer. For DCI format 2_1, the UE does not expect to be configured with more than one PDCCH monitoring occasions in a slot, by higher layer parameter *monitoringSymbolsWithinSlot.*

< Unchanged parts are omitted >

===== end of TP =====

Wednesday

R1-1809838 Summary for DL/UL data scheduling maintenance Qualcomm

Decision: The document is noted.

Agreements:

The following UE capabilities are added:

- Duplicate 5-11,5-11a,5-11b for Capability #2
  - Note: 5-11,5-11a,5-11b will be associated only with Capability #1
- Duplicate 5-12,5-12a,5-12b for Capability #2
  - Note: 5-12,5-12a,5-12b will be associated only with Capability #1

R1-1808210 Remaining Issues of NR scheduling and HARQ process ZTE
R1-1808226 Remaining issues on scheduling and HARQ vivo
R1-1808261 Remaining issues of DLUL data scheduling and HARQ procedure MediaTek Inc.
R1-1808380 Corrections to DL/UL scheduling and HARQ management CATT
R1-1808492 Discussion on DL/UL data scheduling and HARQ procedure LG ELECTRONICS
R1-1809731 NR scheduling and HARQ procedures Intel Corporation (revision of R1-1808674)
R1-1808755 Remaining Issues on UL/DL Scheduling Samsung
R1-1808808 Remaining issues on DL/UL data scheduling and HARQ procedure Spreadtrum Communications
R1-1808870 Maintenance for DL/UL data scheduling and HARQ procedure Panasonic Corporation
R1-1808887 Text proposal for DL/UL data scheduling and HARQ procedure Guangdong OPPO Mobile Telecom
R1-1809051 38.214 Text Proposal to align PUSCH-AllocationList and PDSCH-AllocationList to ASN.1 SPRINT Corporation
R1-1809060 Remaining details on PDSCH time domain resource allocation AT&T
R1-1809110 Remaining issues on Msg3 PUSCH frequency resource allocation Sharp
R1-1809143 Maintenance for DL/UL data scheduling and HARQ procedure NTT DOCOMO, INC.
R1-1809297 Discussion on Remaining issues on HARQ-ACK bundling and multiplexing China Telecommunications
R1-1809322 Remining issues on DL/UL data scheduling and HARQ procedure WILUS Inc.
R1-1809392 Remaining issues on resource allocation and UE processing times Nokia, Nokia Shanghai Bell
R1-1809407 Maintenance issues of DL/UL data scheduling and HARQ procedure Ericsson
R1-1809428 Maintenance for DL/UL data scheduling and HARQ procedure Qualcomm Incorporated

R1-1809949 Proposal for Data rate and TBS Ericsson
R1-1809957 Above Peak-Rate Skip-Decoding Rule Qualcomm Incorporated
R1-1809980 General principle of re-transmission of PUSCH with configured grant NTT DOCOMO

7.1.3.4 Maintenance for carrier aggregation and bandwidth parts

R1-1809773 **Summary of Bandwidth Part Remaining Issues MediaTek**
Decision: The document is noted.

Agreements:

- **Issue #1:** In case multiplexing pattern 2 or 3 is used for the initial DL BWP, for an active DL BWP that overlaps with the initial DL BWP but not with the SS/PBCH block associated to the initial DL BWP, is it possible for the UE to:
  - **Question #1a:** Perform BM based on the SS/PBCH block associated to the initial DL BWP?
    - **Answer:** No, a UE is not expected to perform BM based on the SS/PBCH block outside the active DL BWP. Note that the scenario can be supported with appropriate CSI-RS configuration.
  - **Question #1b:** Perform BFD based on the SS/PBCH block associated to the initial DL BWP?
    - **Answer:** No, a UE is not expected to perform BFD based on the SS/PBCH block outside the active DL BWP. Note that the scenario can be supported with appropriate CSI-RS configuration.
  - **Question #1c:** Perform RLM based on the SS/PBCH block associated to the initial DL BWP?
    - **Answer:** No, a UE is not expected to perform RLM based on the SS/PBCH block outside the active DL BWP. Note that the scenario can be supported with appropriate CSI-RS configuration.
  - **Question #1d:** Monitor the SS/PBCH block associated to the initial DL BWP to receive broadcast SI / paging based on CORESET#0 and searchspace#0? (assuming the same SCS is used in the active BWP as that of initial BWP)
    - **Answer:** No, a UE is not expected to monitor the SS/PBCH block outside the active DL BWP and associated to the initial DL BWP to receive broadcast SI / paging based on CORESET#0 and searchspace#0.
- **Issue #2:** For an active DL BWP that overlaps with neither the initial DL BWP nor with the SS/PBCH block associated to the initial DL BWP (from now on: "non-overlapping" active DL BWP), RAN2 understands that additional CORESET/search space(s) need to be configured in the active DL BWP to provide SI broadcast and paging to a connected UE. What is not clear is whether an SS/PBCH block necessarily needs to be associated to the additional CORESET/search space(s) and, specifically, if a UE needs to monitor such SS/PBCH block.
  - **Question #2a:** In a "non-overlapping" active DL BWP, does a UE necessarily need to monitor an SS/PBCH block associated to the additional CORESET/search space to be able to receive SI broadcast? If yes, could this be the SS/PBCH block associated to the initial DL BWP? And under which conditions, if any, could the UE monitor it for this purpose?
    - **Answer:** No, a UE does not necessarily need to monitor an SS/PBCH block associated to the additional CORESET/search space to be able to receive SI broadcast. The UE can be configured with TCI states for the additional CORESET/search space to enable SI broadcast reception.
  - **Question #2b:** In a "non-overlapping" active DL BWP, does a UE necessarily need to monitor an SS/PBCH block associated to the additional CORESET/search space to be able to receive paging? If yes, could this be the SS/PBCH block associated to the initial DL BWP? And under which conditions, if any, could the UE monitor it for this purpose?
    - **Answer:** No, a UE does not necessarily need to monitor an SS/PBCH block associated to the additional CORESET/search space to be able to receive paging. The UE can be configured with TCI states for the additional CORESET/search space to enable paging reception.

R1-1809800 **[Draft] reply LS on active DL BWPs overlapping/non-overlapping with initial DL BWP MediaTek**
Decision: The document is endorsed and final LS is approved in R1-1809810.

Offline Proposal:

- For the support of Option #2 at least in PSCell & SCell, modify the agreements in RAN1#92bis as follows.
  - When monitoring for DCI in a BWP, the size of DCI format 0-0/1-0 is given by
    - For format 0-0/1-0 (regardless of RNTI) in CSS, the size is given by ~~the initial DL BWP~~CORESET0

        - For format 0-0/1-0 in USS, the size is given by the active BWP as long as the DCI size budget is fulfilled
            - Otherwise, for format 0-0/1-0, the size is given by ~~the initial DL BWP~~CORESET0
    - For DCI format 1-0 in CSS with P-RNTI, SI-RNTI, RA-RNTI, C-RNTI, CS-RNTI, or TC-RNTI:
        - the RB numbering for the scheduled PDSCH starts from the lowest RB in the CORESET the DCI is received in
        - the maximum number of RBs possible to indicate in the DCI is given by the size of ~~the initial DL BWP~~CORESET0.
        - Note: P-RNTI & SI-RNTI are only applicable to PCell (if supported)
    - Payload sizes for 2-2 and 2-3 are padded (if needed) to match the size of formats 0-0/1-0 ~~as defined by the initial BWP~~ in CSS
- Send LS to RAN2 stating that there is no consensus on whether to support Option #2 in PCell in RAN1

Thursday session

R1-1809929 **Summary of Bandwidth Part Remaining Issues MediaTek**

Decision: The document is noted.

Agreements:

- To adopt the following TP to section 12 of 38.213:

===== start of TP =====

If a UE is configured by higher layer parameter *bwp-InactivityTimer* a timer value for the primary cell [11, TS 38.321] and the timer is running, the UE increments the timer every interval of 1 millisecond for frequency range 1 or every 0.5 milliseconds for frequency range 2 ~~if the UE does not detect a DCI format for PDSCH reception on the primary cell for paired spectrum operation or~~ if ~~the UE does not detect a DCI format for PDSCH reception or a DCI format for PUSCH transmission on the primary cell for unpaired spectrum operation~~ the restarting conditions in [11, TS 38.321] are not met during the interval ~~[11, TS 38.321]~~.

If a UE is configured by higher layer parameter ~~BWP-InactivityTimer~~ *bwp-InactivityTimer* a timer value for a secondary cell [11, TS 38.321] and the timer is running, the UE increments the timer every interval of 1 millisecond for frequency range 1 or every 0.5 milliseconds for frequency range 2 ~~if the UE does not detect a DCI format for PDSCH reception on the secondary cell for paired spectrum operation or~~ if ~~the UE does not detect a DCI format for PDSCH reception or a DCI format for PUSCH transmission on the secondary cell~~ the restarting conditions in [11, TS 38.321] are not met during the interval ~~for unpaired spectrum operation during the interval~~. ~~The UE may deactivate the secondary cell when the timer expires.~~

===== end of TP =====

Agreements:

- To adopt the following TP to section 12 of 38.213:

===== start of TP =====

- set the active UL BWP or DL BWP to the UL BWP or DL BWP indicated by the bandwidth part indicator in the DCI format 0_1 or DCI format 1_1, respectively.

A UE does not expect to detect a DCI format 1_1 or DCI format 0_1 indicating active DL or UL BWP change with a time domain resource assignment field value providing a slot offset K_0 or K_2 for corresponding PDSCH reception or PUSCH transmission that is smaller than the active DL or UL BWP switching delay required by the UE [TS 38.133].

If a UE detects DCI format 1_1 indicating active DL BWP change for a cell, the UE is not required to receive or transmit in that cell during a time duration from the end of the 3rd OFDM symbol of a slot containing the PDCCH carrying DCI format 1_1 indicating active DL BWP change in the scheduling cell till the beginning of a slot indicated by K_0 in the DCI format 1_1.

If a UE detects DCI format 0_1 indicating active UL BWP change for a cell, the UE is not required to receive or transmit in that cell during a time duration from the end of the 3rd OFDM symbol of a slot containing the PDCCH carrying DCI format 0_1 indicating active UL BWP change in the scheduling cell till the beginning of a slot indicated by K_2 in the DCI format 0_1.

A UE expects to detect a DCI format 0_1 indicating active UL BWP change, or a DCI format 1_1 indicating active DL BWP change, only if a corresponding PDCCH is received within the first 3 symbols of a slot.

===== end of TP =====

Agreements:

- To adopt the following TP in section 12 of 38.213

===== start of TP =====

If a UE is configured by higher layer parameter BWP-InactivityTimer a timer value for a secondary cell [11, TS 38.321] and the timer is running, the UE increments the timer every interval of 1 millisecond for frequency range 1 or every 0.5 milliseconds for frequency range 2 if the UE does not detect a DCI format for PDSCH reception on the secondary cell for paired spectrum operation or if the UE does not detect a DCI format for PDSCH reception or a DCI format for PUSCH transmission on the secondary cell for unpaired spectrum operation during the interval. The UE may deactivate the secondary cell when the timer expires.

In a cell where the active DL BWP changes due to BWP inactivity timer expiration, a UE is not required to receive or transmit in that cell during a time duration from the beginning of the subframe for frequency range 1 or the half of a subframe for frequency range 2 immediately after a BWP inactivity timer expires till the beginning of the slot the UE is able receive DL signals or transmit UL signals to accommodate the BWP switching delay required by the UE [TS 38.133].

===== end of TP =====

Proposals:

- Modify the agreements in RAN1#92bis as follows.
  - When monitoring for DCI in a BWP, the size of DCI format 0-0/1-0 is given by
    - For format 0-0/1-0 (regardless of RNTI) in CSS, the size is given by ~~the initial DL BWP~~CORESET#0
    - For format 0-0/1-0 in USS, the size is given by the active BWP as long as the DCI size budget is fulfilled
      - Otherwise, for format 0-0/1-0, the size is given by ~~the initial DL BWP~~CORESET#0
  - For DCI format 1-0 in CSS with P-RNTI, SI-RNTI, RA-RNTI, C-RNTI, CS-RNTI, or TC-RNTI:
    - the RB numbering for the scheduled PDSCH starts from the lowest RB in the CORESET the DCI is received in
    - the maximum number of RBs possible to indicate in the DCI is given by the size of ~~the initial DL BWP~~CORESET#0.
  - Payload sizes for 2-2 and 2-3 are padded (if needed) to match the size of formats 0-0/1-0 ~~as defined by the initial BWP~~ in CSS
- For PSCell and SCell,
  - The initial DL BWP of a cell can be configured to be the same as or larger than CORESET#0 of the cell
  - The initial DL BWP of a cell includes CORESET#0 of the cell in frequency domain
- Note (earlier agreements) For PCell,
  - The initial DL BWP of a cell is defined as the frequency location and bandwidth of CORESET#0 of the cell, which was agreed and captured in the current spec
- There is no consensus on whether to support Option #2 in PCell
- Send LS to RAN2 stating that there is no consensus on whether to support Option #2 in PCell in RAN1 (including informing the above agreements)

Friday session

R1-1809961 Summary of Bandwidth Part Remaining Issues MediaTek

Decision: The document is noted.

Agreements:

- Modify the agreements in RAN1#92bis as follows.
  - When monitoring for DCI in a BWP, the size of DCI format 0-0/1-0 is given by
    - For format 0-0/1-0 (regardless of RNTI) in CSS, the size is given by ~~the initial DL BWP~~CORESET#0
    - For format 0-0/1-0 in USS, the size is given by the active BWP as long as the DCI size budget is fulfilled
      - Otherwise, for format 0-0/1-0, the size is given by ~~the initial DL BWP~~CORESET#0
  - For DCI format 1-0 in CSS with P-RNTI, SI-RNTI, RA-RNTI, C-RNTI, CS-RNTI, or TC-RNTI:
    - the RB numbering for the scheduled PDSCH starts from the lowest RB in the CORESET the DCI is received in

        - the maximum number of RBs possible to indicate in the DCI is given by the size of ~~the initial DL BWP~~CORESET#0.
    - Payload sizes for 2-2 and 2-3 are padded (if needed) to match the size of formats 0-0/1-0 ~~as defined by the initial BWP~~ in CSS
- Modify the agreements in RAN1#91 as follows if Option #2 is supported in PCell
    - CORESET configured by RMSI is confined within ~~the initial DL BWP~~the bandwidth of CORESET#0
- For PCell, the initial DL BWP can be configured in SIB1 to be the same as or different with the initial DL BWP as initially defined by CORESET#0
    - The initial DL BWP configured in SIB1 includes the bandwidth of CORESET#0
    - If the initial DL BWP configured by SIB1 is different with the initial DL BWP as initially defined by CORESET#0, the configuration of the initial DL BWP configured by SIB1 is applicable after the initial access
- For PSCell and SCell, the initial DL BWP of a cell can be configured to be the same as or different with the initial DL BWP as defined by CORESET#0 of the cell
    - The initial DL BWP of a cell includes the bandwidth of CORESET#0 of the cell
- Note: RAN1 assumes that the above agreements related to PCell, PSCell and SCell have no RAN1 specification impact and will be captured in RAN2 specs
- Send LS to RAN2 to ask RAN2 to capture the above agreements related to PCell, PSCell and SCell in RAN2 specs

R1-1810000 [Draft] LS on bandwidth configuration for initial BWP MediaTek
Decision: The document is endorsed and final LS is approved in R1-1810002.

R1-1809811 CA Offline Session 1 Samsung
Decision: The document is noted.

Agreement:
- Use *firstActiveDownlinkBWP* as reference BWP for a deactivated SCell for semi-static HARQ codebook determination.

Thursday session
R1-1809848 CA Offline Session 2 Samsung
Decision: The document is noted.

Agreements:
- To support fallback operation for semi-static HARQ-ACK codebook on a PUSCH subject to the following conditions
    - DAI in UL grant is equal to 0 (when PUSCH is in response to detection of an UL grant)
    - Include in section 9.1.2.2 the following (exact text subject to editorial adjustments)
        - If a UE reports HARQ-ACK information in a PUSCH only for a SPS PDSCH release or only for a PDSCH reception within the occasions for candidate PDSCH receptions, as determined in Subclause 9.1.2.1, that is scheduled by DCI format 1_0 with a counter downlink assignment indicator (DAI) field value of 1 on the PCell, the UE determines a HARQ-ACK codebook only for the SPS PDSCH release or only for the PDSCH reception

Agreements:
- For determination of Type 1 (semi-static) HARQ-ACK codebook, the SLIV values are the union of the SLIV values in the default table and the SLIV values in the table provided by UE-dedicated RRC

Friday session
R1-1809988 CA Offline Session 3 Samsung
Decision: The document is noted. Companies are encouraged to check slide 4 of R1-1809988.

Agreements:
- The UE multiplexes HARQ-ACK in any slot of a multi-slot PUSCH transmission where the UE would otherwise transmit HARQ-ACK in a single slot PUCCH transmission, based on the HARQ timeline
- DAI is applicable in any slot where the UE would transmit HARQ-ACK

R1-1809706	Specification Update on HARQ-ACK Codebooks Incorporating Proposals in RAN1#94	Samsung	
R1-1809752	Remaining issues on bandwidth part and CA	Huawei, HiSilicon	(revision of R1-1808104)
R1-1808208	Remaining issues on BWP	ZTE	
R1-1808270	Remaining issues on bandwidth part operation	MediaTek Inc.	
R1-1808381	Corrections on carrier aggregation and bandwidth part operation	CATT	
R1-1808493	Correction on CA and BWP operation for NR	LG Electronics	
R1-1808756	Remaining Issues on BWP and CA	Samsung	
R1-1808805	Remaining issues on bandwidth parts and carrier aggregation	Spreadtrum Communications	
R1-1808894	Text proposals for HARQ-ACK transmission	Guangdong OPPO Mobile Telecom	
R1-1808953	On remaining details of BWPs and CA	Nokia, Nokia Shanghai Bell	
R1-1809144	Maintenance for carrier aggregation and bandwidth parts	NTT DOCOMO, INC.	
R1-1809183	Latency due to bandwidth part switching	ITRI	
R1-1809247	Remaining issue on BWP	ASUSTEK COMPUTER (SHANGHAI)	
R1-1809323	Remaining issues on HARQ-ACK transmission on CA	WILUS Inc.	
R1-1809408	Remaining issues related to CA and BWP operation	Ericsson	
R1-1809429	Maintenance for carrier aggregation and bandwidth parts	Qualcomm Incorporated	

7.1.3.5 Other

Including rate matching, TA, etc.

R1-1809746 Summary of maintenance related to rate-matching in NR Nokia, Nokia Shanghai Bell
Decision: The document is noted.

Agreements:

- To adopt the following TP (Section 2.1 of R1-1809746):

===== start of TP =====

7.4.3.1 Time-frequency structure of an SS/PBCH block

< Unchanged parts are omitted >

The UE may assume that the complex-valued symbols corresponding to resource elements that are part of a common resource block partially or fully overlapping with an SS/PBCH block and not used for SS/PBCH transmission are set to zero in the OFDM symbols that partially or fully overlapping with OFDM symbols where SS/PBCH is transmitted. ~~where SS/PBCH block is transmitted.~~

< Unchanged parts are omitted >

===== end of TP =====

Agreement:
Update the following agreement as follows:
When a PDCCH candidate collides with ~~any~~ RB-level resource (RateMatchPattern) configured without controlResourceSetId, where PDSCH is semi-statically not mapped, as described in TS38.214 Section 5.1.4.1 then

- The UE is not required to monitor the PDCCH candidate overlapping with the resource even only by one RE
- Note: the current spec already reflects the above updated agreements

Thursday session
R1-1809846 Summary of offline on maintenance related to rate-matching in NR Nokia, Nokia Shanghai Bell
Decision: The document is noted.

Agreements:

- To adopt the following TP to 5.1.4 of 38.214:

===== start of TP =====

within a BWP, a frequency domain resource of a CORESET with *controlResourceSetId* and time domain resource determined by the higher layer parameters *monitoringSlotPeriodicityAndOffset, duration* and *monitoringSymbolsWithinSlot* of search-space-sets configured by *SearchSpace* and time domain resource of search-space-set zero configured by *pdcch-ConfigSIB1 or searchSpaceZero* associated with the CORESET with *controlResourceSetId* as well

as CORESET *duration* configured by *ControlResourceSet* with *controlResourceSetId*. This resource not available for PDSCH can be included in one or two groups of resource sets (higher layer parameters *rateMatchPatternGroup1* and *rateMatchPatternGroup2*).
===== end of TP =====

Agreements:
- To adopt the following TP to 5.1.4.1 of 38.214:

===== start of TP =====
If a PDSCH scheduled by a PDCCH would overlap with resources in the CORESET containing the PDCCH, ~~otherwise~~ the resources corresponding to a union of the detected PDCCH that scheduled the PDSCH and associated PDCCH DM-RS are not available for the PDSCH. When *precoderGranularity* configured in a CORESET where the PDCCH was detected is equal to *allContiguousRBs*, the associated PDCCH DMRS are DMRS in all REGs of the CORESET. Otherwise, the associated DMRS are the DMRS in REGs of the PDCCH.
===== end of TP =====

Agreements:
- When configured with higher-layer parameter *RateMatchPatternLTE-CRS* for a serving cell in unpaired spectrum, UE assumes LTE CRS are present for rate matching in DL and flexible symbols based on NR TDD UL/DL semi-static configuration.
  - Note: Also subject to MBSFN configured in *RateMatchPatternLTE-CRS*.
  - Further check whether there is any specification impact

Proposal:
- When UE is configured to rate-match around the LTE CRS, it rate-matches also around the center carrier provided with the configuration in the symbols containing LTE CRS

Agreements:
- To adopt the following TP to 7.3.1.2.2 of 38.212:

===== start of TP =====
- Rate matching indicator – 0, 1, or 2 bits according to higher layer parameters *rateMatchPatternGroup1* and *rateMatchPatternGroup2*.

===== end of TP =====

Discuss further Section 3.2 of R1-1809846
Friday
Agreement:
- The TP in Section 3.2 in R1-1809846 (before the wording "offline consensus") for Section 5.1.4.1 of 38.214 is endorsed

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Wednesday
R1-1809824 Summary of TA related aspects Panasonic
Decision: The document is noted.

Thursday
R1-1809910 Summary of TA related aspects Panasonic
Decision: The document is noted.

Agreement: The TP in Section 3 of R1-1809910 is endorsed (38.213)

R1-1808209 Remaining aspects for rate matching ZTE
R1-1808314 Corrections on Type 1 HARQ-ACK codebook on PUCCH Fujitsu
R1-1808315 Corrections on HARQ-ACK codebooks on PUSCH Fujitsu
R1-1808382 Corrections on rate matching CATT
R1-1808494 TA command reception with dynamic BWP change LG ELECTRONICS

R1-1808803 Remaining issues on PDSCH rate matchingSpreadtrum Communications
R1-1808871 TP on rate matching Subclause 5.1.4 in TS38.214 Panasonic Corporation
R1-1808928 On the number of CRC bits for PUCCH resource determination Huawei, HiSilicon
Withdrawn
R1-1808944 Corrections on configured grant related procedures Huawei, HiSilicon
R1-1808954 On remaining details of rate-matching in NR Nokia, Nokia Shanghai Bell
R1-1808967 URLLC aspects for overlapped UL transmissions of single UE Nokia, Nokia Shanghai Bell
R1-1809328 On VRB-to-PRB interleaving for SIB transmission Huawei, HiSilicon
R1-1809329 Remaining issues on reserved resources and rate matching Huawei, HiSilicon
R1-1809330 Remaining issues on search space Huawei, HiSilicon
R1-1809331 Remaining issues on DCI budget for CA Huawei, HiSilicon
R1-1809332 Remaining issues on ECP Huawei, HiSilicon
R1-1809505 Remaining issues on PDSCH rate matching in CORESET Qualcomm Incorporated (R1-1809430)

7.1.4 Maintenance for NR-LTE co-existence

*Including architecture option 4 related issues for **both NR and LTE**, if any (please refer to RP-181473 for detailed scoping)*

Friday
R1-1809914 Chairman's notes of AI 7.1.4 Maintenance for NR-LTE co-existence Ad-hoc chair (Ericsson)
Decision: The document is endorsed, content is incorporated below.

R1-1808266 MPR and A-MPR considerations for EN-DC UE MediaTek Inc.
Revised in **R1-1809730**
R1-1808383 Remaining issues of LTE-NR Dual Connectivity CATT
R1-1808495 Remaining issues on NR LTE coexistence LG ELECTRONICS

Agreement:
A UE is not expected to be configured with sTTI and/or shortened processing time operation on a carrier that is part of an EN-DC configuration in Rel-15.

R1-1808675 Remaining issues of NR-LTE co-existence Intel Corporation
R1-1808757 Remaining Issues on LTE-NR Coexistence Samsung
R1-1808872 Maintenance for NR-LTE co-existence Panasonic Corporation
R1-1808930 Remaining issues on EN-DC, NE-DC, and SUL Huawei, HiSilicon

Agreement:
For a serving cell configured with SUL, the same uplink carrier is used for both initial transmission and re-transmission(s) of a TB in Rel-15.

R1-1809075 Power control for Option 4 DC AT&T
R1-1809102 MPR and A-MPR considerations in EN-DC dynamic power sharing SPRINT Corporation
R1-1809393 Intra-band EN-DC UE Tx power requirements Nokia, Nokia Shanghai Bell
R1-1809397 Maintenance for NR-LTE co-existence Motorola Mobility, Lenovo
R1-1809409 Remaining issues related to LTE-NR coexistence Ericsson
R1-1809847 (Revision of R1-1809409) **Remaining issues related to LTE-NR coexistence Ericsson**

R1-1809431 Maintenance for NR-LTE co-existence Qualcomm Incorporated

R1-1809831 Clarifications for EN-DC power control Qualcomm
R1-1809830 Clarification for FR1-FR2 power control in EN-DC Qualcomm
The text proposal on slide 3 of R1-1809830 is endorsed with the indentation of the last sub-bullet modified to be at the same level as the previous two main sub-bullets (i.e., no change to the indentation in the current specification).

Note: Currently the definition of $P_{cmax,c}$ is incomplete in the RAN4 specifications (TS38.101-3) for the EN-DC case. If P_{LTE}, P_{NR} are incorporated in the $P_{cmax,c}$ definition in RAN4, the specification text addressed by the above agreement should be revised to take that into account.

Continue offline discussions on the following topics:
A-MPR on intra-band EN-DC (Qualcomm)
R1-1809833 **Proposals on intra-band EN-DC MPR handling Qualcomm**

Phase continuity issues (Hong)
R1-1809823 **Summary on the phase continuity issue of intra-band EN-DC Intel**

Agreement:
UE capability signalling that indicates per band per band combination whether the UE can handle (motivated by impacts of PA phase discontinuity) cases with overlapping transmissions with non-aligned starting or ending times or hop boundaries across carriers is beneficial and is introduced.

- Only applicable to intra-band EN-DC, intra-band CA, FDM-based ULSUP (UL Sharing from UE Perspective)
  - Note: Normal UE behaviour is assumed when the UE does not indicate the lack of this capability through the capability signalling or when the capability is not applicable
- RAN4 to determine whether a UE that cannot handle such cases needs different performance requirements or whether these cases are treated as error cases.
- For intra-band EN-DC and FDM-based ULSUP, whether the capability is applicable also when NR is operated with different numerology than LTE should be determined in RAN4
- RAN4 to determine in which bands, in which band-combinations (including in which bands in the band-combination) the capability is applicable
  - Note: This is not intended to change other UE capabilities and minimum performance requirements related to the number of antennas and PAs as per the RAN4 requirements.

R1-1809967 **[Draft] LS on UE capability for NR-LTE co-existence Intel**
Final LS approved in R1-1809992 with the following modifications:

- Change title to "LS on NR-LTE co-existence
- Add the agreement on sTTI and SPT to the draft LS in R1-1809967
- LS to be addressed to RAN4 and RAN2 with the same action, i.e., to take the agreements into account in their work.

R1-1809832 **Limitations on EN-DC PHR Qualcomm**

R1-1809843 Offline discussion on LTE sTTI for EN-DC LG
R1-1809885 **Offline discussion on LTE sTTI for EN-DC LG**

R1-1809874 Issue on EN-DC Dynamic Power Sharing with LTE SPS UL Skipping Motorola Mobility, Lenovo
R1-1809954 **Issue on EN-DC Dynamic Power Sharing with LTE SPS UL Skipping Motorola Mobility, Lenovo**

7.1.5 Maintenance for UL power control

Including both non-CA and CA aspects, NR-NR DC related power control issues (if any) (please refer to RP-181473 for detailed scoping), etc.
Please use separate sections for each of the respective sub-topic to facilitate reviews and summary.

Friday
R1-1809915 **Chairman's notes of AI 7.1.5 Maintenance for UL power control Ad-hoc chair (Samsung)**
Decision: The document is endorsed, content is incorporated below.

Samsung Exhibit 1029, Page 263 of 684

R1-1809772 **Summary for Al 7.1.5 NR UL power control in non-CA aspects** **ZTE**

Conclusion
Editor to reflect the following existing agreement into the specification:
A UE is not expected to simultaneously maintain more than four pathloss estimates per serving cell for all PUSCH/PUCCH/SRS transmissions

Agreement
Following working assumption is confirmed
For PUCCH, K value for non-scheduled UL transmission is the minimum of the common configured K2 values

Agreement
The text in the paragraph on the PUSCH power control in {38.213: 7.1.1 UE behaviour}.

- If the PUSCH transmission is configured by higher layer parameter *ConfiguredGrantConfig*, K_{PUSCH} is a number of $K_{\text{PUSCH,min}}$ symbols equal to the product of a number of symbols per slot, $N_{\text{symb}}^{\text{slot}}$, and the minimum of the values provided by higher layer parameter *k2* in *PUSCH-ConfigCommon* and for UL BWP b of carrier f of serving cell c

Agreement
The text in the paragraph on the PUCCH power control in {38.213:7.2.1 UE behaviour}.

- If the PUCCH transmission is not in response to a detection by the UE of a DCI format 1_0 or DCI format 1_1, K_{PUCCH} is a number of $K_{\text{PUCCH,min}}$ symbols equal to the product of a number of symbols per slot, $N_{\text{symb}}^{\text{slot}}$, and the minimum of the values provided by higher layer parameter *k2* in *PUSCH-ConfigCommon* and for UL BWP b of carrier f of serving cell c

Agreement
The text in the paragraph on the SRS power control in {38.213: 7.3.1 UE behaviour}.

- if the SRS transmission is semi-persistent or periodic, K_{SRS} is a number of $K_{\text{SRS,min}}$ symbols equal to the product of a number of symbols per slot, $N_{\text{symb}}^{\text{slot}}$, and the minimum of the values provided by higher layer parameter *k2* in *PUSCH-ConfigCommon* and for UL BWP b of carrier f of serving cell c

Agreement
Editor to update the specification to reflect the following existing agreement:

- If {P0, alpha} is reconfigured for one closed loop process by higher layer change, the CL PC is reset.
- If {P0, alpha} is changed for one closed loop process by DCI, the CL PC is not reset.

Conclusion:
If the UE has reached $P_{\text{CMAX},f,c}(i)$ for UL BWP c of carrier f of serving cell c for closed loop l, the UE does not accumulate positive TPC commands for closed-loop l of UL BWP b of carrier f of serving cell c.

- Up to the editor to capture the above conclusion

Agreement:
Power control for PRACH BFR should be captured in the specifications. Editor to come up with wording. Vivo tdoc provides some reference for TP.

Agreement
UE-specific P0 for PUCCH should be assumed as 0 before UE specific RRC configuration

Agreement
For PUCCH format 1, $10\log_{10}(O_{\text{UCI}})$ factor is added in $\Delta_{\text{TF,b,f,c}}$ (i)

- FFS: Whether the same factor is added for PUCCH format 0

R1-1809778 **Summary of NR UL power control – CA/DC aspects** **Samsung**

Agreement
In NR-NR DC where one cell group is in FR1 and the other in FR2, the two cell groups perform power control independently according to section 7 of 38.213.
- Applies for synchronous NR-NR DC for late drop of Rel-15 per RAN agreement
- It is RAN1 understanding that a common power limit for FR1+FR2 is not defined in RAN4 specifications
- It is up to the editor to whether and how to capture the above

Send an LS to RAN4 to inform them of the above agreement

R1-1809873 **[Draft] LS on power control for NR(FR1)-NR(FR2) Dual Connectivity** **Ericsson**
Decision: The draft LS is endorsed and final LS is approved in R1-1809886.

R1-1809124 **[Draft] reply LS on UE power class and UE capability on SRS carrier switch** **Huawei**

Power control issues to be resolved in the next RAN1 meeting on whether any specification change is needed or not:
- Issue#1: Cross-carrier indication for power control parameters for PUCCH, SRS and PUSCH
- Issue#2: UE behavior for PHR on SUL/non-SUL, e.g.,
  - For UEs capable of simultaneous transmission of PUSCH at SUL/non-SUL and transmission of SRS at the other UL carrier, if PHR is triggered, which type of PHR to report
- Issue#3: How to set $P_{0\_NOMINAL\_PUSCH,f,c}(j)$ for virtual PHR
  - Regarding the cell-specific P0 for virtual PHR, the cell-specific P0 for grant-free transmission should be used if *P0alphasetindex* = 0 is configured in higher layer parameter *ConfiguredGrantConfig*; otherwise, the cell-specific P0 for grant-based transmission should be used.
- Issue#4: Linkage between DL BWP and UL BWP for paired spectrum, e.g.,
  - PL is measured using reference signal for DL BWP which has the same BWP ID as UL BWP or PL is measured using reference signal for the active DL BWP.

Agreement
Selection of UL carrier for virtual SRS PHR
- For the PC setting for virtual SRS PHR in case of CA/DC, for a cell configured with non-SUL and SUL, a default UL carrier is selected according to the following rules:
  - The UL carrier configured for PUCCH if present, otherwise the non-SUL carrier

R1-1808070	Discussion on UE power control	Huawei, HiSilicon
R1-1808200	Maintenance for UL power control	ZTE
R1-1808228	Remaining issues on UL power control	vivo
R1-1808384	Remaining issues of NR power control	CATT
R1-1808597	Power scaling with transmissions associated to different MCS tables	InterDigital, Inc.
R1-1808676	Remaining Issues on UL Power Control	Intel Corporation
R1-1808758	Remaining Issues on UL Power Control	Samsung
R1-1808882	Text proposals for uplink power control	Guangdong OPPO Mobile Telecom
R1-1809074	Power control for Option 2 DC	AT&T
R1-1809145	Correction on EN-DC power sharing	NTT DOCOMO, INC.
R1-1809282	Further clarification on NR PUSCH power control	Nokia, Nokia Shanghai Bell
R1-1809295	Remaining issues on PUSCH power control	ASUSTeK
R1-1809398	Maintenance for UL power control	Motorola Mobility, Lenovo
Late submission		
R1-1809410	Remaining issues on Power Control	Ericsson
R1-1809432	Maintenace for NR power control	Qualcomm Incorporated

7.1.6 Maintenance for URLLC

Focusing on CQI/MCS aspects

R1-1809784 **Summary of 7.1.6 Maintenance for URLLC** **Ericsson**
Decision: The document is noted.

R1-1809836 **Text Proposal to 38.300 for URLLC** **Ericsson**
Decision: The document is noted.

Proposal
16.1 URLLC
16.1.4 CQI and MCS
For channel state reporting, A CQI table for target block error rate 10^{-5} is introduced.
For scheduling data packets with higher reliability, 64QAM MCS tables containing entries with lower spectral efficiency are introduced for both downlink and uplink. The tables are different for CP-OFDM and DFT-s-OFDM. The MCS tables can be configured semi-statically or dynamically. The dynamic signalling of MCS table is supported by configuring UE with new-RNTI, where new-RNTI indicates the 64QAM MCS tables with entries of lower spectral efficiency.

Offline discussion to idenfity impact of "new-RNTI" to NR specs such as 38.211, 38.213 and 38.214 and to capture in a document for the editors to take into account in the spec update.

Friday session
R1-1809869 Text Proposal to 38.300 for URLLC Ericsson
Decision: The document is noted. The TP to 38.300 in R1-1809869 is endorsed. Send an LS to RAN2.
R1-1809984 [Draft] LS on Text Proposal to 38.300 for URLLC Ericsson
Decision: The document is endorsed and final LS is approved in R1-1809991

R1-1809871 Text Proposal to Capture MCS-C-RNTI EricssonAgreements:
Decision: The document is noted.

Agreements:
- Use "MCS-C-RNTI" instead of placeholder name "new-RNTI" in RAN1 specifications and TPs.
- The TPs in R1-1809871 are endorsed (38.211, 213, & 214)

R1-1809870 **Text Proposal for MCS Determination** **Ericsson**
Decision: The document is noted.

Agreement:
- The TPs in R1-1809870 are endorsed

R1-1809837 Text Proposal for MCS determination Ericsson

R1-1808496 Discussion on MCS table selection for URLLC LG Electronics
R1-1808945 Correction on interrupted transmission indication in 213 Huawei, HiSilicon
R1-1809042 Maintenance of Rel-15 URLLC Ericsson
R1-1809146 Maintenance for URLLC NTT DOCOMO, INC.
R1-1809172 Corrections on MCS table determination Nokia, Nokia Shanghai Bell
R1-1809733 Text proposal on physical layer mechanisms for URLLC in 38.300 Huawei, HiSilicon (R1-1809349)

7.1.7 NR Release 15 UE features

Including both eMBB and URLLC

Friday

R1-1809918 **Chairman's notes of AI 7.1.7 UE features Ad-hoc chair (NTT DOCOMO)**
Decision: The document is endorsed, content is incorporated below.

R1-1808097 **Discussion on remaining issues of UE features Huawei, HiSilicon**
R1-1808229 Rel-15 UE features for eMBB and URLLC vivo
R1-1809723 Remaining issues in NR R-15 UE features MediaTek Inc.
Revision of R1-1808259
R1-1808327 Remaining issues on Rel-15 NR UE features ZTE
R1-1809506 On Rel-15 UE features CATT
Revision of R1-1808385
R1-1808497 Discussion on UE features including URLLC LG Electronics
R1-1808610 Discussions on NR UE feature list Apple Inc.
R1-1808759 Remaining Issues on UE Features for Rel-15 Samsung
R1-1808974 On NR UE feature list Ericsson
R1-1809147 Remaining issues on NR UE features NTT DOCOMO, INC.
R1-1809712 On selected UE features Nokia, Nokia Shanghai Bell
Revision of R1-1809394
R1-1809433 NR Features and Capabilities Qualcomm Incorporated
R1-1809486 Rel-15 NR UE feature list Intel Corporation

Conclusion
How/if the following component is captured in the spec will be discussed in the CR sessions.

7) Processing no more than one DCI with each RNTI in each of Type 0 CSS, Type 0A CSS, Type 1 CSS, Type 2 CSS, Type 3 CSS excluding unicast DCI per slot

Agreement
- RAN1 asks RAN2 to define the capability signalling for 1-8 in the LS.
- RAN1 and RAN2 will check other potential missing capability signalling.

R1-1809883 Proposal on Rel-15 UE feature group 6-23, 4-19 and 8-2 Intel
R1-1809905 Remaining issues for non-MIMO features and capabilities Qualcomm

R1-1809884 Remaining issues on BWP features in R15 NR MediaTek
Come back in RAN1#94bis

R1-1809942 LS on UE capability for simultaneousTxSUL-NonSUL RAN2, Huawei
Possible agreement
RAN1 understanding is that simultaneousTxSUL-NonSUL capability is per band combination
Draft reply LS will be drafted by Zukang (Huawei)

Friday session

Agreement: RAN1 understanding is that simultaneousTxSUL-NonSUL capability is per band per band combination.

R1-1809999 Draft reply LS on UE capability for simultaneousTxSUL-NonSUL Huawei
Decision: The document is endorsed with the following update:
~~In a band combination including SUL and multiple other NR bands, RAN1's understanding is that the SUL carrier can be paired with a non-SUL carrier in any of the NR bands in the band combination. Thus,~~
Final LS is approved in R1-1810004.

R1-1809922 New UE features list for NR NTT DOCOMO, AT&T
R1-1809989 UE UL beam capability Qualcomm

Agreements
- R1-1809922 is endorsed, with the following updates:
  - Incorporating R1-1809989

- Remove yellow-highlight of 2-24 (by updating "configured to measure")
  - 2-24, add component 1A (which is the same as component 2)
- 6-23, the tdoc # is R1-1809992

Agreements:
- Change [5-5b?] as indicated in red

	2 [5-5b]?	UE PDSCH processing capability #2 with scheduling limitation for 30kHz-SCS	~~1) Support of carrier aggregation?~~ Capability #2 supported only if 1 carrier configured in the band (independent of #carriers configured in other bands) 2) Max PDSCH BW of 136 PRBs 3) N1 based on Table 5.3-2 of TS 38.214 for 30 kHz SCS

The updated new UE feature list for NR is agreed in R1-1809998.

R1-1809923 [Draft] LS on new UE features list for NR NTT DOCOMO, AT&T
Decision: The document is endorsed (by updating the new UE feature list tdoc #), and final LS is approved in R1-1810005.

7.1.8 Other

R1-1808316 Clarification on UCI multiplexing on PUSCH Fujitsu
R1-1809411 PUSCH power scaling in UL power control Ericsson
R1-1809412 SRS power scaling in UL power control Ericsson
R1-1809491 A comparison of polar and LDPC codes for URLLC Polaran
R1-1810007 Correction and confirmation of some evaluation assumption parameters LG Electronics

7.2 NR in Release 16

7.2.1 Study on non-orthogonal multiple access for NR

FS_NR_NOMA; SID in RP-181403. Please refer to the SID for detailed scoping

R1-1808150 Text proposal to capture agreements made in RAN1#93 to TR 38.812 (NOMA) ZTE
Decision: The text proposal is endorsed.
MCC post meeting: Clean-up of the version endorsed in RAN1#94 and creation of v0.1.0 as baseline for further update (R1-1810046).

7.2.1.1 Transmitter side signal processing schemes for NOMA

R1-1809753 Discussion on the design of SCMA Huawei, HiSilicon (rev of R1-1808049)
- Observation 1: The structured symbol dependency in the bits-to-symbols mapping of SCMA provides more flexibility and better distance properties than sequence or repetition based linear spreading.
- Observation 2: The bits-to-symbols mapping design in SCMA provides more modulation granularity than the sequence or repetition based linear spreading.
- Observation 3: UE-specific sparse mapping of SCMA provides good tradeoff between the coding gain and the multi-user interference mitigation capability.
- Observation 4: SCMA provides flexible and scalable solution for NoMA transmission to address versatile KPIs in different application scenarios.
- Observation 5: With both CP-OFDM and DFT-s-OFDM waveform, SCMA can provide large SNR gain over sequence spreading based NoMA schemes with layer and/or spreading factor adaptation in all the cases simulated.
- Observation 6: Multi-layer sequence spreading based NoMA schemes without sparsity increase the PAPR for DFT-s-OFDM, compared to QAM baseline.
- Proposal 1: SCMA should be a candidate NoMA scheme of Rel-16 NoMA SI and captured in the TR.

Decision: The document is noted.

R1-1809148 Transmitter design for uplink NOMA NTT DOCOMO, INC.
- Observation 1: UE-specific bit-level scrambling has already been supported in NR Rel-15. UE-specific bit-level interleaving can be equivalent to UE-specific symbol-level interleaving.

- Observation 2: Less iteration is needed for NOMA scheme with symbol-level spreading and lower decoding complexity can be expected compared to bit-level design.
- Observation 3: Higher throughput or larger overloading can be obtained by power domain NOMA than OMA.
- Observation 4 Low code rate coding may not be sure to give a significantly better performance than repetition but has a higher decoding complexity.
- Observation 5 Symbol level design is a more suitable way for NR NOMA schemes.
- Observation 6: Sequences targeting to generalized welch-bound equality under any powers can achieve optimal cross-correlation performance.
- Observation 7: NOMA with user grouping can achieve much higher sum throughput than existing NOMA schemes with WBE sequences and equal SNR.
- Observation 8: NOMA with user grouping has better flexibility and robustness on user number and TBS than existing NOMA schemes with WBE sequences and equal SNR.
- Proposal 1 Adopt power assignment and multi-branch based data processing units for NOMA.
- Proposal 2: Sequence grouping based on cross-correlations can be further discussed.
- Proposal 3: NOMA with user grouping should be considered as the candidate technique for further performance enhancement.
- Proposal 4: Sequences meeting generalized welch-bound equality (GWBE) have low cross-correlation and should be considered as one candidate of sequence pools for NOMA.

Decision: The document is noted.

R1-1809434 **Transmitter side signaling processing schemes for NOMA Qualcomm Incorporated**

- Observation 1
  - When the network operates in grant-based mode, transmission schemes proposed for NOMA can be applied to MU-MIMO as well. The gain of NOMA over MU-MIMO in spectral efficiency is questionable, especially for underloading scenarios.
  - When the network operates in grant-free mode and the UL access is contention-free, the gain of NOMA over MU-MIMO in spectral efficiency is questionable.
  - The most significant gain of NOMA over MU-MIMO can be achieved in the following scenarios:
    - contention-based, grant-free transmission
    - small data transmission from RRC_INACTIVE state
- Proposal 1: NR NOMA solutions achieving performance gains over NR Rel-15 MU-MIMO should be prioritized in the study and evaluation.
- Proposal 2: For normal cell coverage and DL synchronized UE, solutions capable of achieving a better tradeoff than 4-step RACH and CP extension in performance, latency and complexity should be studied for asynchronized NOMA.
- Proposal 3: The asynchronized NOMA transmission scheme in normal cell coverage, such as two-step RACH, should be studied, wherein MSG1 carries MA signature and small data, and UE does not need to perform timing advance prior to MSG1 transmission.
- Proposal 4: For grant-based UL transmission, the degree of freedom can be defined as the number of orthogonal physical resource units in time, frequency and space domains, which is measured for a given TTI, a given transmission bandwidth and a given number of transceiver antennas.
- Proposal 5: For synchronized NOMA transmission, TX solutions incapable of UE overloading and/or unsuitable for scalable configuration should be deprioritized and FFS whether they have significant performance gains over OMA or MU-MIMO with the same transceiver complexity.
- Proposal 6: NR NOMA should re-use linear modulations compliant with NR Rel-15. NR NOMA should consider the use of group or cell-specific scrambling at symbol level, multi-branch transmission and power domain multiplexing to optimize the tradeoff in performance and transceiver complexity.
- Proposal 7: NOMA transmission scheme should provide flexibility and scalability to support different spectral efficiencies and overloading factors. To reduce the description complexity and memory size of transceivers, it should consider:
  - a closed form design for the short spreading codes that achieves Welch bound equality (WBE) for arbitrary spreading factor (K) and overloading ratio (N/K>1);
  - a closed from design for the long scrambling codes that is compliant with NR Rel-15;
  - reuse the same spreading codes and scrambling codes for both DFT-s-OFDM and CF-OFDM waveforms;
  - reuse linear modulations compliant with NR Rel-15 Tx chain.
- Proposal 8: Intra-cell and inter-cell interference in NOMA transmission can be mitigated by UE grouping, power control, symbol-level scrambling, and the hopping of MA signatures. Specifically:
  - NOMA UEs within the same cell can be partitioned into multiple groups. Same or different short spreading codes achieving WBE can be applied to each group. Group-specific scrambling and power domain multiplexing can be applied to each UE group, wherein the configuration of scrambling codes can be made as a function of cell ID and UE group ID.

- To average the intra-cell and inter-cell interference, the use of short spreading codes and long scrambling codes can be hopping in time domain.

- Proposal 9: The design of linear spreading scheme for NOMA should consider the inclusion of symbol-wise scrambling to improve the PAPR performance. The PAPR performance of QPSK can be used as a baseline.

Decision: The document is noted.

Wednesday session

R1-1809786 Offline summary of transmitter processing for NOMA ZTE

Decision: The document is noted.

Agreements:

- Capture Section 2 and Annex in R1-1809786 into TR38.812.
  - ~~Companies are encouraged to check the exact content of Section 2 and Annex in R1-1809786 and to provide comments if any by Friday~~
  - (Update on Friday) R1-1809974 – section 2 and Annex are agreed
- Comparnies to provide more detailed description of the proposed scheme (to the extent that solid simulations can be performed) by email by 8/28, and to be commented by 8/31. These schemes are to be captured in R1-1809844 – Li (ZTE)

Friday session

R1-1809974 Updated summary of transmitter side signal processing schemes for NOMA ZTE

Decision: see the agreements above.

R1-1808151 Transmitter side designs for NOMA ZTE
R1-1808230 Discussion on NOMA transmittersvivo
R1-1808331 Consideration on the transmitter side signal processing for NOMA Sony
R1-1808386 NOMA transmitter side signal processing CATT
R1-1808499 Transmitter side signal processing schemes for NCMA LG Electronics
R1-1808563 Discussion on NOMA Schemes for NR NEC
R1-1808677 NOMA transmission scheme Intel Corporation
R1-1809499 Transmitter side signal processing schemes for NOMA Samsung (rev of R1-1808760)
R1-1808834 Discussion on NoMA transmitter schemes CMCC
R1-1809515 New Coding Scheme for NOMA with Traffic Control Sequans Communications(rev of R1-1808948)
R1-1808955 Discussion on general symbol-to-resource mapping for NR-NOMA Fraunhofer HHI, Fraunhofer IIS
R1-1808968 Considerations on NOMA Transmitter Nokia, Nokia Shanghai Bell
R1-1808975 TX schemes for NoMA Ericsson
R1-1809056 On Transmitter Side signal Processing for NOMA AT&T
R1-1809841 Discussion on Transmit Timing Offset for NOMA Evaluation InterDigital, Inc. (rev of R1-1809078)

7.2.1.2 Receivers for NOMA

R1-1808231 Receiver design considerations for NOMA vivo

- Proposal 1: NR Rx discussion should focus on the typical receiver classification and should not take too much details of receiver implementation for performance and complexity comparison.
- Proposal 2: Performance of different Tx schemes are compared under the same Rx complexity class
- Proposal 3: For asynchronous scenarios, Rx classification could be based on the same rule as synchronous cases.
- Proposal 4: Tx scheme performance comparison should mainly be based on MMSE-IRC considering the commercial interest of the industry.

Decision: The document is noted.

R1-1808969 Receiver considerations for UL NOMA Nokia, Nokia Shanghai Bell

- Observation 1: The choice of receiver architecture influences the size and latency of the receiver.
- Observation 2: Latency of the receiver depends on the computational complexity of each block, and the number of iterations.
- Proposal 1: The overall computational complexity is a good indication of the latency at a constant receiver size.

- Observation 3: The overall computation complexity depends on the complexity of each functional block of the receiver, the number of iterations and number of users processed per iteration.
- Proposal 2: For computational complexity analysis of the receiver for different NOMA schemes use Table 1 of x8969.
- Proposal 3: Use parameters in Table 2 of x8969 for computation complexity evaluation assuming eMBB user.
- Proposal 4: For NOMA evaluation consider an MMES-based Hard IC receiver.
- Proposal 5: For NOMA evaluation consider an ESE-based Soft IC receiver.

Decision: The document is noted.

R1-1809180 **Discussion on Receiver for NOMA** **KDDI Corporation**

- Proposal 1: RAN1 should set a target performance to evaluate the receiver complexity for fair comparison.
- Proposal 2: Receiver evaluation relating to complexity should be based on the mMTC scenario as the first priority.
- Proposal 3: Performance evaluation for asynchronous transmission should take the additional signal processing into account, such as multiple FFT timing decision, multiple timing FFT, multi-user detection for each FFT timing and interference mitigation among different FFT timings, and should clarify the effectiveness from the aspects of performance gain by neglecting TA procedure and receiver complexity
- Proposal 4: For asynchronous transmission, effect of interference from asynchronous UEs to UEs for synchronous transmission including grant-based access which are simultaneously operated in the same system bandwidth should be evaluated

Decision: The document is noted.

Wednesday session

R1-1809787 **Offline summary of receiver for NOMA** **ZTE**

Decision: The document is noted.

Thursday session

R1-1809859 **Updated offline summary of receiver for NOMA** **ZTE**

Decision: The document is noted.

Agreements:

- The following table for computation complexity analysis of the receiver as the starting point, entries can be updated till RAN1#94bis.

Table I Template of Receiver Computation Complexity breakup

Receiver component	Detailed component	Computation in parametric number of usages, O(.) analysis, [impact factor]		
		Receiver type 1	Receiver type 2	…
Detector	UE detection			
	Channel estimation			
	Rx combining, if any			
	Covariance matrix calculation, if any			
	Demodulation weight computation, if any			
	UE ordering, if any			
	Demodulation, if any			
	Soft information generation, if any			
	Soft symbol reconstruction, if any			
	Message passing, if any			
	Others			
Decoder	LDPC decoding			
Interference cancellation	Symbol reconstruction(Including FFT operations for DFT-S-OFDM waveform), if any			
	LLR to probability conversion, if any			
	Interference cancellation			
	LDPC encoding, if any			
	Others			

- The impact factor is to be estimated based on the analysis of computation, memory size, hardware and software

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implementation, etc.
  - If/How and which entries are to be combined/compared in order to get the total complexity estimate is FFS.
- Companies may provide the impact factor
  - The impact factor is for each cell
- The rows in the above table are subject to potential re-finement, e.g., adding new row(s), merge some rows, etc.
- Note: the numbers may or may not be a function of UL waveform
- FFS whether or not to add row(s) for memory blocks

R1-1808050	Discussion on the design of NoMA receiver	Huawei, HiSilicon
R1-1808152	Multi-user advanced receivers for NOMA	ZTE
R1-1808387	Discussion on NOMA receivers	CATT
R1-1808500	Considerations on the receiver types and NoMA schemes	LG Electronics
R1-1808678	NOMA receiver structure	Intel Corporation
R1-1808761	Receivers for NOMA	Samsung
R1-1808976	Receiver design for NOMA	Ericsson
R1-1809057	Receiver techniques for NOMA	AT&T
R1-1809079	Complexity Analysis of IDMA NOMA Reception	InterDigital, Inc.
R1-1809149	Receiver for uplink NOMA	NTT DOCOMO, INC.
R1-1809435	Receivers for NOMA	Qualcomm Incorporated

7.2.1.3 Procedures related to NOMA

R1-1808153 Procedures related to NOMA ZTE

- Observation 1: Configured grant transmission is not suited to eMBB small data or mMTC scenario due to its limitation in conveying an efficient small data transmission, in particular sporadically.
- Observation 2: NOMA based UL transmission in RRC-inactive can well support the usage in all cases with maximizing the benefits on signaling/latency and power saving.
- Observation 3: Collision of RS allocation/selection could happen in both configured-grant and purely grant free transmission.
- Observation 4: RS enhancement with directly increasing the overhead is not efficient.
- Observation 5: DM-RS enhancement via either reducing the density in frequency domain or introducing quasi-orthogonal sequence has negative impacts on the performance.
- Observation 6: In case of fixed MA/RS allocation, up to 24 UEs can be supported with enhanced RS.
- Observation 7: In case of randomly selection of MA/RS allocation with timing offset within CP, simultaneously transmission with medium number of UE can be well supported with enhanced RS.
- Observation 8: The necessity of the enhancement on link adaption for NOMA based UL transmission should be further verified.
- Observation 9: Minor gain from network perspective can be expected with introducing the mechanism to enable the switching between NOMA and OMA.
- Proposal 1: UL data transmission from UE_INACTIVE state should be also studied to fully utilize the benefits of NOMA techniques.
- Proposal 2: Enhancement on the RS with different numerology should be considered to achieving the large pool size with supporting both UE detection and channel estimation.
- Proposal 3: The mechanism of HARQ via both explicit and implicit way should be considered for supporting NOMA transmission.
- Proposal 4: Additional enhancements, e.g., MA hooping or power ramping, can be considered to ensure the performance of re-transmission.
- Proposal 5: Study on the link adaption and transmission scheme switching should be down-prioritized in NOMA SI.

Decision: The document is noted.

R1-1808288 On NOMA procedures for Grant Free Orange

- Observation 1: grant free NOMA benefits at least mMTC and URLLC
- Observation 2: To perform a grant-free uplink transmission, a UE has access to at least one pool of resources pre-allocated for grant-free access which are shared between several UEs. In mMTC scenarios, many UEs could share the same pool.
- Observation 3: Blind resource selection is very often considered for uplink grant free transmission, even if sub-optimal, it is due to the UE inability to acquire information on current grant-free resource use

- Observation 4: The gNB knows the information of the use of grant-free resources that UE are lacking. This lack of information leads them to perform sub-optimal blind resource selection.
- Proposal 1: The ability by the gNB to broadcast a real-time view of the use of the resource pool for grant-free access currently in operation should be considered, and its associated benefits should be evaluated with respect to a fixed or a pure random grant free resource selection.
- Proposal 2: Including into the broadcasted resource pool for grant-free access relevant statistical information on the use made by UEs configured to these resource pools should be considered and its associated benefits should be evaluated with respect to a pure random or fixed grant free resource selection. Which information is relevant depends on the considered NOMA techniques and should be further studied.

Decision: The document is noted.

Wednesday session

R1-1808762 Procedures related consideration to NOMA Samsung

- Observation 1: Purely no TA acquisition, i.e., Type 3, suffers from severe ISI, ICI and channel estimation degradation in NR OFDM based system. Additional means are needed in order to support type 3 and should be carefully investigated.
- Observation 2: pure asynchronized case may need large CP overhead in order to support grant free transmission, subject to cell radius.
- Observation 3: Grant-based NoMA is more efficient way to schedule a number of UEs in the same resources compared to MU-MIMO.
- Observation 4: Grant-based NoMA is a good supplement to remedy weak points of grant-free NoMA.
- Observation 5: For grant-based NoMA, downlink control signalling should be minimized to support huge connection density at least for mMTC.
- Proposal 1: The channel structure of a preamble preceding a data payload can be considered for grant-free transmission based non-orthogonal multiple access.
- Proposal 2: the resource configuration for grant free transmission should consider the GFO indication, preamble/DMRS indication and MA signature indication.
- Proposal 3: Means to determine the GF-RNTI need to be studied.
- Proposal 4: For grant-based NoMA, an enhancement in downlink control siganling needs to be further studied.

Decision: The document is noted.

Friday session

R1-1809788 Offline summary of procedures for NOMA ZTE

Decision: The document is noted.

Agreements:

- Consider mechanism to handle or mitigate the collision on MA signature/RS/resource, if needed
- FFS whether the number of configured MA signature/RS/resource from UE perspective can be 1 or multiple
- FFS whether multiple sets of MA signature/RS/resource can be configured to a UE

R1-1808051	Discussion on NoMA related procedures	Huawei, HiSilicon
R1-1808232	Discussion on NOMA procedures	vivo
R1-1808290	Considerations on procedures related to NOMA	Fujitsu
R1-1808332	Considerations on NOMA related procedures	Sony
R1-1808388	Discussion on NOMA procedures	CATT
R1-1808501	Discussion on procedures related to NOMA	LG Electronics
R1-1808564	Considerations on NOMA related procedures	NEC
R1-1808679	NOMA related procedure	Intel Corporation
R1-1808835	Discussion on NoMA related procedures	CMCC
R1-1808915	Consideration on NoMA procedure	Guangdong OPPO Mobile Telecom
R1-1808970	Procedures to be considered for NOMA operation	Nokia, Nokia Shanghai Bell
R1-1808977	Procedures for NoMA	Ericsson
R1-1809058	On NOMA Procedures	AT&T
R1-1809080	On NOMA Related Procedures in NR	InterDigital, Inc.
R1-1809150	Extended DMRS design and NOMA related procedures	NTT DOCOMO, INC.
R1-1809181	Discussion on procedures related to NOMA	KDDI Corporation
R1-1809190	Discussion on NOMA related procedures	ITRI

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R1-1809283 Considerations on Procedures of Non-orthogonal Multiple Access Schemes CAICT
R1-1809316 Considerations on MA Preamble Design for NOMA KT Corp.
R1-1809379 Design consideration on NOMA procedure Convida Wireless LLC
R1-1809436 Procedures related to NOMA Qualcomm Incorporated
R1-1809487 NOMA Procedure Considerations Sierra Wireless, S.A.

7.2.1.4 Link and system level performance evaluation for NOMA

R1-1808159 Email discussion on the templates of reporting LLS evaluation results ZTE
Decision: The document is noted.

R1-1809789 Offline summary of performance evaluations for NOMA ZTE
Decision: The document is noted.

Agreements:
- An exemplary list of simulation cases are included in the companion spreadsheet 'template 1' in R1-1809789, for initial collection of BLER vs. SNR curves.
  - Companies can select among the list of simulation conditions in templates 1 & 2 when performing initial link level simulations
    - Companies are encouraged to simulate enough cases to support a broad understanding for scenarios under study in NOMA
    - Additional simulation cases may be captured in template 1.
  - For unequal SNR distribution within range [x - a, x + a] (dB), per UE SNR is the average SNR in dB, i.e. x (dB)
- Adopt the companion spreadsheet 'template 2' in R1-1809789 as the template for collecting the initial evaluation results of per UE SNR at the target BLER level (in addition to BLER vs. SNR curve).
- CM/PAPR results as proposed for 'template 3' in R1-1809789 can be collected
  - It is FFS how the CM/PAPR relates to UE performance tradeoffs, PA backoff, and UE power saving
  - It is FFS how to compare the CM/PAPR results using this template, e.g. modulation order should be aligned or not
  - PAPR is reported as the CCDF of instantaneous power divided by mean power over all the samples.

Agreements:
- Refine the relative SINR and/or I(inter-cell interference)NR values used for link level simulations to reflect those observed in a cell, if needed
  - The extent of the refinement, if any, is to be determined according to evaluations.

Agreements:
- Further study how many NOMA UEs can be multiplexed in the same PRBs in practical multi-cell deployments by system-level evaluations, taking inter-cell interference and per UE performance into account

R1-1809790 Email discussion on the calibration results of reference OMA single user cases ZTE (rev of R1-1808160)
Decision: The document is noted.

Agreements:
- Adopt the calibration results in R1-1809790, to be captured in TR38.812.
  - To update the legends of the results by replacing companies' names with the reference indexing
  - Further update is possible
- Further alignment on the decoding algorithm for NOMA evaluations can be considered in the future, if necessary.
  - Note: this is not intended to revise the corresponding calibration results

Thursday session
R1-1809860 Updated offline summary of performance evaluations for NOMA ZTE
Decision: The document is noted.

Agreements:

- Determine the value y for the evaluation with non-zero timing offset (including asynchronous)
  - For Case 1: y = NCP/2
  - For Case 2: y = 1.5*NCP

Agreements:

- For random MA signature (including RS) in LLS, companies report the details of the chosen Option(s):
  - Opt 1: Fixed number of UEs, with each UE randomly selects a MA signature from a pre-configured MA signature pool
    - Number of potential UEs and the pool size should be reported
  - Opt 2: Fixed number of randomly activated UEs, with each potential UE's MA signature pre-configured.
    - Number of potential UEs and the pool size should be reported
  - Realistic UE/MA signature detection should be performed.
  - DMRS extension, if any
  - FFS whether to align the pool size for performance evaluations.

Agreements:

- Adopt the additional assumptions in the following table for SLS calibration:

Parameters	Assumptions
Minimum distance between UE and BS	35m for Case 1, 10m for Case 2 and Case 3
Building penetration loss	Follow the evaluation assumptions
TXRU mapping to antenna elements on BS side	One TXRU per vertical dimension per polarization
TXRU mapping weights on BS side	TXRU virtualization only in the vertical dimension, i.e., sub-array partition model with 1D virtualization, refer to TR36.897
BS Tx power	46 dBm for 500m/1732m ISD; 41 dBm for 200m ISD
Polarized antenna modeling	Model-2 in TR36.873
Bandwidth	10MHz
UE antenna configuration	1 (vertical polarization)
UT array orientation	uniformly distributed on [0,360] degree
UE receiver noise figure	9dB
UE distribution and antenna height	Follow the evaluation assumptions
Handover margin	0dB
Wrapping method	Geographical distance based wrapping
UE attachment	Based on RSRP

Agreements:

- The target higher layer system PDR to be used to evaluate the supported system capability in terms of high layer system PAR for mMTC or eMBB scenarios is 1%
- The target percentage of users satisfying reliability and latency requirements to be used to evaluate the supported system capability in terms per UE PAR for URLLC scenario is 95%

Agreements:

- At least for eMBB, companies are encouraged to report the distribution of PDCCH RB utilization (including PDCCH outage) in each slot at each gNB, which can be used for representing the signalling overhead for grants.
  - If used, companies report the system bandwidth and the scheduling mechanism used in simulation.
    - The simulation should contain both DL and UL transmissions.

Email discussion on SLS calibration and templates for collecting the SLS evaluation results, by 09/07 – Li (ZTE)

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Friday session

R1-1809975 Updated offline summary of performance evaluations for NOMA ZTE

Decision: The document is noted.

Agreements

- For performance metric of Sum throughput v.s. SNR at given BLER level, for a given pair of {per UE SE, # of UEs}
  - Same TBS is assumed for each curve
  - Total SNR is used
    - Total SNR is simplified as sum of average SNR conducted in dB, i.e. x+10*log10(N) (dB), where N is the number of UEs.

Agreement:

- Confirm frequency offset for 4GHz carrier frequency as
  - uniform distribution between -140 and 140 Hz

Agreements:

- For non-zero timing offset (for asynchronous)
  - For all UEs in Case 1 or all UEs in Case 2, TO values for each UE for each transmission are i.i.d from uniform distribution [0, y], and independent between UEs.
  - For mixed sync and async, X% of UEs with zero TO and (100–X)% with non-zero TO.
    - X = 80
    - Other values are not precluded
  - Note: Companies should provide the details of receiver structure and TO estimation.

Agreements:

- The packet size for NOMA evaluations in eMBB scenario
  - 50~600 bytes Pareto distribution, with shaping parameter alpha = 1.5
- Clarification of "8 dBi, including 3dB cable loss" for both system-level evaluation and calibration as
  - 8dBi, 0dB cable loss
- In the case of packet segmentation, use 5 bytes packet segmentation overhead for each TB in the SLS evaluation of the NoMA schemes.
  - Company report the details of packet segmentation

R1-1809754 Further discussion on NoMA evaluations Huawei, HiSilicon (rev of R1-1808052)
R1-1808154 Prelimenary system-level simulation results for NOMA ZTE
R1-1808204 Link-Level Simulation Results for ACMA with Synchronous, Asynchronous transmission HUGHES Network Systems Ltd
R1-1808205 Partially Asynchronous and Multi-stream Transmission of ACMA HUGHES Network Systems Ltd
R1-1808233 Evaluations for NOMA vivo
R1-1808389 Link level and initial system level evaluation results of NOMA CATT
R1-1808502 Further LLS evaluation for NCMA in mMTC LG Electronics
R1-1808680 Performance evaluation for NOMA Intel Corporation
R1-1809500 Performance evaluation for NoMA Samsung (rev of R1-1808763)
R1-1808971 Evaluations for NOCA Nokia, Nokia Shanghai Bell
R1-1808978 Evaluation methodology and metrics for NoMA Ericsson
R1-1809059 Link Level Performance for NOMA AT&T
R1-1809081 System Level Simulation Methodology in mMTC Scenario InterDigital, Inc.
R1-1809151 Link and system level simulation results and analysis of UL NOMA NTT DOCOMO, INC.
R1-1809284 Further LLS results of NOMA schemes CAICT
R1-1809437 System level evaluation for NOMA Qualcomm Incorporated
R1-1809438 Link level evaluation for NOMA Qualcomm Incorporated

7.2.1.5 Other

R1-1808053 Evaluation results for OMA calibration Huawei, HiSilicon

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R1-1808054 Evaluation results for mMTC scenario Huawei, HiSilicon
R1-1808055 Evaluation results for URLLC scenario Huawei, HiSilicon
R1-1808056 Evaluation results for eMBB scenario Huawei, HiSilicon
R1-1808155 Link-level simulation results for mMTC scenraio ZTE
R1-1808156 Link-level simulation results for URLLC scenraio ZTE
R1-1808157 Link-level simulation results for eMBB scenraio ZTE
R1-1808158 Physical layer abstraction for NOMA SLS ZTE
R1-1808390 Link level evaluation results of OMA CATT
R1-1808391 System level calibration of NOMACATT
R1-1808541 A comparison of polar and LDPC codes for URLLC Polaran
Withdrawn
R1-1808972 Initial Link Level Simulation Results of IDMA Nokia, Nokia Shanghai Bell
R1-1808979 DMRS design for NoMA Ericsson
R1-1808980 Impairments model for link and system evaluations Ericsson
R1-1808981 Link level evaluations for MU-MIMO Ericsson
R1-1808982 Observations on NOMA traffic models Ericsson
R1-1808983 MU-MIMO operation in NR with configured grants Ericsson
R1-1809082 On the impact of timing offset in NOMA Evaluation InterDigital, Inc.
R1-1809083 Aspects of IDMA NOMA Transmitter InterDigital, Inc.
R1-1809084 Link Level Simulation Results on IDMA OFDM/DFT-s-OFDM InterDigital, Inc.
R1-1809152 LLS evaluation results of UGMA NTT DOCOMO, INC.
R1-1809182 LLS evaluation results for OMA calibrationKDDI Corporation

7.2.2 Study on NR-based Access to Unlicensed Spectrum

FS_NR_unlic; SID in RP-181339. Please refer to the SID for detailed scoping

Friday
R1-1809916 "Chairman's notes of AI 7.2.2 Study on NR-based Access to Unlicensed Spectrum" Ad-hoc chair (Ericsson)
Decision: The document is endorsed, content is incorporated below.

R1-1809439 TR38.889 v0.0.2 Qualcomm Incorporated
R1-1809795 TR38.889 v0.0.3 Qualcomm Incorporated
Version v0.0.3 of TR38.889 is endorsed.
MCC post meeting: Clean-up of the version endorsed in RAN1#94 and creation of v0.1.0 as baseline for further update (R1-1810047).

7.2.2.1 Simulation Methodology for NR-U operation

R1-1808317 Simulation Methodology and Preliminary Results for NR-UZTE
R1-1808503 Simulation methodology for NR unlicensed operation LG Electronics
R1-1808681 On calibrating the outdoor simulation models for NR-unlicensed Intel Corporation
R1-1808764 Remaining simulation methodology for NR-U Samsung
R1-1808816 Simulation Methodology for NR-U operation Nokia, Nokia Shanghai Bell
R1-1808926 Simulation assumptions and preliminary results for NR unlicensed bands Huawei, HiSilicon
R1-1809085 Simulation and calibration for NR-U outdoor sub-7GHz InterDigital, Inc.
R1-1809200 NR-U evaluation methodology Ericsson
R1-1809440 Email discussion summary for sub7 outdoor evalution calibration Qualcomm Incorporated
R1-1809441 Simulation methodology for NR unlicensed Qualcomm Incorporated

R1-1809764 Feature summary on Simulation Methodology for NR-U operationQualcomm Incorporated

Agreements:

- The base metrics for NR-U evaluation are the same as in LTE-LAA in TR 36.889.

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- For coexistence evaluations below 7GHz, for parameters not covered by previous agreements, the evaluations assumptions specified for LTE (e)LAA coexistence evaluations apply.
    - For example, the minimum distance between a small cell and a UE, and between two UEs is three meters.

Agreement:
- For coexistence evaluation, WiFi+WiFi, WiFi+NR-U and NR-U+NR-U evaluations are baseline with equal priority.

Agreement:
A=1.0 for scenario 1 and A=1.5 for scenario 2
Note: The agreed scenarios are the baseline for generation of results to be included in the TR. Contributions based on other scenarios are not precluded from being considered for discussion and decisions on NR-U design.

7.2.2.2 Frame structure for NR-U operation

R1-1808058 NR numerology and frame structure for unlicensed bands Huawei, HiSilicon
R1-1808234 Frame structure for NR-U operation vivo
R1-1808271 On frame structure design for NR-U operation MediaTek Inc.
R1-1808291 On flexible starting positions and related PDCCH monitoring for NR-U Fujitsu
R1-1808318 Discussion on frame structure for NR-U ZTE
R1-1808333 Considerations on Frame Structure for NR Unlicensed Operations Sony
R1-1808392 Frame Structure for NR Unlicencensed Operations CATT
R1-1808504 Frame structure for NR unlicensed operation LG Electronics
R1-1808543 Frame structure for NR-U operation Lenovo, Motorola Mobility
R1-1808618 Numerology for NR-U Panasonic Corporation
R1-1808682 On the NR-unlicensed frame structure Intel Corporation
R1-1808765 Frame structure for NR-U Samsung
R1-1808817 Frame structure for NR-U operation Nokia, Nokia Shanghai Bell
R1-1808896 Frame structure for NR-U Guangdong OPPO Mobile Telecom
R1-1809061 Frame structure for NR-U operation AT&T
R1-1809086 On NR-U frame structure InterDigital, Inc.
R1-1809201 Frame Structure for NR-U Ericsson
R1-1809220 Discussion on the frame structure for NR-U Xiaomi
R1-1809227 Discussion on frame structure for NR-U operation ASUSTEK COMPUTER (SHANGHAI)
R1-1809285 Discussions on frame structure design in NR-U CAICT
R1-1809476 Frame structure for NR-U operation Qualcomm Incorporated

R1-1809738 Summary on frame structure for NR-U LG Electronics

Agreement:
- It is identified that being able to operate all DL signal/channels with the same numerology for a carrier and at least for intra-band CA on serving cells on unlicensed bands has at least the following benefits (at least for standalone operation, FFS whether this is benefit is realizable for inter-operator measurements)
    - Lower implementation complexity (e.g., a single FFT, no switching gaps)
    - Lower specification impact
    - No need for gaps for measurements on frequencies with a configured serving cell in unlicensed bands
- It is identified that being able to operate all UL signal/channels with the same numerology for a carrier and at least for intra-band CA on serving cells on unlicensed bands has at least the following benefits
    - Lower implementation complexity (e.g., a single FFT, no switching gaps)
    - Lower specification impact
    - Common interlace structure
    - No need for gaps for transmission of SRS on a configured serving cell in unlicensed bands
    - FFS: PRACH benefits
- FFS: same numerology for DL and UL considering switching gap

R1-1809972 Summary #2 on frame structure for NR-U LG Electronics

7.2.2.3 *Potential physical layer channel design*

7.2.2.3.1 DL Signals and Channels

Including DL data channel, DL control channel, DL RS, Sync channel, etc.

R1-1808059	DL channels and signals in NR unlicensed band	Huawei, HiSilicon
R1-1808235	Discussion on physical DL channel design in unlicensed spectrum	vivo
R1-1808272	On downlink transmission detection in NR-U	MediaTek Inc.
R1-1808319	Considerations on DL reference signals and channels design for NR-U	ZTE
R1-1808334	Considerations on DL Signals and Channels for NR unlicensed operation	Sony
R1-1808393	DL Physical Channel and Signal Design for NR Unlicensed Operations	CATT
R1-1808505	Physical layer design of DL signals and channels for NR unlicensed operation	LG Electronics
R1-1808612	On DL signals and channels for NR-U	Apple Inc.
R1-1808683	Enhancements to NR DL signals and channels for unlicensed operation	Intel Corporation
R1-1808766	Downlink signal and channel design for NR-U	Samsung
R1-1808807	Discussion on SS_PBCH block in NR-U operation	Spreadtrum Communications
R1-1808897	DL design for NR-U	Guangdong OPPO Mobile Telecom
R1-1808917	On DL Signals and Channels for NR-U	Nokia, Nokia Shanghai Bell
R1-1809062	NR-U design for DL signals and channels	AT&T
R1-1809087	On downlink signals and channels for NR-U	InterDigital, Inc.
R1-1809184	Discussion on SSB transmission for NR-U	ITRI
R1-1809202	On DL signals and channels	Ericsson
R1-1809380	Discussion on partial slot transmission in NR-U	TCL Communication Ltd.
R1-1809477	DL signals and channels for NR-U	Qualcomm Incorporated
R1-1809791	Feature lead summary for NR-U DL Signals and Channels	Motorola Mobility, Lenovo
R1-1809822	**Feature lead summary for NR-U DL Signals and Channels**	**Motorola Mobility, Lenovo**

Agreement:

- Inclusion of the CSI-RS and RMSI-CORESET(s)+PDSCH(s) (carrying RMSI) associated with SS/PBCH block(s) in addition to the SS/PBCH burst set in one contiguous burst (tentatively referred to as the NR-U DRS) can be beneficial for
  - Meeting OCB requirement
  - Compacting signals in time domain to limit the required number of channel access and for short channel occupancy
  - Support of stand-alone NR-U deployments
  - Support of automatic neighbour relations (ANR) functionality in an NR-U deployment
  - Resolution of PCI confusion in an NR-U deployment
  - Note: The NR-U DRS (it can be called something else in the future) can include signals and channels that are required for cell acquisition etc. and is not limited only to reference signals
- The transmission of additional signals such as OSI and paging within the NR-U DRS is allowed and can be beneficial
- Note: This does not imply that RMSI-CORESET+PDSCH and CSI-RS can only be transmitted as part of the NR-U DRS, and does not imply that these are necessarily part of all NR-U DRS transmissions.

7.2.2.3.2 UL Signals and Channels

Including UL data channel, UL control channel, UL RS, PRACH, etc.

R1-1808060	UL PHY channels for NR unlicensed	Huawei, HiSilicon
R1-1808236	Discussion on physical UL channel design in unlicensed spectrum	vivo
R1-1808273	On UL signals and channels in NR-U	MediaTek Inc.
R1-1808292	On UL signals and channels design for NR-U	Fujitsu
R1-1808320	Considerations on UL reference signals and channels design for NR-U	ZTE
R1-1808394	UL Physical Channel and Signal Design for NR Unlicensed Operations	CATT
R1-1808506	Physical layer design of UL signals and channels for NR unlicensed operation	LG Electronics

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R1-1808544 UL signals and channels for NR-U operation Lenovo, Motorola Mobility
R1-1808613 On UL signals and channels for NR-U Apple Inc.
R1-1808619 Resource allocation for NR-U UL channels Panasonic Corporation
R1-1808684 Enhancements to NR UL signals and channels for unlicensed operation Intel Corporation
R1-1808767 Uplink signal and channel design for NR-U Samsung
R1-1808798 Discussion on UL Signals and Channels in NR-U Spreadtrum Communications
R1-1808818 On uplink signal and channel structures for NR-U Nokia, Nokia Shanghai Bell
R1-1808898 UL design for NR-U Guangdong OPPO Mobile Telecom
R1-1809088 On uplink signals and channels for NR-U InterDigital, Inc.
R1-1809153 UL Signals and Channels for NR-U operation NTT DOCOMO, INC.
R1-1809203 On UL signals and channels Ericsson
R1-1809324 Discussion on UL signals and channels for NR-U operation WILUS Inc.
R1-1809478 UL signals and channels for NR-U Qualcomm Incorporated

R1-1809726 Feature lead summary for UL Signals and Channels Ericsson

Agreement:

- For scenarios in which a block-interlaced waveform is used for PUCCH/PUSCH, it has been identified that from FDM-based user-multiplexing standpoint it can be beneficial to have UL channels on a common interlace structure, at least for PUSCH, PUCCH, associated DMRS, and potentially PRACH
    - Note: This is only from a user-multiplexing perspective. Other aspects of PRACH design need to be considered, i.e., timing estimation accuracy, miss detection rate, PAPR, RACH capacity, transmission power
- For scenarios in which a contiguous allocation for PUSCH and PUCCH is used, it is beneficial to use contiguous resource allocation for PRACH
- FFS: Potential LBT blocking due to TA difference between FDM'd PUSCH, PUCCH, and PRACH

R1-1809819 Feature lead summary 2 for UL Signals and Channels Ericsson

Agreement:

- For scenarios in which a block-interlaced waveform is used for UL transmission, a PRB-based block-interlace design has been identified as beneficial at least for 15 and 30 kHz SCS, and potentially for 60 kHz SCS
    - Link budget limited cases with given PSD constraint
        - It is observed that power boosting gains decrease with increasing SCS
    - As one option to efficiently meet the occupied channel bandwidth requirement
    - Comparatively less specification impact than Sub-PRB interlace design
- Design for 60 kHz requires further discussion, e.g., sub-PRB vs. PRB-based block interlace designs
- The following has been observed for sub-PRB block interlace designs
    - In some scenarios sub-PRB interlacing can be beneficial in terms of power boosting
        - FFS: scenario details, e.g., small resource allocations
    - Sub-PRB interlace design has at least the following specification impact:
        - Reference signal design (e.g., DMRS)
        - Channel estimation aspects
        - Resource allocation

Agreement:

- It has been identified as beneficial to support a block-interlaced structure in which the number of interlaces (M) decreases with increasing SCS, and the nominal number of PRBs per interlace (N) is similar for each SCS (in a given bandwidth) at least for 15 and 30 kHz SCS, and potentially 60 kHz depending on supported interlace design
- FFS: M and N for each supported SCS
- FFS: 60 kHz in case a sub-PRB interlace is introduced

Agreement:

- From a RAN1 perspective it has been identified that supporting a non-uniform interlace structure in which the number of PRBs per interlace is allowed to be different for different interlaces is beneficial from a spectrum utilization point of view
  - FFS: Exact number of PRBs per interlace for supported value(s) of M and N
    - Note: M is the number of interlaces and N is the nominal number of PRBs per interlace in a given bandwidth
  - FFS: Whether or not there are issues in the interlace design in the resource allocation to 2^n1*3^n2*5^n3 in the case of DFT-s-OFDM

7.2.2.4 Potential physical layer procedures

7.2.2.4.1 Channel access procedures

R1-1808061 Coexistence and channel access for NR unlicensed band operations Huawei, HiSilicon
R1-1808237 Discussion on the channel access procedures vivo
R1-1808253 Discussion on synchronized user multiplexing for NR-U TCL Communication Ltd.
R1-1808274 On channel access procedure in NR-U MediaTek Inc.
R1-1808293 On channel access procedure for NR-U Fujitsu
R1-1808321 Discussion on Channel access mechanism for NR-UZTE
R1-1808335 Considerations on channel access for NR unlicensed operations Sony
R1-1808359 Discussion on subband based channel access procedures for NR-U NEC
R1-1808395 Channel Access Procedures for NR Unlicensed Operations CATT
R1-1808507 Channel access procedure for NR unlicensed operation LG Electronics
R1-1808611 Channel access procedures for NR-U Apple Inc.
R1-1808685 Enhancements to channel access mechanism for NR-unlicensed Intel Corporation
R1-1808768 Channel access procedure for NR-U Samsung
R1-1808819 Channel access and co-existence for NR-U operation Nokia, Nokia Shanghai Bell
R1-1808899 Channel access mechanisms on NR-U Guangdong OPPO Mobile Telecom
R1-1809063 Enhancements for the NR-U channel access procedure AT&T
R1-1809089 Channel access procedure and coexistence in NR-U InterDigital, Inc.
R1-1809111 Channel access procedures for NR unlicensed operation Sharp
R1-1809154 Channel access procedures for NR-U operation NTT DOCOMO, INC.
R1-1809204 Channel access mechanisms for NR-U Ericsson
R1-1809248 Channel access procedure in NR-U ASUSTEK COMPUTER (SHANGHAI)
R1-1809296 Discussion on proposed channel access schemes for NR-Unlicensed BROADCOM LTD
R1-1809300 Extensions for Channel Access Procedures Motorola Mobility, Lenovo
R1-1809325 Discussion on channel access procedure for NR-U operation WILUS Inc.
R1-1809381 Design considerations on channel accessing Convida Wireless LLC
R1-1809479 Channel access procedure for NR-U Qualcomm Incorporated
R1-1809821 WF on the use of No-LBT and one-shot LBT for transmissions outside a shared COT Broadcom, CableLabs, BlackBerry, HPE (Aruba), Ruckus

R1-1809801 Feature Lead's Summary on Channel Access Procedures Nokia, Nokia Shanghai Bell

Agreement:
In addition to aspects considered in LTE LAA, CWS adjustment procedure in NR-U may additionally consider at least the following aspects:
- CBG based HARQ-ACK operation,
- NR scheduling and HARQ-feedback delays and processing times
- wideband (>20 MHz) operation including BWPs
- Configured grant operation

7.2.2.4.2 Initial access and mobility

R1-1808062 Initial access in NR unlicensed Huawei, HiSilicon
R1-1808238 Discussion on initial access and mobility procedure for NR-U vivo

R1-1808275 On initial access procedure in NR-U MediaTek Inc.
R1-1808322 Discussion on initial access and mobility for NR-U ZTE
R1-1808336 Considerations on initial access and mobility for NR unlicensed operations Sony
R1-1808396 Initial Access and Mobiity for NR Unlicensed Operations CATT
R1-1808508 Initial access and mobility for NR unlicensed operation LG Electronics
R1-1808686 Enhancements to initial access and mobility for NR-unlicensed Intel Corporation
R1-1808769 Initial access and mobility procedure for NR-U Samsung
R1-1808900 Initial access procedure on NR-U Guangdong OPPO Mobile Telecom
R1-1808920 Discussion on initial access for NR-U Potevio
R1-1808951 On Initial Access and Mobility for NR-U Nokia, Nokia Shanghai Bell
R1-1809064 NR-U design for initial access and mobility AT&T
R1-1809090 On Initial Access and Mobility for NR-U InterDigital, Inc.
R1-1809179 SI Transmission in NR-U Charter Communications
R1-1809185 Enhancement of configured grant for NR unlicensed band ITRI
R1-1809205 On initial access, RRM, mobility and RLM Ericsson
R1-1809219 Initial access in NR Unlicensed Xiaomi Technology
R1-1809492 Diversity in RACH transmissions Motorola Mobility, Lenovo (Revision of R1-1809315)
R1-1809326 Discussion on initial access and mobility for NR-U operation WILUS Inc.
R1-1809399 Initial access and mobility in NR-U Motorola Mobility, Lenovo
Withdrawn
R1-1809402 Discussion on initial access in NR-U KT Corp.
R1-1809473 Initial access and mobility for NR-U ITL
R1-1809480 Initial access and mobility for NR-U Qualcomm Incorporated

R1-1809727 Feature lead summary #1 of initial access and mobility Charter Communications
R1-1809826 Feature lead summary #1 of initial access and mobility Charter Communications

Agreement:
- It is recommended to define a mechanism to transmit SSBs dropped due to LBT failure
- Following are examples of candidate mechanisms for further consideration with enhancements or modifications not precluded:
  - Alt-1: Shift SSB(s) in time to the next transmission instance
  - Alt-2: Cyclically wrap the SSBs dropped due to LBT failure around to the end of the burst set transmission
  - Alt-3: Network to flexibly position SSB index and indicate the timing information
  - Other alternatives are not precluded
- It is recommended to define a mechanism for UE(s) to determine the timing and QCL assumptions from the detected SSB

Agreement:
If preamble transmissions are dropped due to LBT failure, then
- From a RAN1 perspective, it is recommended that preamble power ramping is not performed and that the preamble transmission counter is not incremented

Agreement:
- In some scenarios it is beneficial for the maximum RAR window size to be extended beyond 10 ms to increase robustness to DL LBT failure
  - FFS: Value of maximum RAR window size

Agreement:
It is beneficial to support reporting of RSSI
- FFS: The time and frequency resources on which RSSI is measured

7.2.2.4.3 Potential HARQ enhancements

R1-1808063 HARQ enhancement in NR unlicensed Huawei, HiSilicon

R1-1808239	Discussion on HARQ operation for NR-U	vivo
R1-1808276	Enhancements on HARQ for NR-U operation	MediaTek Inc.
R1-1808323	Discussion on scheduling and HARQ for NR-U	ZTE
R1-1808337	Considerations on HARQ enhancements for NR unlicensed operations	Sony
R1-1808360	Discussion on HARQ enhancements for NR-U	NEC
R1-1808397	HARQ Operations in NR-U	CATT
R1-1808509	HARQ procedure for NR unlicensed operation	LG Electronics
R1-1808545	HARQ-ACK enhancement for NR-U	Lenovo, Motorola Mobility
R1-1808687	Enhancements to HARQ for NR-unlicensed	Intel Corporation
R1-1808770	HARQ enhancements for NR-U	Samsung
R1-1808811	Consideration on HARQ enhancements in NR-U	Spreadtrum Communications
R1-1808820	HARQ Operation in NR-Unlicensed	Nokia, Nokia Shanghai Bell
R1-1808895	HARQ enhancements for NR-U	Guangdong OPPO Mobile Telecom
R1-1809065	HARQ enhancements for NR-U	AT&T
R1-1809091	On HARQ enhancements for NR-U	InterDigital, Inc.
R1-1809186	Potential HARQ enhancements for NR-U	ITRI
R1-1809206	HARQ enhancements for NR-U	Ericsson
R1-1809286	Discussions on HARQ enhancement for NR-U	CAICT
R1-1809403	Considerations on HARQ operation for NR-U	KT Corp.
R1-1809481	Potential HARQ enhancements for NR-U	Qualcomm Incorporated

R1-1809750	**Feature lead summary of HARQ enhancement in NR-U**	**Huawei, HiSilicon**
R1-1809921	**Feature lead summary of HARQ enhancement in NR-U**	**Huawei, HiSilicon**

Agreement:

- NR-U should support both:
  - HARQ feedback corresponding to some or all the PDSCHs of a channel occupancy can be reported in the same channel occupancy
    - It is found beneficial to extend the PDSCH-to-HARQ-timing to support indicating timings up to the end of the longest COT allowed by regulations, one or more of the following would be needed:
      - Allow values larger than 15 by RRC signaling (FFS the largest value needed)
        - Note: in some cases this may point outside of the COT
      - Allow more bits for the PDSCH-to-HARQ-timing-indicator
  - HARQ feedback corresponding to PDSCHs of a channel occupancy can be reported outside of that channel occupancy. These possible candidate solutions can be considered:
    - Alt1: gNB requests/triggers feedback for PDSCH from earlier COT(s)
    - Alt2: UE is configured to report HARQ feedback for PDSCH from earlier COT(s) without an explicit request/trigger
    - Alt3: by PDSCH-to-HARQ-timing-indicator in the DCI scheduling the PDSCH
    - Note: the alternatives above are at least applicable for the case where there is no HARQ feedback expected in the same channel occupancy as the PDSCH
    - Study the impact of the above candidate solutions on the HARQ codebook

7.2.2.4.4 Potential enhancements to configured grants

R1-1808064	Transmission with configured grant in NR unlicensed band	Huawei, HiSilicon
R1-1808240	Discussion on the enhancements to configured grants	vivo
R1-1808277	Discussion on NR-U configured grant	MediaTek Inc.
R1-1808324	Discussion on configured grant for NR-U	ZTE
R1-1808338	Considerations on Enhancements to Configured Grants for NR Unlicensed operation	Sony
R1-1808361	Discussion on configured grants in NR-U	NEC
R1-1808510	Discussion on configured grant for NR unlicensed operation	LG Electronics
R1-1808688	Enhancements to NR configured grants for unlicensed operation	Intel Corporation
R1-1808771	Enhancements on configured grant for NR-U	Samsung
R1-1808806	Consideration on autonomous UL transmission in NR-U operation	Spreadtrum Communications

R1-1808821 On support of UL transmission with configured grants in NR-U Nokia, Nokia Shanghai Bell
R1-1808901 Configured grant transmission on NR-U Guangdong OPPO Mobile Telecom
R1-1809092 Configured grant enhancements in NR-U InterDigital, Inc.
R1-1809207 Configured UL grant for NR-U Ericsson
R1-1809382 Autonomous Uplink Transmission in NR Unlicensed Convida Wireless LLC
R1-1809482 Potential enhancements to configured grants for NR-U Qualcomm Incorporated

R1-1809747 Summary of views on the potential enhancements to configured grants Intel Corporation

Agreement:
Allowing consecutive configured grant resources in time without any gaps in between the resources and non-consecutive configured grant resources (not necessarily periodic) with gaps in between the resources is beneficial and should be considered for NR in unlicensed spectrum

R1-1809825 Summary of views on the potential enhancements to configured grants Intel Corporation

Conclusion:
There is no necessity to exclude Type-1 or Type-2 configured grant mechanism for operation of NR in unlicensed spectrum.

Agreement:
UE selects the HARQ process ID from an RRC configured set of HARQ IDs for NR-unlicensed configured grant transmission.

Agreement:
It is identified to be beneficial to support DFI to include pending HARQ ACK feedback for prior configured grant transmissions from the same UE.
- FFS: DFI to include HARQ ACK feedback for scheduled UL transmissions using HARQ IDs configured for NR-unlicensed configured grant transmission.

Agreement:
- Retransmission via same configured grant resource is supported for a HARQ process that was initially transmitted via configured grant resource.
- Retransmission via resource scheduled by UL grant is supported for a HARQ process that was initially transmitted via configured grant resource.

Agreement:
UE may autonomously initiate retransmission for a HARQ process that was initially transmitted via configured grant mechanism for NR-unlicensed when one of the following conditions is met:
- Reception of NACK feedback via DFI for the corresponding HARQ process
- FFS: No reception of feedback from gNB upon the timer expiration.
    - To introduce a new timer or reuse *configuredGrantTimer.*

Agreement:
It is identified to be beneficial to consider UE multiplexing and collision avoidance mechanisms between configured grant transmissions and between configured grant and scheduled grant transmissions.
- FFS: detailed mechanism.

Agreement:
NR-unlicensed configured grant transmission is not allowed during the time when it overlaps with occasions configured for potential NR-U DRS of the serving cell irrespective of the configured time domain resource for configured grant transmission.

7.2.2.4.5 Other

R1-1808065 BWP operation in NR unlicensed band Huawei, HiSilicon
R1-1808825 On Wideband Operation for NR-U Nokia, Nokia Shanghai Bell

R1-1809208 On SRS design for unlicensed operation Ericsson
R1-1809209 On interlace design for NR-U uplinks Ericsson
R1-1809210 Indoor coexistence evaluation results for NR-U and WiFi Ericsson

7.2.2.5 Other

R1-1808066 Zero-Autocorrelation zone of frequency-interlaced PRACH Huawei, HiSilicon
R1-1808257 Discussion on user multiplexing for NR-U TCL Communication Ltd.
R1-1808258 Discussion on Frequency Reuse for NR-U TCL Communication Ltd.
R1-1808689 On the consideration for spatial reuse for NR-unlicensed Intel Corporation
R1-1808690 Initial design on technology neutral preamble for unlicensed operation Intel Corporation
R1-1808826 On Maximum TX Power for UL Interlace Structures Nokia, Nokia Shanghai Bell
R1-1809223 Wideband operation in NR unlicensed PANASONIC

7.2.3 Study on Integrated Access and Backhaul for NR

FS_NR_IAB; SID in RP_181349. Please refer to the SID for detailed scoping

R1-1809488 **Work plan for Integrated Access and Backhaul Study Item** **AT&T, KDDI, Qualcomm, Samsung**
Decision: The document is noted.

R1-1809489 **TR38.874, Version 0.4.0 AT&T, KDDI, Qualcomm, Samsung**
Discussion: Sharp: is the document content the same for all WG? AT&T --> yes, RAN2 lead WI - the TR provides the current status of progress.
Decision: The document is noted.

7.2.3.1 Enhancements to support NR backhaul links

R1-1808101 **Physical layer design for NR IAB** **Huawei, HiSilicon**

- Proposal 1: Study whether the maximum number of candidate SSBs in Rel-15 is sufficient to serve both access UEs and IAB nodes for initial access.
- Proposal 2: Support TDM of SSBs for IAB nodes and access UEs considering the following two options (1) TDM within a SSB burst set; (2) TDM across SSB burst sets with dedicated periodicity and offset settings for IAB nodes.
- Proposal 3: The SSBs for IAB node discovery and RRM measurement can be placed at the frequency location different from those for initial access, in order not to cause UE confusion.
  - Off-raster frequency position can be an option for further study
- Proposal 4: The SSBs for IAB node discovery/measurement among IAB nodes can be overlapped.
- Proposal 5: For a given IAB node, its SSB transmission should be muted to facilitate the measurement for other IAB nodes if its SMTC window is overlapped with its SSB transmission.
- Proposal 6: For IAB node discovery and backhaul link RRM measurement, the principle defined in Rel-15 should be a starting point and further optimization can be studied for backhaul links to save measurement overhead
  - Longer SMTC period and CSI-RS measurement period
  - Aperiodic measurement configuration
- Proposal 7: Faster beam failure recovery mechanism for backhaul link should be studied.
- Proposal 8: Beam failure notification mechanism to child node and child node's behavior should be studied.
- Proposal 9: Semi-static slot configuration for each IAB node should be supported,
  - For L2 IAB, the configuration is determined by the CU of IAB donor according to centralized coordination, and configured by the CU to the DU of is associated IAB nodes
  - For L3 IAB, the configuration is determined by each IAB node according to distributed coordination
- Proposal 10: An IAB node can be configured with a set of slots for backhaul and access transmission including the link directions.
- Proposal 11: For the backhaul-access dynamic sharing slot, the PDCCH time location for IAB node MT's backhaul link and the PDCCH for its DU's access link should meet the following requirement
  - The backhaul link PDCCH (BH-PDCCH) should be ahead of its associated PDSCH/PUSCH
  - The backhaul link PDCCH (BH-PDCCH) should be ahead of the access link PDCCH (AC-PDCCH)
- Proposal 12: To support FDM and SDM between backhaul and access links, enhanced downlink power control scheme on backhaul link should be studied in order to solve the power imbalance issue between backhaul and access links.
- Proposal 13: For FR1, it should be studied whether TA/2 timing adjustment for OTA based DL Tx timing synchronization can work for multi-hop topology.

- Proposal 14: It should be studied how the DL Tx timing of IAB node can be configured in an accurately and timely manner to avoid timing error propagation and system performance degradation.
- Proposal 15: It should be studied how to maintain IAB node local DL Tx timing in case of route switching after it finishes initial DL Tx timing configuration.
- Proposal 16: In order to support symbol alignment between access and backhaul link within IAB node, additional TA adjustment on IAB node or UE should be further studied.
- Proposal 17: In addition to symbol alignment, other mechanisms to enable SDM based interference mitigation should also be studied, at least including
  - DMRS orthogonal configuration between access and backhaul links
  - Interference mitigation receiver
- Proposal 18: Both distributed and centralized interference management schemes should be studied for inter-IAB CLI management.
- Proposal 19: RAN1 should study the enabling mechanisms to support the inter-IAB node CLI mitigation method, at least including
  - Time/frequency coordination
  - Beam coordination
  - Power control
- Proposal 20: Up to 1024QAM should be considered for backhaul link.
- Proposal 21: Phase noise compensation performance improvement on backhaul link should be investigated to support higher order modulation above 64QAM. Two possible directions are: 1) PT-RS redesign 2) Compensation algorithm improvement, e.g., CPE with ICI.

Decision: The document is noted.

R1-1808578 **NR support for IAB** **Nokia, Nokia Shanghai Bell**

- Observation 1: IAB node discovery can be handled by (access UE) SSB search in the initial access, followed by CSI-RS detection in later phases.
- Observation 2: $\binom{N}{M}$-patterns for IAB SSB TX-RX would provide discovery opportunities for a group of IAB nodes within a fixed number of SSB set TX/RX windows but co-ordination for pattern reuse would be needed.
- Observation 3: From access UEs' point of view, IAB SSBs could be handled the same way as access UE SSBs that are not connected to SIB1.
- Observation 4: CSI-RS based IAB link monitoring of candidate links can be done like UE measurements for mobility except that the maximum periodicity could be larger for IAB.
- Observation 5: Resource allocation schemes developed for different access link scenarios can be reused for BH link.
- Observation 6: Depending on the IAB architecture and protocol choices, RRC signalling may need to be enhanced to support multiple hops with centralized resource pool coordination.
- Observation 7: Random access of the UE part of the IAB node is less frequent compared to access UEs.
- Observation 8: For sharing RACH resources between IAB and UE access, the maximum round-trip time (i.e. cyclic shift step) should be estimated based on the IAB hop length rather than the maximum path loss supported by IAB node for a RACH format.
- Proposal 1: RAN1 is asked to consider the need for IAB specific SSB transmissions and if the CSI-RS (or SRS) based detection and monitoring of the IAB nodes is sufficient between nodes that have done cell selection and network access.
- Proposal 2: Distributed resource pool coordination scheme is the baseline resource allocation scheme. It can be enhanced by centralized coordination by IAB-donor.
- Proposal 3: Granularity for the resource pool coordination between IAB-donor and IAB-nodes is one slot.
- Proposal 4: GC-PDCCH enhancements are needed to facilitate dynamic resource allocation between the backhaul and access links as well as centralized resource coordination.
- Proposal 5: RN processing time capabilities need to be discussed as part of the IAB studies.
- Proposal 6: Multiplexing RACH transmissions of access UEs and IAB nodes can be handled within the Rel-15 framework.
- Proposal 7: It should be clarified whether there will be standard impacts related to use of different timing options or could they be left for implementation options.
- Proposal 8: Options leading to synchronized network can be taken as a baseline for IAB operation and deployment. The other options can be left for later studies and/or choices for implementation.

Decision: The document is noted.

R1-1808691 **PHY layer enhancement to support NR IAB** **Intel Corporation**

- Observation 1: Different PRACH Configuration Index does not guarantee the orthogonality of PRACH transmitting time in an IAB RN and its child node.
- Observation 2: The semi-static configuration on cell-specific DL-UL-F configurations and the set of slot format combinations in Rel-15 NR design is expected to be sufficient for time-domain resource allocation for IAB nodes.

- Observation 3: Current NR design support frequency resource allocation across IAB node in RB level.
- Observation 4: IAB relaying is effective in improving coverage. But the user perceived throughput could be undermined due to half-duplexed constraint.
- Proposal 1: For NR IAB node discovery and RRM, use Solutions 1 or 5 as baseline solution and use Solution 3 as a supplementary solution.
- Proposal 2: To coordinate the SSB resource or periodicity across IAB nodes, either RRC or F1-AP signalling can be applied.
- Proposal 3: For UE or RN cell selection, the backhaul link condition should be factored in. The following two options are preferred considering latency, power consumption and specification effort:
  - Option 1a: use *cellBarred* indication in MIB;
  - Option 2: adjust RSRP threshold in initial access based on backhaul link condition.
- Proposal 4: For Rel-16, no additional specification effort is needed for IAB node selection considering backhaul link condition. Further enhancement can be considered in future releases.
- Proposal 5: For NR IAB synchronization, support Case 1 for NR IAB.
- Proposal 6: For an IAB RN to operate in half-duplex mode, the PRACH Configuration Index of the IAB RN and its child node needs to be carefully chosen to guarantee the orthogonality among adjacent hops.
- Proposal 7: Study approaches to offset the impact of half-duplex constraint on per link and overall system performance.
- Proposal 8: Consider link adaptation based on measurement that emulates the upcoming interference level for NR IAB CLI management.
- Proposal 9: Clarify that in NR IAB, if FDM and SDM are supported, it should assume that the IAB node has multiple antenna panels and multiple basebands each serving different frequency bands or transmission directions.
- Proposal 10: Study mechanisms on IAB node power saving.

Decision: The document is noted.

R1-1809442 **Enhancements to support NR backhaul links** **Qualcomm Incorporated**

--- RACH design ---

Observation 1.1: The ratio of backhaul link distance to access link distance might be much higher than two in NR.

Observation 1.2: If access and backhaul links use same resources for RACH, supportable number of cyclic shifts for each ZC root sequence decrease significantly.

- This, in turn, leads to the use of higher number of ZC root sequences in each cells and higher interference during RACH transmission.

Observation 1.3: Periodicity of backhaul RACH resources, that are orthogonal to access RACH resources, can be extended to reduce overhead.

Proposal 1.1: NR allows network the flexibility to configure access and backhaul RACH resources with different occasions and periodicities.

- Different mechanisms can be considered to enable this, e.g., additional bits can be introduced in RMSI to indicate backhaul CBRA occasions.

--- inter-relay discovery and measurements ---

Proposal 2.1: to address the half-duplex constraint in the IAB-node discovery and measurements, support different TX/RX coordination patterns. The patterns may be (pseudo-)random, semi-persistent/periodic, or dynamically configured.

Proposal 2.2: support configuring the TX/RX pattern both centrally (baseline) and in a distributed manner.

- FFS the required signaling.

Observation 2.1: Sporadic SSB transmissions, following a muting pattern, may confuse the initial access UEs, if they are transmitted on a sync raster.

Proposal 2.3: use off-raster SSBs for IAB discovery and measurements.

Proposal 2.4: simple modifications to the NR R15 RRM framework should be considered to make it more suitable for backhaul operations, such as

- configuring new values for CSI-RS/SMTC periodicity (e.g. larger than 160 msec),
- increasing the maximum number of SMTC configured per frequency,
- supporting more flexible time-domain location of the SSBs within a SMTC,
- leveraging SMTC design to configure transmission windows (STTC).

Proposal 2.5: adopt the proposed framework in **Error! Reference source not found.** for initial acquisition, inter-IAB-node discovery and BH measurements.

--- link failure recovery ---

Observation 3.1: In Rel-15, RLF is declared after a N310 consecutive OOS are detected and T310 timer runs for the configured time without receiving N311 consecutive IS indications.

- In Rel-15, failure of beam recovery procedure leads to RLF declaration.
- In Rel-15, Success of beam recovery procedure does not impact RLF procedure.

Observation 3.2: Radio link monitoring and candidate beam reference signals can be different.
- Communication can happen via candidate beam reference signal even if radio link monitoring reference fail.

Observation 3.3: Declaring RLF is costly for an IAB UEF node.
- The corresponding IAB DU will have to release all resources of its child nodes.

Proposal 3.1: NR supports success of beam recovery procedure stopping the T310 timer and preventing IAB UEF to declare RLF.

--- over-the-air synchronization ---

Observation 4.1: TA-based OTA synchronization can support multi-hop IAB network (4~5 hops) for mmw bands. TA-based OTA synchronization is not sufficient to support multiple hops in lower bands.

Proposal 4.1: To tighten the OTA timing error, especially in lower bands, RAN1 should consider the following solutions:
- Using wider band signals (UL and DL) to achieve more accurate timing estimation
- Enhancing TA, e.g. by reducing its granularity and increasing the number of bits

Proposal 4.2: IAB TR should mention TA-based OTA synchronization can support up to [5] hops in MMW bands.

Proposal 4.3: IAB network should use other synchronization techniques, such as GNSS and PTP, along with OTA techniques to achieve tight network synchronization.

Proposal 4.4: it should be further studied how timing adjustment of an IAB-node (following OTA synchronization) impacts the operation of its child IAB-nodes and UEs.

--- multi-hop timing alignment ---

Proposal 5.1: the timing alignment case 1 (where slot boundaries across multi-hop IAB network are aligned) is adopted as the baseline.
- The other cases that allow simultaneous transmissions and/or receptions over two adjacent hops should also be supported.
- It is left to network, which case to select.

--- resource allocation and coordination ---

Proposal 6.1: A semi-static resource partitioning shall be supported as a baseline approach, where a set of resources, called schedulable resources, are determined for each IAB-node to schedule its child nodes.
- To support a centralized implementation of the semi-static resource partitioning schemes. New upper-layer (F1-AP) signaling is needed to indicate the required reports for selecting schedulable resources and provide the selected resources.
  - Exact signaling format is out of RAN1 scope.
- The granularity for schedulable resource pattern shall be configurable.
- A schedulable resource pattern for an IAB-node can be associated with only a subset of its child links.
- Interaction between schedulable resource pattern and the resource allocation (e.g. RRC-configured resources) shall be further studied, including e.g. conflict resolution rules.

Proposal 6.2: A dynamic coordination approach shall be supported with potentially using enhanced slot format indication framework.

--- cross-link interference ---

Observation 7.1: in a homogenous IAB network, the worst-case SINR (due to BH-to-BH interference) is sufficiently high: >20dB at 10% and >30dB at 50%.

Observation 7.2: IAB CLI scenarios are very similar to cross-link (in flexible TDD) and inter-cell interference scenarios in the access network.

Proposal 7.1: IAB CLI study should be unified with other CLI scenarios and worked out in the CLI WI.

--- power control ---

Proposal 8.1: the power of the concurrent access and backhaul links (multiplexed in frequency or spatial)
- should be controlled semi-statically – at least for the transmissions that cannot dynamically change the power (like DL RS for RRM, periodic CSI-RS)
- can be determined dynamically for the remaining transmissions.
- FFS: enhancements to allow more efficient SDM/FDM of the access and backhaul links.

Decision: The document is noted.

Thursday session

R1-1809857 **Summary of 7.2.3.1 Enhancements to support NR backhaul links AT&T**

Decision: The document is noted.

Agreements:
- In case of SA deployments, initial IAB node discovery by the MT (Stage 1) follows the Rel.15 procedure for cell search and initial access based on SSBs available for access UEs without additional required specification support.
  - FFS: how to support NSA deployment
  - FFS whether Stage 2 enhancements (if any) can be applied to Stage 1

Agreements:

- For the purpose of inter-IAB node and donor detection after the IAB node DU becomes active (Stage 2) at least one of the following solutions should be supported:
  - SSB-based solutions (Solution 1):
    - Solution 1-A) Reusing the same set of SSBs used for access UEs
    - Solution 1-B) Use of SSBs which are orthogonal (TDM and/or FDM) with SSBs used for access UEs
    - Mechanisms to support half-duplex transmission/measurement of SSBs (e.g. muting patterns) for Solution 1-A) or Solution 1-B)
    - Further study potential impacts of the above solutions on access UEs performing initial access/in IDLE mode, including:
      - Cell detection/measurement performance impact due to loss of SSB occasions due to muting
      - Discovery of SSBs by access UEs which are intended only for IAB node discovery
  - CSI-RS based solutions (Solution 2)
    - Feasibility of CSI-RS only based discovery in case of unsynchronized network operation
- Further study enhancements to existing configurations (e.g. SMTC and CSI-RS configuration) and inter-node coordination (e.g. F1) for Solutions 1) or 2) and possibility of aperiodic transmission of SSBs/CSI-RS

Agreements:

- IAB supports the ability of network flexibility to configure backhaul RACH resources with different occasions, periodicities, and/or formats, compared to access RACH resources without impacting Rel.15 UEs
  - Further study mechanisms under current PRACH design framework to ensure that after initial access, IAB nodes and access UE of its mother node can be configured or identify TDMed PRACH occasions.
  - Further study the need for new RACH formats/configurations specific for IAB node random access

Agreements:

- For the purpose of backhaul link measurements IAB supports both SSB and CSI-RS for backhaul link RSRP/RSRQ RRM measurements. Further consider the following aspects:
  - Enhancements to Rel.15 CSI-RS and SSB measurement configurations and required coordination

Agreements:

- To support RLM/RLF procedures for IAB nodes, the following should be further studied:
  - Enhancements to support interaction between Beam Failure Recovery success indication and RLF
  - Enhancements to existing beam management procedures for faster beam switching/coordination/recovery to avoid backhaul link outages should be considered for IAB nodes

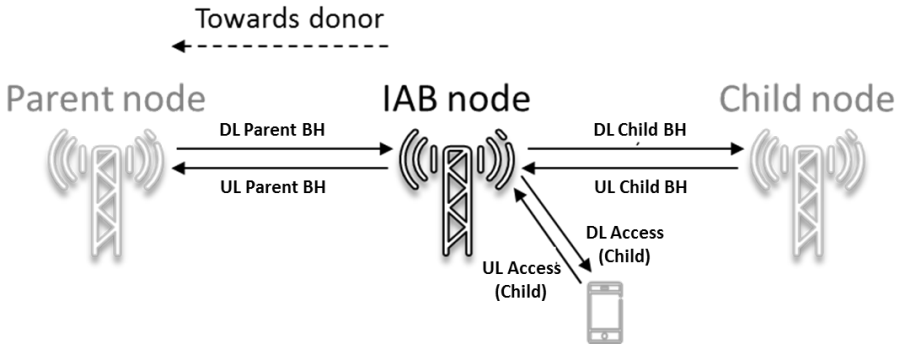
Agreements:

- Study the need for additional backhaul link condition notification mechanism from the parent IAB node DU to the child IAB node as well as corresponding IAB node behavior.
  - E.g., if the parent IAB node's backhaul link fails (RLF or BF)
  - Note: this study is intended to focus on RAN1 aspecs only (any higher layers aspects are to be handled by other WGs)

Agreements:

Capture the following definitions in the TR:

- Access link: a link between an access UE and an IAB node or IAB donor ($L_{A,DL}$ or $L_{A,UL}$)
- Backhaul link: a link between an IAB node and an IAB child node ($L_{C,DL}$ or $L_{C,UL}$)or IAB parent node ($L_{P,DL}$ or $L_{P,UL}$)
- Note: the IAB node may have its functions for UL access and child BH respectively in the same location or different locations, which is not the scope of RAN1 discussion
- Note: For a given BH link for an IAB node, it may be a parent BH or a child BH, depending on the topology/architecture, which is not the scope of RAN1 disucssion



Proposals:
To support TDM of parent and child links, where child links can include access links to UEs and/or backhaul links to child IAB nodes, a pattern which is specific to an IAB node is configured which indicates resources in time available for parent and child links:

- Further study details of the adaptation period and granularity (e.g. slot or symbol-level) of the pattern provided to the IAB node, including
  - Explicit or implicit indication of the resources
  - Enhancements to existing signaling mechanisms to indicate the pattern
  - Potential need to differentiate the resources for UL child backhaul and UL access transmissions in time
- Further study the indication of resources within the configuration which can be dynamically and flexibly used for parent and child links by the IAB node, including
  - The need to consider the scheduling delay or information required to be available for the use of flexible resources
  - Mechanisms to schedule flexible resources (e.g. GC-PDCCH)
- Note: this does not address the question of how access and child backhaul links are multiplexed by an IAB node

Agreements:
An IAB node can support the following cases using existing MU-MIMO or sectorization mechanisms:

- Case A: multiplexing of DL transmissions to access UEs and child IAB nodes
- Case B: multiplexing of UL transmissions from access UEs and child IAB nodes

Agreements:
Clarify the SDM scenario definition:

- SDM Tx: An IAB node simultaneous transmits in the DL (to an access UE and/or child IAB node) and transmits in the UL (to a parent IAB node)
- SDM Rx: An IAB node simultaneous receives in the DL (a transmission from a parent node) and receives in the UL (from an access UE and/or child IAB node)

For the support of SDM, further study the following aspects:

- Transmit power coordination between parent and child links
- Considerations of single panel vs. multi-panel operation (single or multiple baseband)
- Requirements of symbol-level timing alignment within an IAB node (e.g. Case #6/Case #7)

Agreements:

- At least Case #1 is supported for both access and backhaul link transmission timing.
- Further study includes additionally the following two cases (in addition to other cases #2/3/4/5)
  - Case #6 (Case#1 DL transmission timing + Case #2 UL transmission timing):
    - the DL transmission timing for all IAB nodes is aligned with the parent IAB node or donor DL timing (e.g. TA/2 adjustment as in Case #1)
    - the UL transmission timing of an IAB node can be aligned with the IAB node's DL transmission timing
  - Case #7 (Case#1 DL transmission timing + Case #3 UL reception timing):
    - the DL transmission timing for all IAB nodes is aligned with the parent IAB node or donor DL timing (e.g. TA/2 adjustment as in Case #1)
    - the UL reception timing of an IAB node can be aligned with the IAB node's DL reception timing

- FFS: TA required for IAB nodes to support these cases
- For Case #6 and Case #7 further consider the potential impact of imperfect timing adjustment, overhead of required DL/UL switching gaps, and scheduling impact on access UEs and child IAB nodes
- Study to include aspects (including feasibility) when the IAB node is connected to one or multiple parent nodes

Friday session

R1-1809941 Summary of 7.2.3.1 Enhancements to support NR backhaul links AT&T

Decision: The document is noted.

Agreements:

- For the support of TDM, at least the following cases are supported:

	TDM Between:		
Case	**Link 1**	**Link 2**	**Supported by a pattern?**
1	$L_{P,DL}$	$L_{C,DL}$	Yes
2	$L_{P,UL}$	$L_{C,UL}$	Yes
3	$L_{P,DL}$	$L_{C,UL}$	Yes
4	$L_{P,UL}$	$L_{C,DL}$	Yes
5	$L_{P,DL}$	$L_{A,DL}$	Yes
6	$L_{P,UL}$	$L_{A,UL}$	Yes
7	$L_{P,DL}$	$L_{A,UL}$	Yes
8	$L_{P,UL}$	$L_{A,DL}$	Yes
9	$L_{P,DL}$	$L_{A,DL}$ and $L_{C,DL}$	Yes
10	$L_{P,UL}$	$L_{A,UL}$ and $L_{C,UL}$	Yes
11	$L_{P,DL}$	$L_{A,UL}$ and $L_{C,UL}$	Yes
12	$L_{P,UL}$	$L_{A,DL}$ and $L_{A,DL}$	Yes
13	$L_{C,DL}$	$L_{A,DL}$	* At least Rel. 15 mechanisms can be used, FFS enhancements
14	$L_{C,UL}$	$L_{A,UL}$	* At least Rel. 15 mechanisms can be used, FFS enhancements
15	$L_{C,DL}$	$L_{A,UL}$	* At least Rel. 15 mechanisms can be used, FFS enhancements
16	$L_{C,UL}$	$L_{A,DL}$	* At least Rel. 15 mechanisms can be used, FFS enhancements

Note: A given pattern may include support for multiple cases, details FFS.
At least for Cases 1-12, an IAB node is configured with IAB-node specific resources in time available for the links:

- Further study details of the adaptation period and granularity (e.g. slot or symbol-level) of the pattern provided to the IAB node, including
  - Explicit or implicit indication of the resources
  - Enhancements to existing signaling mechanisms to indicate the pattern
- Further study the indication of resources within the configuration which can be dynamically and flexibly used for different links, including
  - The need to consider the scheduling delay, IAB node processing delays, or information required to be available for the use of flexible resources
  - Mechanisms to schedule flexible resources (e.g. GC-PDCCH)

R1-1808241 Enhancements to support NR backhaul links vivo
R1-1808339 Discussion on Enhancements to support NR backhaul links Sony
R1-1808398 NR Physical Layer design for IAB backhual link CATT
R1-1808511 Discussions on NR IAB support LG Electronics
R1-1808551 Discussion on resource partitioning for IAB network Lenovo, Motorola Mobility
R1-1808772 Necessary Enhancements for NR IAB Samsung
R1-1808836 Discussion on enhancements to support NR Backhaul links CMCC
R1-1808879 Discussion of backhaul link enhancement for IAB Guangdong OPPO Mobile Telecom
R1-1808918 Discussion on IAB node discovery and measurement Potevio
R1-1809072 Enhancements to support NR backhaul links AT&T
R1-1809103 Discussion on physical layer enhancements for IAB ZTE, Sanechips
R1-1809155 Discussion on enhancements to support NR backhaul links NTT DOCOMO, INC.
R1-1809231 IAB physical layer enhancements for backhaul link management Ericsson
R1-1809250 Discussion on Timing Alignment for IAB nodes ASUSTEK COMPUTER (SHANGHAI)

7.2.3.2 Evaluation methodology for NR IAB

Including remaining details on deployment scenarios and evaluation assumptions, evaluation results, etc.

R1-1809073 **Evaluation methodology and simulation results for NR IAB** **AT&T**

Observation 1: Multi-hop backhaul links experience significant gains in RSRP compared to access links.
Observation 2: Multi-hop backhaul networks benefit from resource allocation partitioning across backhaul links.
Observation 3: IAB provides coverage and system performance improvements even when nodes are subject to a half-duplex constraint.
Proposal 1: Capture the observations in this contribution in TR 38.874. RAN1 should further study potential gains and techniques for resource allocation and interference mitigation across multiple backhaul hops.
Decision: The document is noted.

R1-1809817 **Evaluation Methodology for NR IAB** **Samsung** (rev of R1-1808773)

The contribution presents initial evaluation results on IAB topology constructions for the heterogeneous scenario (200m and 500m inter macro BS distances and 3 micro BSs per macro BS) based on the agreed evaluation assumptions from the last meeting.
For 200m inter macro BS distance, it can be observed that ~66% of the relay nodes are directly connected to the macro BS (first hop relay nodes), 28% of the relay nodes are connected to the first hop relay nodes, and 6% of the relay nodes are connected to the second hop relay nodes. For 500m inter macro BS distance, it can be observed that ~70% of the relay nodes are directly connected to the macro BS (first hop relay nodes), 25% of the relay nodes are connected to the first hop relay nodes, and 5% of the relay nodes are connected to the second hop relay nodes. Finally, the long term SINR CDFs of the wireless backhaul links under half-duplex constraint per node are provided.
Decision: The document is noted.

R1-1809232 **More details on IAB evaluation methodology** **Ericsson**

- Observation 1: When the IAB node is assumed to have 3 panels, the current two options of adding panel orientation do not serve properly to multi-hop topology formation. Option 1 which adds panel orientation after topology formation may change the link strength towards the potential child nodes and therefore make the current topology no longer optimal. Option 2 which uses random orientation degrades the advantage of using directional antenna panels.
- Observation 2: In case of multi-hop topology, using only the per-link pass-loss or RSRP to determine the parent node does not consider the end-to-end performance achieved by the IAB chain from the donor all the way to the outermost IAB nod.
- Observation 3: Multi-hop IAB deployment improves the connection between the UE and the serving IAB donor comparing to the single-hop relay.
- Proposal 1: The panel orientation of IAB nodes should be included in the process of topology formation.
- Proposal 2: The decision of parent node for a given IAB node should be based on the end-to-end performance from the donor to the IAB node instead of only based on the link performance between the parent node and the IAB node.
- Proposal 3: The decision of associating an IAB node to a parent node should not only consider for maximizing the performance of users served by the new IAB node, but also consider for minimizing the impact on the performance of all affected higher-level nodes that have already been in the network as well as the users served by those IAB nodes.
- Proposal 4: Adding weights of each IAB node regarding the served traffic or the number of hops to topology formation should be studied to avoid link congestion.
- Proposal 5: The tradeoff between the connection improvement brought by the multi-hop deployment and the associated disadvantages, e.g., increased overhead, aggregated traffic, changed interference environment, etc., should be further investigated.

Decision: The document is noted.

Thursday session

R1-1809816 **Summary of 7.2.3.2 Evaluation Methodology for NR IAB** **AT&T**

Decision: The document is noted.

Agreements:

- Update the Heterogeneous scenario with the following additional network dropping assumptions:

Distance	ISD 500m	ISD 200m
Minimum distance between Micro TRPs	40m	40m
Minimum distance between Macro TRP and UE	35m	10m
Minimum distance between Micro TRP and UE	10m	10m
Minimum distance between Micro TRPs and Macro TRP	40 m	20m

Agreements:
The following factors can be considered as input to the IAB node parent-node selection, in addition to parent-node RSRP as measured by the IAB node

- Number of hops to between the candidate parent node to the donor node
- "Capacity" measures (downlink and uplink) of links on the path between the candidate parent node to the donor node
  - e.g. min RSRP of a route, harmonic mean of RSRP, Shannon capacity of the link, IAB node capability
- Load (downlink and uplink) of the candidate parent node as well as nodes on the paths between the candidate parent node to the donor node
  - Examples: Number of IAB nodes and access UEs served by a certain node

Agreements:
Add the following to the list of reported metrics for IAB evaluations:

- Distribution of minimum backhaul link RSRP of a given route between an IAB node and IAB donor
- Distribution of number of child IAB nodes per IAB node and per IAB donor
- Distribution of number of access UEs per IAB donor
- Hop count distribution

Agreements:

- At least for the purpose of IAB evaluations, when the IAB node has multiple panels, RAN1 assumes access and backhaul traffic can be sent on any panel, subject to the per IAB-node half duplex constraint.

Friday session
R1-1809978 TP for 38.874 on Evaluation Methodology for NR IAB AT&T
Decision: The document is noted.

Agreement:

- The TP in Section 2 of R1-1809978 to 38.874 is endorsed

R1-1808090 System performance evaluation in multi-hop topology IAB network Huawei, HiSilicon
R1-1808512 Remaining issue on evaluation assumptions in IAB scenario LG ELECTRONICS
R1-1808579 Evaluation of IAB Nokia, Nokia Shanghai Bell
R1-1808692 Evaluation methodology for NR IAB Intel Corporation
R1-1809443 Evaluation methodology for NR IAB Qualcomm Incorporated

7.2.3.3 Other

R1-1808085 Consideration on IAB node discovery and RRM measurement Huawei, HiSilicon
Withdrawn
R1-1808086 On resource coordination and dynamic scheduling in IAB Huawei, HiSilicon
Withdrawn
R1-1808087 On IAB node synchronization and timing alignment Huawei, HiSilicon
R1-1808088 Consideration on cross-link interference in IAB Huawei, HiSilicon
R1-1808089 On high order modulation in IAB Huawei, HiSilicon
R1-1808513 Discussions on discovery among NR IAB nodes LG Electronics
R1-1808514 Discussions on access and backhaul link timing for NR IAB LG Electronics
R1-1808515 Discussions on node behavior for IAB link management LG Electronics
R1-1808516 Discussions on HARQ-ACK transmission for NR IAB LG Electronics
R1-1808517 Initial access procedure in IAB scenario LG ELECTRONICS
R1-1808552 Discussion on discovery and measurement for IAB network Lenovo, Motorola Mobility
R1-1808580 Resource allocation between backhaul and access link Nokia, Nokia Shanghai Bell
R1-1808581 Measurements with IAB Nokia, Nokia Shanghai Bell

R1-1808582 IAB Timing Nokia, Nokia Shanghai Bell
R1-1808583 Enhancements on RACH for IAB Nokia, Nokia Shanghai Bell
R1-1808774 CLI Management in NR IAB Samsung
R1-1808904 Utilising sidelink in IAB Guangdong OPPO Mobile Telecom
R1-1809233 Transmission timing of IAB nodes Ericsson
R1-1809444 IAB resource management Qualcomm Incorporated
R1-1809445 Network synchronization for multi-hop IAB Qualcomm Incorporated

7.2.4 Study on NR V2X

FS_NR_V2X; SID in RP-181480. Please refer to the SID for detailed scoping

R1-1808518 Work plan of Study on NR V2X LG Electronics
Discussion: CATT don't think LTE PC5 design should be reused
Decision: The document is noted. For information.

R1-1808942 TR for Study on NR V2XHuawei, HiSilicon
Decision: The skeleton of TR 38.885 is endorsed.

7.2.4.1 Sidelink design

R1-1808092 Overview of general PHY sidelink design Huawei, HiSilicon,
R1-1808905 Discussion on V2X use cases and priority of work in RAN1 Guangdong OPPO Mobile Telecom
R1-1809043 Overview of NR Sidelink Design Nokia, Nokia Shanghai Bell

7.2.4.1.1 Support of unicast, groupcast and broadcast

R1-1808307 Sidelink design for unicast and groupcast Fraunhofer HHI
Observation 1: Existing blind retransmission mechanisms in V2X broadcast are not spectrally efficient to support V2X unicast.
Proposal 1: Study different CQI reporting mechanisms and its implications for in-coverage NR V2X UEs.
Proposal 2: Study the implications for introducing HARQ for unicast and groupcast SL in NR V2X.
Proposal 3: Evaluate the suitability of blind retransmission mechanisms for NR V2X.
Decision: The document is noted.

R1-1808519 Discussion on support of unicast, groupcast and broadcast for sidelink LG Electronics
Proposal 1: HARQ feedback is supported at least for unicast. FFS for groupcast and broadcast.
Proposal 2: Further study is needed whether to adopt a separate discovery channel.
Observation 1: Identifier for communication can be included in physical control channel.
Decision: The document is noted.

R1-1808775 Discussion on unicast, groupcast and broadcast for NR V2X Samsung
Observation 1:
- High layer unicast/groupcast causes useless decoding and increases UE power consumption.
- It is better to use a ID in physical layer to identify a unicast/groupcast transmission. An ID is also required to support HARQ transmission and other physical layer functions.

Observation 2:
- Discovery is needed before setting up unicast transmission of a pair of UEs.
- HARQ based data transmission could be more resource efficient. Further discussion on how to support HARQ-ACK/CSI feedback in NR V2X.

Observation 3:
- Discussion on how to distinguish between groupcast and broadcast is needed.Discovery procedure can be used to form a group of UEs doing groupcast transmission.
- Add/release of UEs to a groupcast group may be needed.
- Further study on HARQ-ACK feedback and increasing retransmission efficiency. Further study on obtaining channel state information.

Observation 4:
- Strive to have a common design to support unicast, groupcast and broadcast.

Decision: The document is noted.

R1-1809156 Support of unicast, groupcast and broadcast NTT DOCOMO, INC.

- Proposal 1: Support UE grouping procedure in NR V2X.
- Proposal 2: Rel-13 D2D relay UE discovery and selection procedure can be a start point to study UE grouping procedure.
- Proposal 3: Study the necessity to specify discovery channel (PSDCH) to support UE grouping procedure.
- Proposal 4: Study UE grouping procedure based on base station instruction, e.g., using SL measurement report.
- Proposal 5: Study link level QoS management mechanism at least for unicast and/or groupcast transmission, e.g., HARQ-ACK feedback, CSI feedback, SL pathloss compensation and closed-loop power control.
  - FFS: Method to distinguish unicast, groupcast and broadcast in PHY layer
- Proposal 6: Study the following PSCCH/PSSCH configuration for unicast, groupcast and broadcast transmission.
  - Common PSCCH/PSSCH resource configuration among unicast, groupcast and broadcast
  - Dedicated PSCCH/PSSCH resource configured for unicast, groupcast and broadcast respectively

Decision: The document is noted.

Tuesday session conclusion: Continue discussion offline – Hanbyul (LGE)

Wednesday
R1-1809798 Offline summary for 7.2.4.1.1 Support of unicast, groupcast and broadcast LG Electronics
Decision: The document is noted.

Agreements:

- RAN1 assumes that higher layer decides if a certain data has to be transmitted in a unicast, groupcast, or broadcast manner and inform the physical layer of the decision. For a transmission for unicast or groupcast, RAN1 assumes that the UE has established the session to which the transmission belongs to. Note that RAN1 has not made agreement about the difference among transmissions in unicast, groupcast, and broadcast manner.
- RAN1 assumes that the physical layer knows the following information for a certain transmission belonging to a unicast or groupcast session. Note RAN1 has not made agreement about the usage of this information.
  - ID
    - Groupcast: destination group ID, FFS: source ID
    - Unicast: destination ID, FFS: source ID
    - HARQ process ID (FFS for groupcast)
  - RAN1 can continue discussion on other information

Send an LS to RAN2 and SA2 for the above agreements – Hanbyul, R1-1809834

Agreements:

- RAN1 to study the following topics for the SL enhancement for unicast and/or groupcast. Other topics are not precluded.
  - HARQ feedback
  - CSI acquisition
  - Open loop and/or closed-loop power control
  - Link adaptation
  - Multi-antenna transmission scheme

Thursday session
R1-1809834 [Draft] LS on support of unicast, groupcast, and broadcast LG Electronics
Decision: The draft LS is endorsed by updating action to "provide feedback if necessary". Final LS is approved in R1-1809907.

R1-1808091	Overview of sidelink unicast, groupcast and broadcast support for NR V2X	Huawei, HiSilicon,
R1-1808242	Considerations on sidelink unicast, groupcast and broadcast	vivo
R1-1808340	Discussion on support of unicast, groupcast and broadcast in NR V2X	Sony
R1-1808399	Support of unicast, groupcast and broadcast in NR sidelink	CATT
R1-1808553	Support of unicast, groupcast and broadcast for NR V2X	Lenovo, Motorola Mobility
R1-1808602	Support of unicast, groupcast and broadcast in NR V2X	ZTE
R1-1808646	Discussion on supporting unicast, groupcast and broadcast via NR sidelink	Panasonic

R1-1808693 Support of sidelink unicast, groupcast and broadcast modes for NR V2X communication Intel Corporation
R1-1808722 Design issues for NR V2X unicast, groupcast and broadcast ITRI
R1-1808837 Discussion on support of V2X unicast transmission CMCC
R1-1808875 Discussion of sidelink unicast, groupcast and broadcast for NR-V2X Guangdong OPPO Mobile Telecom
R1-1809044 Initial View on Support of unicast, groupcast and broadcast for NR Sidelink Nokia, Nokia Shanghai Bell
R1-1809066 V2X sidelink design in supporting unicast, groupcast and broadcast AT&T
R1-1809093 NR Sidelink Support of Unicast Groupcast and Broadcast InterDigital, Inc.
R1-1809174 On support of sidelink unicast, groupcast and broadcast Xiaomi Communications
R1-1809301 Support of unicast, groupcast and broadcast Ericsson
R1-1809446 Support for unicast, groupcast and broadcast Qualcomm Incorporated

7.2.4.1.2 Physical layer structures and procedure(s)

R1-1808554 Physical layer structures and procedure in NR V2X Lenovo, Motorola Mobility

- Proposal 1: The following sidelink physical signal/channel should be studied in NR V2X:
  - Synchronization signal and sidelink broadcast channel
  - Sidelink control channel
  - Sidelink data channel
- Proposal 2: Reuse the following sidelink communication modes for NR V2X:
  - Scheduling based communication mode
  - UE autonomous resource selection based communication mode
- Proposal 3: Link adaptation mechanism should be studied for both unicast and groupcast communication.
- Proposal 4: Flexible numerology on different frequency spectrum can be studied.
- Proposal 5: For the waveform, DFT-s-OFDM and CP-OFDM can be studied.

Decision: The document is noted.

R1-1808694 Sidelink Physical Layer Structure and Procedures for NR V2X Communication Intel Corporation

- Further discuss if there are benefits to support different SCS options for the sidelink of eV2X use cases
- Based on the assumption of ~0.5 km maximum communication distance, a maximum delay spread of 1 μs and a timing offset error analysis, a CP size not leading to degradation of the system performance should be selected
- At least for FR1, consider OFDM as the baseline waveform for both PSCCH and PSSCH
  - SC-FDMA is considered only if significant benefits over OFDM are observed
- Consider a common DMRS design for PSSCH and PSCCH in the case of FDM between PSSCH and PSCCH
- Consider the PDCCH reference structure as a starting point for PSCCH in TDM mode and introduce enhancements if the evaluation shows insufficient performance
- Prioritize the evaluation of transparent schemes for transmit diversity
  - Study the effects of the bundling size on the different schemes, as well as give recommendation for a useful bundling parametrization of the different schemes
- For a SCS of 30 kHz or 60 kHz consider to reuse the existing DMRS patterns in PDSCH at least as a baseline for the initial study
- If 15 kHz is selected for the ITS band, consider to define new DMRS patterns to improve demodulation performance
- Consider to support up to 8 antenna ports from a system perspective with orthogonal reference signals to support spatial multiplexing of UEs as well as to resolve collisions of different devices transmitting in the same resources
- Evaluate open loop spatial multiplexing as a primary option for spatial multiplexing.
- Evaluate transparent transmit diversity schemes for PSSCH

Decision: The document is noted.

R1-1809447 Design principles for physical layer aspects of NR V2X Qualcomm Incorporated

- Principle 1: NR-V2X sidelink should be based on synchronous communications between UEs, so that the resource wastage due to asynchronous operation can be avoided.
- Principle 2: NR-V2X sidelink operates either in license exempt ITS spectrum or utilizes uplink spectrum for
- Principle 3: CP-OFDM is used for NR-V2X sidelink.
- Principle 4: Similar to NR Uu, NR-V2X sidelink supports multiple numerologies. The exact numerology used should be (pre-)configurable and should apply to all UEs using a common pool of time and frequency resources.
- Principle 5: Sidelink control channel is introduced to provide detail transmission characteristics of data channel.
- Principle 6: To reduce the delay in data channel decoding control channel is TDMed with data channel for NR-V2X sidelink.

- Principle 7: Similar to NR Uu, front loaded DMRS and variable number of DMRS are used for NR-V2X sidelink. Control channel can indicate the DMRS structure used in the transmission.
- Principle 9: Introduce HARQ feedback channel for efficient unicast & groupcast.
- Principle 10: Introduce channel state feedback to support special multiplexing for unicast.
- Principle 11: Introduce implementation friendly synchronization channel for enabling communication when GNSS coverage is challenging.
- Principle 12: Similar to LTE-V2X, resource pool definition for NR-V2X sidelink is required to indicate time and frequency resources that can be used by UE to select resource for sidelink transmission.
- Principle 13: Sub-channel based resource pool design is used for NR-V2X sidelink.
- Principle 14: Similar to NR Uu a radio frame of fixed 10ms, a subframe of fixed 1 ms and a slot of fixed 14 OFDM symbols are used for NR-V2X sidelink. Where basic scheduling unit is a slot.
- Principle 15: No need to define mini slots for NR-V2X sidelink as due to dominated mechanical aspects, vehicular communication latency below few ms is not required.
- Principle 16: NR-V2X sidelink should be able to operate out of coverage, partial coverage and in-coverage.
- Principle 17: UE autonomous resource selection and gNB scheduled resource allocation should be supported for NR-V2X sidelink.
- Principle 18: Allow LTE network to allocate NR V2X sidelink.
- Principle 19: NR network should also be able to allocate LTE V2X sidelink.
- Principle 20: Study the feasibility to enable UE-type RSU scheduling for sidelink transmissions.
- Principle 21: To support periodic, aperiodic, fixed and variable size packet from one transmission to another transmission a common framework based on per slot scheduling is used which is flexible in utilising time and frequency resources used for a transmission.

Decision: The document is noted.

R1-1809507 **Discussion on physical layer structure for NR V2X** **Xiaomi Communications(rev of R1-1809175)**

- Observation 1: In order to better match the time-varying characteristics of high-speed channel, the density of DMRS in time domain should be increased.
- Observation 2: The benefit of higher SCS on combating Doppler effect may not be dominant for H-type DMRS structure.

Decision: The document is noted.

Tuesday session conclusion: Continue discussion offline – Hanbyul (LGE)

Thursday session

R1-1809799 **Offline summary for 7.2.4.1.2 Physical layer structures and procedure(s)** **LG Electronics**

Decision: The document is noted.

Agreements:

- At least PSCCH and PSSCH are defined for NR V2X. PSCCH at least carries information necessary to decode PSSCH.
  - Note: PSBCH will be discussed in the synchronization agenda.
- RAN1 continues study on the necessity of other channels.
- Further study on
  - Whether/which sidelink feedback information is carried by PSCCH or by another channel/signal.
  - Whether/which information to assist resource allocation and/or schedule UE's transmission resource(s) is carried by PSCCH or by another channel/signal.
  - PSCCH format(s) and content(s) for unicast, groupcast, and broadcast

Agreements:

- RAN1 to continue study on the physical channel considering at least the following aspects:
  - Waveform
    - Candidates: CP-OFDM, DFT-s-OFDM
    - Proposals from companies:
      - CP-OFDM only
      - Support both
    - Consideration points:
      - Different channel can have different waveform?
      - Benefit and impact of supporting only one waveform and supporting both waveforms
  - Subcarrier spacing

- Candidates for further study are:
  - FR1: 15 kHz, 30 kHz, 60 kHz, 120 kHz
  - FR2: 30 kHz, 60 kHz, 120 kHz, 240 kHz
- Companies are encouraged to consider the potential issues and benefit of introducing new subcarrier spacing.

- CP length
- RS design
  - Candidates are:
    - DM-RS
      - DM-RS defined in Rel-15 NR Uu is the starting point.
    - PT-RS
    - CSI-RS
    - SRS
    - AGC training signal
- Channel coding
  - For data, channel coding defined for data in Rel-15 NR Uu is the starting point.
  - For control, channel coding defined for control in Rel-15 NR Uu is the starting point.
- Modulation
- RE mapping and rate-matching
- Scrambling

Agreement:
- RAN1 continues study on the necessity, benefits and relationship between bandwidth part and resource pool.

Agreement:
Agree the following assumptions as tentative assumptions for the simulation at least till RAN1#94bis
- AGC
  - Up to [15] us in FR1. Up to [10] us in FR2.
- TX/RX switching time
  - [13] us in FR1 and [7] us in FR2
- Time error
  - Up to [0.4] us between a UE and its synchronization reference
- Frequency error
  - Up to [0.1] PPM between a UE and its synchronization reference

To send an LS to RAN4 for feedback (to be included in the IBE LS)

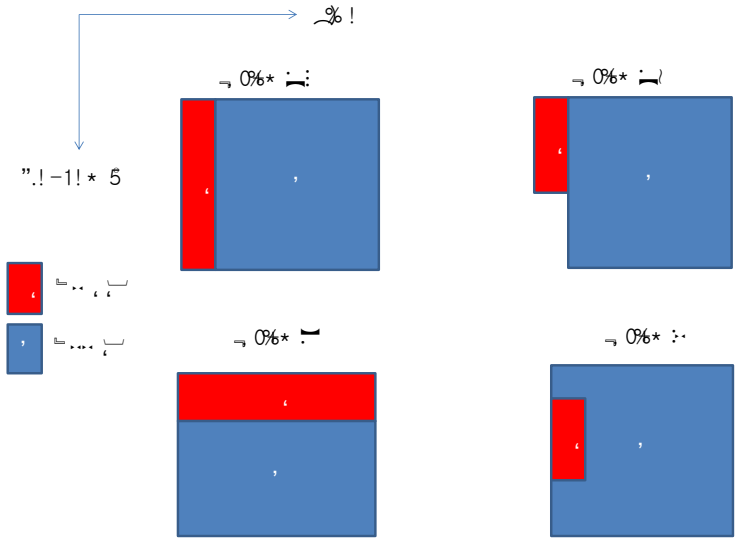
R1-1809748 [Draft] LS on IBE model for V2X Ericsson, Intel
Decision: The document is noted.

Friday session
R1-1809964 **Updated offline summary for 7.2.4.1.2 Physical layer structures and procedure(s) LG Electronics**
Decision: The document is noted.

Agreements:
RAN1 to continue study on multiplexing physical channels considering at least the above aspects:
- Multiplexing of PSCCH and the associated PSSCH (here, the "associated" means that the PSCCH at least carries information necessary to decode the PSSCH).
  - Study further the following options:
    - Option 1: PSCCH and the associated PSSCH are transmitted using non-overlapping time resources.
      - Option 1A: The frequency resources used by the two channels are the same.
      - Option 1B: The frequency resources used by the two channels can be different.
    - Option 2: PSCCH and the associated PSSCH are transmitted using non-overlapping frequency resources in the all the time resources used for transmission. The time resources used by the two channels are the same.

- Option 3: A part of PSCCH and the associated PSSCH are transmitted using overlapping time resources in non-overlapping frequency resources, but another part of the associated PSSCH and/or another part of the PSCCH are transmitted using non-overlapping time resources.

Illustration of the above options:



R1-1809945 [Draft] LS on IBE model for V2X Ericsson, Intel
Discussion: Huawei do not understand why Intel is indicated as contact - SI rapporteur is enough
Decision: The draft LS is endorsed (by removing the 2nd contact name), and final LS is approved in R1-1810006.

R1-1808093 PHY sidelink structure and procedure for NR V2X Huawei, HiSilicon
R1-1808203 On sidelink design for NR V2X Mitsubishi Electric RCE
R1-1808243 Physical layer structure and procedure for NR sidelink vivo
R1-1808280 On NR V2X physical channel design issues MediaTek Inc.
R1-1808294 SLS Study on Realization of Stringent Reliability in Mode-4 NR-V2X Fujitsu
R1-1808295 Considerations on sidelink physical layer structures Fujitsu
R1-1808400 Physical layer structure and procedure in NR V2X CATT
R1-1808520 Discussion on sidelink physical layer structures and procedures LG Electronics
R1-1808603 Discussion on NR Sidelink Physical layer structures ZTE
R1-1808616 NR sidelink design NEC
R1-1808647 Discussion on physical layer structures and procedure(s) of NR sidelink Panasonic
R1-1808776 Discussion on physical layer structures and procedures for NR V2X Samsung
R1-1808813 Sidelink Design for NR V2X ETRI
R1-1808876 Discussion of physical layer structure and procedure for NR-V2X Guangdong OPPO Mobile Telecom
R1-1809039 Discussion on beam management for NR-V2X sidelink in millimeter-wave bands TOYOTA InfoTechnology Center
R1-1809045 Initial View on NR V2X Sidelink Physical Layer Structures and Procedures Nokia, Nokia Shanghai Bell
R1-1809067 V2X sidelink PHY structure and procedures AT&T
R1-1809094 NR Sidelink Physical Layer Structures and Procedures InterDigital, Inc.
R1-1809157 Physical layer structures and procedure(s) NTT DOCOMO, INC.
R1-1809302 Physical layer design of NR sidelink Ericsson
R1-1809507 Discussion on physical layer structure for NR V2X Xiaomi Communications (rev of R1-1809175)

7.2.4.1.3 Synchronization mechanism

R1-1808401 Considerations on synchronization mechanism in NR V2X CATT

- Proposal 1: The design of NR V2X synchronization mechanism needs to take into consideration of the SSB structure and the beamforming of SSB for extended coverage.

- Proposal 2: NR V2X synchronization priority order should consider the following issues:
- The NR V2X synchronization priority order should consider NR gNB-based and GNSS-based synchronization with similar synchronization priority order to that of LTE V2X.
    - The accuracy of different synchronization priority order should be further investigated with NR SSB design with different duty cycle.
    - The limitation of UE capability should be considered in the multi-carrier synchronization mechanism of NR-V2X.
- Proposal 3: The PBCH payload content of NR can be modified in NR V2X for adapting different traffic model and scenarios.

Decision: The document is noted.

R1-1808604 **Discussion about synchronization mechanism for NR V2X** **ZTE**

- Proposal 1: The synchronization mechanism in LTE V2X can be used as the starting point for NR V2X synchronization study and to be modified considering new characteristics in NR, e.g., multiple numerologies, frame structure and beam transmission.
- Proposal 2: SS/PBCH block in NR can be reused as the starting point for Resource pattern of NR-based SLSS/PSBCH. Other patterns would not be precluded.
- Proposal 3: Beam sweeping should be considered for transmission of NR-based SLSS/PSBCH.
- Proposal 4: The contents of PSBCH should be studied considering the new characteristics of the network coverage scenario.
- Proposal 5: Mechanisms for synchronization reference selection should be based on network coverage scenarios in NR V2X.

Decision: The document is noted.

R1-1809046 **Initial View on NR V2X Sidelink Synchronization** **Nokia, Nokia Shanghai Bell**

- Proposal 1: Synchronous operation is used in NR sidelink V2X. Asynchronous operation is not supported.
- Proposal 2: GNSS-based, network-based and device-based synchronization is supported in NR V2X sidelink operation.
- Proposal 3: Study methods that reduce problems related to switching of synchronization source and using different synchronization sources in the V2X UE for SL and Uu.
- Proposal 4: Study interference between sidelink and Uu taking into account potential timing difference between SL and Uu.
- Proposal 5: Study beam-based sidelink synchronization channel design.

Decision: The document is noted.

Tuesday session conclusion: Continue discussion offline – Fangcheng (CATT)

Thursday session

R1-1809818 **Summary of offline discussion on sidelink synchronization in NR V2X** **CATT**

Decision: The document is noted.

Agreements:

- NR V2X Sidelink Synchronization includes at least the following
    - Sidelink synchronization signal(s)
    - PSBCH
    - Sidelink synchronization sources and procedure(s)
        - Synchronization sources – at least GNSS, gNB, eNB, UE, LTE UE
            - Note: this doesn't mean all of them are to be supported

Friday session

R1-1809996 **Summary of Offline Discussion on Sidelink Synchronization in NR V2X** **CATT**

Decision: The document is noted. Above agreement is updated.

R1-1808094 Sidelink synchronization mechanisms for NR V2X Huawei, HiSilicon
R1-1808244 NR sidelink synchronization mechanism vivo
R1-1808282 On NR V2X synchronization issues MediaTek Inc.
R1-1808521 Discussion on sidelink synchronization mechanism LG Electronics

R1-1808555 Synchronization mechanism in NR V2X Lenovo, Motorola Mobility
R1-1808695 Sidelink synchronization for NR V2X communication Intel Corporation
R1-1808723 Considerations of Synchronization Enhancement for NR V2X Communication ITRI
R1-1808777 Discussion on Synchronization mechanisms for NR sidelink Samsung
R1-1808814 Discussion on NR V2X sidelink synchronization ETRI
R1-1808877 Discussion of synchronization mechanism for NR-V2X Guangdong OPPO Mobile Telecom
R1-1809068 Sidelink based synchronization mechanism AT&T
R1-1809095 On V2X Synchronization in NR InterDigital, Inc.
R1-1809158 Synchronization mechanism NTT DOCOMO, INC.
R1-1809177 On synchronization for NR V2X Xiaomi Communications
R1-1809254 Considerations on sidelink synchronization signal for NR V2X ITL
R1-1809303 On Synchronization for Sidelink V2X Ericsson
R1-1809448 Synchronization design for NR V2X Qualcomm Incorporated
R1-1809475 Discussion on NR V2X Synchronization mechanism ITL

7.2.4.1.4 Resource allocation mechanism

R1-1808522 Discussion on sidelink resource allocation mechanism LG Electronics

- Proposal 1: RAN1 studies enhancement of NR SL resource allocation including support of LTE features such as e.g., PPPP based sensing and resource reservation, sensing metric (e.g., PSSCH-RSRP, S-RSSI), FDMed transmission of SA and data, zoning, congestion control.
- Proposal 2: RAN1 studies solution of NR sidelink resource allocation for handling a traffic type with time-varying size and/or generation interval.
- Proposal 3: RAN1 studies mechanism of feedback and adaptive retransmission number (more than 1) to support the advanced V2X services
- Proposal 4: RAN1 studies mechanism of resource allocation and congestion control when using flexible frame structure for NR sidelink.
- Proposal 5: RAN1 studies impact of distributed antenna panel on resource allocation and congestion control.

Decision: The document is noted.

R1-1808696 Sidelink resource allocation mechanisms for NR V2X communication Intel Corporation

- For periodic traffic, study benefits of additional enhancements to LTE V2X sensing and resource selection procedure including the following aspects:
  - Collisions handling in case of simultaneous resource (re)-selection;
  - Configurable sensing window (e.g. based on maximum reservation interval in the system);
  - Dynamic resource selection window (e.g. derived based on packet delay budget);
  - Physical structure and multiplexing of PSCCH and PSSCH;
  - Resource (re)-selection conditions and triggers;
  - Priority handling enhancements;
- For aperiodic traffic, further study benefits and details of small scale sensing schemes, including:
  - Collisions handling when multiple UEs compete for resources;
  - Channel access criteria and conditions;
  - Sidelink resource and channel access granularity in time;
  - Resource reservation mechanisms;
  - Priority handling mechanisms.
- Further study benefits of large and small scale channel sensing procedures as well as their combination in application to periodic, aperiodic and mixed traffic models
- Further study technical challenges and benefits of sub-slot level channel access and resource granularity for sidelink communication (e.g. ½-slot and ¼-slot)
- Further study how to efficiently enable sidelink resource reservation/preemption mechanisms for eV2X sidelink communication.
- Concept of sidelink resource pools is reused and introduced for eV2X sidelink communication
- Strive for sidelink design that supports TDM and FDM between PSCCH and PSSCH from UE perspective
- From system perspective, control and shared channel resources can overlap in time and frequency within sidelink resource pool
- PSCCH and PSSCH resources are separately configured within the same resource pool

Decision: The document is noted.

R1-1809304 Radio Resource Management for NR Sidelink Ericsson

- Observation 1: When the sidelink utilizes licensed spectrum resources, it must not degrade the performance of cellular services.
- Observation 2: Sidelink RRM techniques should consider the specific characteristics of unicast and broadcast communications.
- Observation 3: Sidelink RRM techniques should consider the coexistence of unicast, multicast and/or broadcast communication.
- Observation 4: In case of no network coverage for NR, UEs follow distributed RA mechanisms like LTE mode-4.
- Observation 5: In the case of network coverage, network control RRM helps limiting the interference and providing the required QoS.
- Observation 6: LTE SL mode-4 resource allocation is not suitable for the traffic models considered in eV2X.
- Proposal 1: NR supports an RRM configuration for unicast transmissions that is designed according to the radio resource management techniques described as alternative 2 above.
- Proposal 2: RAN1 studies one-shot and resource reservation schemes to tackle variation in the traffic patterns and intensity.
- Proposal 3: RAN1 studies solutions to reduce resource wastage when future resources reserved for sidelink transmissions are not used.
- Proposal 4: RAN1 studies the possibility of enabling pre-emption based on QoS.
- Proposal 5: RAN1 studies the possibility of enabling a UE to reserve multiple consecutive resources for transmission.
- Proposal 6: RAN1 strives to minimize the collision probability due to random resource selection.
- Proposal 7: RAN1 studies solutions to limit sidelink bandwidth fragmentation.
- Proposal 8: RAN1 studies the possibility of different levels of network control.

Decision: The document is noted.

R1-1809449 **Initial perspectives on resource allocation** **Qualcomm Incorporated**

- Proposal 1: For NR V2X, like LTE V2X both scheduled and autonomous resource allocation need to be defined. Like LTE V2X, the NR V2X autonomous resource allocation should be able to operate independent of network.
- Proposal 2: NR V2X autonomous resource allocation should be able to support arbitrary traffic patterns and target very high reliability service requirements.
- Proposal 3: Study the performance of autonomous resource allocation based on LBT signals on potentially every slot.
- Proposal 4: Study the request/response type handshake mechanisms to further improve reliability for unicast/groupcast transmissions.
- Proposal 5: Study the feasibility to enable UE-type RSU scheduling for NR sidelink transmissions.

Decision: The document is noted.

Wednesday session conclusion: Continue discussion offline - Alexey (Intel)

Thursday session

R1-1809867 **Offline Summary for NR-V2X Agenda Item - 7.2.4.1.4 Resource Allocation Mechanism** **Intel**

Decision: The document is noted.

Agreements:

At least two sidelink resource allocation modes are defined for NR-V2X sidelink communication

- Mode 1: Base station schedules sidelink resource(s) to be used by UE for sidelink transmission(s)
- Mode 2: UE determines (i.e. base station does not schedule) sidelink transmission resource(s) within sidelink resources configured by base station/network or pre-configured sidelink resources

Notes:

- eNB control of NR sidelink and gNB control of LTE sidelink resources will be separately considered in corresponding agenda items.
- Mode-2 definition covers potential sidelink radio-layer functionality or resource allocation sub-modes (subject to further refinement including merging of some or all of them) where
  a) UE autonomously selects sidelink resource for transmission
  b) UE assists sidelink resource selection for other UE(s)
  c) UE is configured with NR configured grant (type-1 like) for sidelink transmission
  d) UE schedules sidelink transmissions of other UEs

RAN1 to continue study details of resource allocation modes for NR-V2X sidelink communication

R1-1808245 NR sidelink resource allocation vivo

R1-1808281 On NR V2X resource allocation MediaTek Inc.
R1-1808296 Discussion on Subframe-based Resource Selection Parameters in Mode-4 NR-V2X Fujitsu
R1-1808297 Resource Allocation for NR V2X Sidelink Communication considering Low Latency Requirement Fujitsu
R1-1808309 Enhancements for NR V2X Resource Allocation Mechanism Fraunhofer HHI
R1-1808341 Initial considerations on NR V2X resource allocation mechanism Sony
R1-1808402 Considerations on resource allocation mechanism in NR V2X CATT
R1-1808556 Resource allocation mechanism in NR V2X Lenovo, Motorola Mobility
R1-1808599 Resource allocation for NR V2X InterDigital, Inc.
R1-1808605 Discussion on NR Sidelink Physical resource pool allocation ZTE
R1-1808648 Discussion on resource allocation mechanism for NR sidelink Panasonic
R1-1808724 Considering geo-based resource management techniques for NR V2X communication ITRI
R1-1808778 Discussion on resource allocation mechanisms for NR V2X Samsung
R1-1808838 Discussion on consideration for V2X resource allocation CMCC
R1-1808906 Discussion on resource allocation in NR-V2X Guangdong OPPO Mobile Telecom
R1-1808939 UE autonomous sidelink allocation for NR V2X Huawei, HiSilicon
R1-1809047 Initial View on NR V2X Sidelink Resource Allocation Nokia, Nokia Shanghai Bell
R1-1809069 Resource allocation mechanism AT&T
R1-1809159 Resource allocation mechanism NTT DOCOMO, INC.
R1-1809178 On resource allocation for NR V2x sidelink communications Xiaomi Communications
R1-1809287 Considerations on Resource Allocation of NR V2X Sidelink CAICT
R1-1809383 Discussion on Sidelink Resource Allocation Convida Wireless LLC

7.2.4.1.5 Other

Including any remaining aspects of simulation assumptions

R1-1809946 Correction and confirmation of some evaluation assumption parameters LG Electronics
Decision: The document is endorsed. Final CR in R1-1810007 (CR0002r1 to 37.885)

R1-1809950 Offline summary for remaining evaluation assumptions LG Electronics
Decision: The document is noted.

Agreement**:**
- Agree CRs to 37.885 in R1-1809924 and R1-1810007

R1-1809924 Correction of optional antenna element patterns for vehicular UEs Fraunhofer HHI, Fraunhofer IIS, General Motors, Nokia, Nokia Shanghai Bell, LG Electronics
Decision: CR0001r2 is agreed.

Conclusion:
It is understood in RAN1 that:
- Regarding whether LOS/NLOS/NLOSv status can be different in different panels, the common understanding is that this status is defined per link between vehicles and not different in the panels of the same vehicle.
- Regarding how fading channel is generated across panels, the common understanding is that one set of clusters is generated and used for both panels.

RAN1 to have an email discussion until the next meeting to complement the existing simulation assumptions, using R1-1809950 and R1-1809944 (traffic model) at a starting point– Hanbyul (LGE)

R1-1808298 Discussion on LLS parameters of fast fading model Fujitsu
R1-1808523 Discussion on remaining aspects of simulation assumptions LG Electronics
R1-1808697 Remaining aspects of eV2X evaluation methodology and assumptions Intel Corporation
R1-1808779 Discussion on AGC settling issue for NR sidelink Samsung
R1-1808937 Sidelink control channel design of NR V2X Huawei, HiSilicon
R1-1808938 Sidelink data channel design of NR V2X Huawei, HiSilicon

R1-1808940 Preliminary system level evaluations on sidelink for NR V2X Huawei, HiSilicon
R1-1808946 Preliminary link level evaluations on sidelink for NR V2X Huawei, HiSilicon
R1-1809048 Required Clarifications on Simulation Assumptions Nokia, Nokia Shanghai Bell
R1-1809305 Link level simulations of DMRS design for NR V2X Ericsson
R1-1809306 Considerations and Design Principles for NR Sidelink Ericsson
R1-1809803 Open issues of evaluation assumptions for NR V2X Ericsson (rev of R1-1809307)
R1-1809450 Baseline simulation assumptions and scenarios Qualcomm Incorporated

7.2.4.2 Evaluation of Uu for advanced V2X use cases

R1-1808102 Evaluation and enhancement of NR Uu and LTE Uu for advanced V2X use cases Huawei, HiSilicon

- Observation 1: NR R15 Uu could support about 80% downlink coverage at 99.999% reliability in Highway deployments.
- Observation 2: NR R15 Uu could support about 60% downlink coverage at 99.999% reliability in Urban Grid deployments.
- Observation 3: NR R15 Uu could support about 90% uplink coverage at 99.999% reliability in Highway deployments.
- Observation 4: NR R15 Uu could support about 55% uplink coverage at 99.999% reliability in Urban Grid deployments.
- Observation 5: DL RRM measurement needs to be improved to meet 0 ms interruption requirement.
- Proposal 1: To support V2X scenarios, NR Uu should support multicast via Group-RNTI and the scheduling multiple groups of multicast services in the same subframe
- Proposal 2: For the evaluation of NR Uu multicast transmission, the vehicle UEs at a road intersection area can be formed as a UE group. The packet size of FTP3 model could be 0.5Mbytes.
- Proposal 3: Mini-slot based repetition within a slot should be supported for both grant based PUSCH and grant-free PUSCH. The mini-slot repetition pattern can be studied.
- Proposal 4: Explicit HARQ-ACK feedback should be introduced in URLLC as an overhead saving method to allow UE to perform initial transmission or non-adaptive retransmission in a grant-free manner.
- Proposal 5: The scheduling/HARQ scheduling limitation in Release 15 URLCC should be removed for Release 16.
- Proposal 6: A-CSI report on short PUCCH should be triggered by DL DCI.
- Proposal 7: To reduce NR mobility latency, UL RRM measurement should be considered.
- Proposal 8: NR V2X should support grant-free UL transmission for RRC-Idle/Inactive V-UEs.
- Proposal 9: NR Uu UL data rate should be considered for V-UEs based on the reliability and latency requirements.
- Proposal 10: To increase the reliability and reducing the collision occasions in contention-based grant-free communication, V-UE geo-location should be taken into account.

- Observation 6: LTE Uu evaluations show 62.5% and 48.3% UEs could be supported at the 99.999% reliability level for downlink for highway and urban grid scenario, respectively.
- Observation 7: LTE Uu evaluations show 60% and 40% UEs could be supported at the 99.999% reliability level for uplink for highway and urban grid scenario, respectively.
- Proposal 11: Study the feasibility of reducing DCI size for HARQ-less transmission to support the advanced V2X service of remote driving.
- Proposal 12: Study the feasibility of disabling downlink HARQ-ACK feedback in order to support the advanced V2X service of remote driving.

Decision: The document is noted.

R1-1808283 On NR Uu to support NR V2X services MediaTek Inc.

- Proposal 1: Study for NR V2X unicast communications via NR uu interface can be deprioritized or leveraged the study in Rel16 eURLLC SI.
- Proposal 2: NR uu interface to support NR V2X broadcast/multicast communications can be studied in a separated SI/WI for a generic mechanism to support broadcast/multicast services rather than restriction to NR V2X.
- Proposal 3: NR uu interface enhancement for facilitating NR V2X sidelink communications is prioritized for study and support.

Decision: The document is noted.

R1-1809308 Study of Uu feasibility for advanced V2X use cases Ericsson

- Observation 1: High reliability can be achieved for both 15 kHz and 30 kHz SCS at fairly low SNR with 250 km/h UE moving speed. That means, the current NR Uu physical layer can achieve the desired reliability for advanced V2X use cases.
- Observation 2: 10ms latency requirement can be met in most times for 15 kHz SCS and 6.5 ms can be achieved for 30 kHz SCS. In other words, the current NR Uu physical layer can achieve the desired latency for advanced V2X use cases.

- Observation 3: Current NR Uu physical layer can achieve the desired eV2X data rate at low SNR (-4 dB) with 100 MHz system bandwidth.

Decision: The document is noted.

Wednesday session conclusion: Continue discussion offline - Ricardo (Ericsson)

Thursday session

R1-1809909 Feature Lead Summary AI 7.2.4.2 v1 Ericsson

Decision: The document is noted.

Friday session

R1-1809944 Feature Lead Summary AI 7.2.4.2 v2 Ericsson

Decision: The document is noted.

R1-1809893	Evaluation and enhancement of NR Uu and LTE Uu for advanced V2X use cases	Huawei, HiSilicon
R1-1808403	Evaluation of Uu for advanced V2X use cases	CATT
R1-1808524	Discussion on evaluation of Uu for advanced V2X use cases	LG Electronics
R1-1808698	Analysis of NR Uu support for advanced V2X use cases	Intel Corporation
R1-1808725	Evaluations of Uu Capability in Supporting Advanced V2X Use Cases	ITRI
R1-1808780	Discussion on Uu enhancements for advanced V2X use cases	Samsung

7.2.4.3 Uu-based sidelink resource allocation/configuration

R1-1808726	Discussion on Uu-based sidelink resource allocation and configuration	ITRI

Thursday session

R1-1809878 Summary of AI: 7.2.4.3 Uu-based sidelink resource allocation/configuration Huawei, HiSilicon

Decision: The document is noted.

Agreements:

- NR Uu can assign NR sidelink resources for the following:
  - Shared licensed carrier between Uu and NR sidelink
  - Dedicated NR sidelink carrier

Agreements:

- Study at least the following NR sidelink resource allocation techniques:
  - Dynamic resource allocation
  - Activation/deactivation based
    - E.g., semi-persistent scheduling allocation or NR grant free type-2
  - RRC (pre-)configured
    - E.g., configured NR grant type-1, UE autonomous selection of resource(s) from resources configured by RRC
- RAN1 will study the level of network control, e.g., whether the UE may select other parameters (e.g., MCS) and/or the exact transmission resources, and whether the selection is autonomous or not

7.2.4.3.1 Enhancements of LTE Uu and NR Uu to control NR sidelink

R1-1808095 Discussion on NR sidelink resource allocation by NR Uu and LTE Uu Huawei, HiSilicon

- Proposal 1: NR SL should support both grant-free and grant-based resource allocation modes.
- Proposal 2: NR should support configuration of SL grant-free resources for in-coverage UEs and pre-configuration of SL grant-free resources for out-of-coverage UEs.
- Proposal 3: For enhanced reliability and latency, NR should support pre-/configuration of SL transmission patterns indicating the repetition location of a given TB for out-of-coverage/in-coverage UEs.
  - Study how many retransmissions are needed.
- Proposal 4: Study dynamic and semi-persistent grant-based SL resource allocation mechanisms for in-coverage and out-of-coverage UEs.

- Proposal 5: For reliability and latency enhancement, NR grant-based sidelink transmission should support allocation of SL transmission patterns indicating the repetition location of a given TB.
- Proposal 6: In case of unicast and groupcast transmissions, consider whether scheduled UEs may report measurements, or resources selected based on such measurements, to gNB to support sidelink scheduler.
- Observation 1: A radio resource may be reused by nearby UEs in case of non-isotropic transmissions.
- Proposal 7: Study whether non-orthogonal resources can be assigned to UEs based on the directionality of their intended transmissions.
- Proposal 8: LTE enhancements to enable NR sidelink control by LTE Uuinclude provision of DCI format 5A contents and SIB/RRC configurations.

Decision: The document is noted.

R1-1808246 Enhancements of LTE Uu and NR Uu to control NR sidelink vivo

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Decision: The document is noted.

R1-1809049 Initial View on Enhancements of LTE Uu and NR Uu to control NR sidelink Nokia, Nokia Shanghai Bell

- Proposal 1: Support both dynamic scheduling and semi-persistent scheduling/configured grant.
- Proposal 2: Support resource pool sharing between gNB-scheduled and UE-autonomous UEs from the beginning.
- Proposal 3: Consider support for sidelink unicast/groupcast enhancements in the work on Uu-based sidelink resource allocation.

Decision: The document is noted.

Wednesday session conclusion: Continue discussion offline - Philippe (Huawei)

R1-1809775 Discussion on Sidelink Bi-mode Transmission in NR-V2X Fujitsu (revision of R1-1808299)
R1-1808300 Discussion on latency performance of Uu-based sidelink resource allocation Fujitsu
R1-1808404 On LTE Uu and NR Uu control NR sidelink in NR V2X CATT
R1-1808525 Discussion on LTE Uu and NR Uu enhancements to control NR sidelink LG Electronics
R1-1808606 Discussion on LTE/NR Uu based resource allocation/configuration for NR sidelink ZTE
R1-1808699 Enhancements of NR and LTE Uu link to control NR sidelink Intel Corporation
R1-1808727 Issues in NR Uu for Mode 3 NR Sidelink Resource Access ITRI
R1-1808781 Discussion on Enhancements of LTE Uu and NR Uu to control NR sidelink Samsung
R1-1808878 Enhancement of LTE Uu and NR Uu to control NR sidelink Guangdong OPPO Mobile Telecom
R1-1809070 Enhancements of LTE Uu and NR Uu to control NR sidelink AT&T
Withdrawn
R1-1809096 Uu Interface Enhancement for NR Sidelink InterDigital, Inc.
R1-1809160 Enhancements of LTE Uu and NR Uu to control NR sidelink NTT DOCOMO, INC.
R1-1809309 On Network Control of NR Sidelink Ericsson
R1-1809451 Enhancements of LTE Uu and NR Uu to control NR sidelink Qualcomm Incorporated

7.2.4.3.2 Enhancements of NR Uu to control LTE sidelink

R1-1808839 Discussion on NR Uu control LTE sidelink CMCC

- Proposal 1: It's necessary to study the case of NR Uu control LTE sidelink in NR V2X.
- Proposal 2: In NR-V2X, the architecture of NR-LTE DC can be used as a baseline to support the case of NR Uu control LTE sidelink.
- Proposal 3: In NR-V2X, we need further study the mechanism of NR Uu control LTE sidelink and identify the necessary enhancements for mode 3 and mode 4 UE respectively.

Decision: The document is noted.

R1-1808907 Enhancement of NR Uu to control LTE sidelink Guangdong OPPO Mobile Telecom

- Proposal 1: For NR Uu to schedule a UE on LTE sidelink, a Tx start timing indicator can be added to the new DCI format (for NR Uu) to allow a NR capable UE to transmit earlier than n+4 subframe.

- Proposal 2: A single DCI format that can be dynamically used for scheduling resources on either NR sidelink or LTE sidelink should be considered for NR Uu to reduce UE processing complexity, time and power consumption of blind decoding of different SL scheduling grants (DCIs).

Decision: The document is noted.

R1-1809071 **Enhancements of NR Uu to control LTE sidelink AT&T**

- Proposal-1: Dual connectivity framework can support NR UU interface as MCG to control NR and LTE sidelink as SCG.
- Proposal-2: The connection between local manager and UE is a "diet" connection

Decision: The document is noted.

Wednesday session conclusion: Continue discussion offline - Philippe (Huawei)

R1-1808096 Discussion on NR Uu to control LTE PC5 Huawei, HiSilicon
R1-1808405 On NR Uu control LTE sidelink in NR V2X CATT
R1-1808526 Discussion on NR Uu enhancements to control LTE sidelink LG Electronics
R1-1808607 Discussion on NR Uu based resource allocation/configuration for LTE sidelink ZTE
R1-1808700 Enhancements of NR Uu link to control LTE sidelink Intel Corporation
R1-1808782 Discussion on Enhancements of NR Uu to control LTE sidelink Samsung
R1-1809097 NR Uu Interface Enhancement for LTE Sidelink InterDigital, Inc.
R1-1809310 On NR Uu controlling LTE sidelink Ericsson
R1-1809452 Enhancements of NR Uu to control LTE sidelink Qualcomm Incorporated

7.2.4.3.3 Other

R1-1809311 On Link Selection for Unicast V2X Communications Ericsson

7.2.4.4 QoS management

R1-1808600 **QoS Management for NR V2X InterDigital, Inc.**

- Observation 1: How to translate VQI and bearer information into parameters used by PHY will be determined by RAN2.
- Proposal 1: NR V2X supports mode 4 transmission prioritization based on priority information in SCI.
- Proposal 2: NR V2X supports mode 4 resource selection based on maximum delay budget for a packet.
- Proposal 3: NR V2X supports mechanism(s) to achieve different target error rate depending on the QoS characteristics of the data to be transmitted.
- Proposal 4: NR V2X supports methods to achieve different minimum communication range depending on the QoS characteristics of the data to be transmitted.
- Proposal 5: NR V2X supports methods to efficiently multiplex UEs with different data rate requirements on sidelink

Decision: The document is noted.

R1-1809312 **QoS framework for NR V2X Ericsson**

- Observation 1: V2X service KPIs are already covered in 5GS QoS management for Uu.
- Observation 2: LTE SL UEs may handle logical channel prioritization differently depending on their implementations.
- Observation 3: A more concrete admission control mechanism in SL is needed.
- Proposal 1: 5GS QoS framework is used for V2X services over Uu-interface.
- Proposal 2: A unified QoS handling rule, e.g. map a packet to a corresponding QoS flow, shall be used for NR SL UEs.
- Proposal 3: RAN1 studies mechanisms to allow the gNB to monitor the resource utilization of SL UEs and mechanisms to allow the gNB to pre-empt transmissions of SL UEs.
- Proposal 4: In Mode4, a pre-emption signalling can be designed. UEs with high priority packets can pre-empt some resources used for low priority packets before starting its own transmission.
- Proposal 5: RAN1 assumes that RAN2 leads the studies on enhancing SL QoS management including unifying QoS handling and introducing proper admission control functionality.

Decision: The document is noted.

Wednesday session conclusion: Continue discussion offline - Torsten (Nokia)

Thursday session

R1-1809840 **Offline Summary for 7.2.4.4 QoS Management FS_NR_V2X Nokia, Nokia Shanghai Bell**

Decision: The document is noted.

Samsung Exhibit 1029, Page 307 of 684

Agreement: From RAN1 perspective, at least the following QoS-related parameters relevant to physical layer studies are considered:

- Priority
- latency
- reliability

R1-1808406 QoS management in NR V2X CATT
R1-1808527 Discussion on QoS management LG Electronics
R1-1808540 QoS Management for NR V2X Fraunhofer IIS
R1-1808608 Discussion on QoS Management ZTE
R1-1808701 QoS management for NR V2X communication Intel Corporation
R1-1808728 Discussion QoS requirement for V2X in Mode 3 like and Mode 4 likeITRI
R1-1808783 Discussion on QoS management for NR V2X Samsung
R1-1809050 Initial View on NR V2X QoS Management Nokia, Nokia Shanghai Bell
R1-1809161 QoS management NTT DOCOMO, INC.
R1-1809336 QoS management for NR V2X Huawei, HiSilicon
R1-1809453 Design aspects and requirements for QoS Qualcomm Incorporated

7.2.4.5 Coexistence

Including feasibility of coexistence mechanisms & advanced V2X services provided by NR V2X under co-existence

R1-1808941 Discussion on co-existence for NR V2X and LTE V2X Huawei, HiSilicon

- Proposal 1: for coexistence studies, consider the case where the NR and LTE carriers share the same or different band.
- Proposal 2: Send an LS to RAN4 to ask them to study the carrier spacing/filtering requirements for simultaneous RX/TX.
- Observation 1: For LTE Mode-4 sidelink CA transmission:
  - For intra-band sidelink CA, transmission may be interrupted when only part of the TX carriers are configured and activated simultaneously.
  - For inter-band sidelink CA, there can be significant inter-band interruption time. Further discussions are needed in RAN4.
- Observation 2: If OFDM is used for NR SL, RAN4 may need to evaluate MPR when the same PA is used on non-adjacent carriers.

Decision: The document is noted.

R1-1809454 Co-existence principles for NR-V2X and LTE-V2X Qualcomm Incorporated

- Observation 1: LTE-V2X and NR-V2X in device coexistence challenges has the same nature as half duplex challenges of LTE-V2X multi-channel operation.
- Observation 2: The main difference here lies in the fact that LTE-V2X and NR-V2X are two different RATs, so they can have different signal design, different physical layer procedure and may be implemented in UE in separated stacks.
- Observation 3: NR sidelink may have other types of traffic than SPS traffic. Some R14-R15 solution optimized for SPS traffic may not be optimal here.
- Observation 4: Inter RAT sidelink scheduling may be supported for mode 3. In device coexistence issue needed to be considered in such kind of solution.

Decision: The document is noted.

Wednesday session conclusion: Continue discussion offline - Arjun (Qualcomm)

Thursday session

R1-1809904 Summary of Coexistence Aspects in NR-V2X Study Qualcomm

Decision: The document is noted.

Proposal:

- For the study of LTE-V2X and NR-V2X co-existence, half-dupelx constraints are assumed at least for the intra-band case

Friday session

Samsung Exhibit 1029, Page 308 of 684

R1-1809990 Summary of Coexistence Aspects in NR-V2X Study Qualcomm
Decision: The document is noted.

Agreements:
For the study of LTE-V2X and NR-V2X sidelink co-existence, at least the following scenarios are considered from the UEs perspective:
- LTE sidelink and NR sidelink do not have any coordinated procedures
- LTE sidelink and NR sidelink have coordinated procedures and half-duplex constraints are assumed
  - RAN1 will focus on this scenario in the SI

Agreements:
RAN1 focus on at least the following potential solutions for coexistence at least until the next meeting:
- TDM of LTE V2X and NR V2X sidelink transmissions
- FDM of LTE V2X and NR V2X sidelink transmissions

R1-1808247 Coexistence mechanism for LTE and NR V2X vivo
R1-1808407 Coexistence of NR sidelink and LTE sidelink in V2X CATT
R1-1808528 Discussion on coexistence mechanisms LG Electronics
R1-1808609 In device coexistence between NR sidelink and LTE sidelink ZTE
R1-1808702 Coexistence mechanisms for eV2X services Intel Corporation
R1-1808784 Discussion on Coexistence between LTE and NR PC5 Samsung
R1-1809076 Coexistence of Different V2X Services AT&T
R1-1809098 The Coexistence between NR V2X and LTE V2X InterDigital, Inc.
R1-1809313 On coexistence aspects of NR V2X Ericsson

7.2.4.6 Other

R1-1808601 Vehicle Platooning Use Case for NR V2X InterDigital, Inc.
R1-1809807 Correction of optional antenna element patterns for vehicular UEs Fraunhofer HHI, Fraunhofer IIS, General Motors (rev of R1-1809253)
R1-1809314 On the Objectives of NR V2X System Ericsson
R1-1809334 NR Uu support for advanced V2X use cases Huawei, HiSilicon
R1-1809335 LTE Uu support for advanced V2X use cases Huawei, HiSilicon
R1-1809485 Configuration and signalling principles for NR sidelink Ericsson

7.2.5 Study on Remote Interference Management for NR

FS_NR_RIM; SID in RP-181430. Please refer to the SID for detailed scoping

R1-1808840 Work plan for Rel-16 SI on NR RIM CMCC
Decision: The document is noted.

R1-1809375 Draft skeleton of TR 38.866 Study on remote interference management for NR CMCC
Discussion: Ericsson suggested offline to restructure the TR, mainly clause 6.
Decision: The document is noted. Discuss further offline

Thursday session
R1-1809872 Draft skeleton of TR 38.866 Study on remote interference management for NR CMCC
Decision: The TR 38.866 v0.0.0 is endorsed.

R1-1809865 Draft summary on Study on NR-RIM CMCC
Decision: The document is noted.

Agreements:
- To include the following in the TR: As shown in Figure 1, it is assumed in the RIM study that the whole network with synchronized macro cells has a common understanding on a DL transmission boundary (denotes as the 1st reference point) which indicates the ending boundary of the DL transmission, and an UL reception boundary (denotes as the 2nd

reference point) which denotes the starting boundary of the first allowed UL reception within a DL-UL transmission periodicity.

- The boundary may be considered for RS design
- The 1st reference point locates before the 2nd reference point.

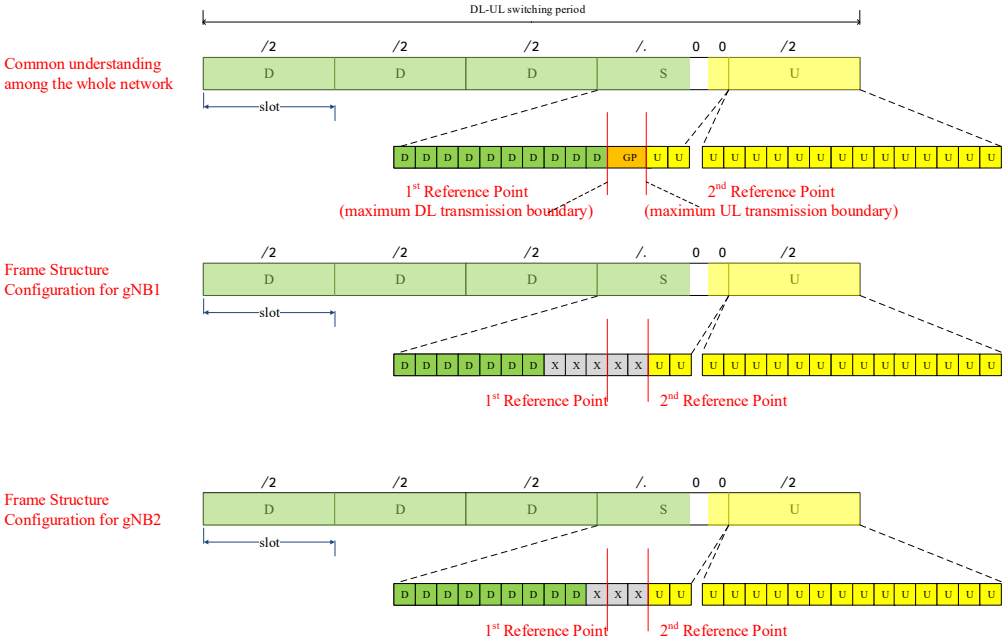


Figure 1. Illustration of DL and UL transmission boundaries within a DL-UL transmission periodicity

Agreements:

- In terms of the IoT (interference over thermal) increase between two sets of gNBs causing remote interference to each other, two scenarios should be considered for NR-RIM,
  - Scenario #1: IoT increases are detectable by one or more gNBs in both sets,
  - Scenario #2: IoT increase is detectable by one or more gNBs in only one set.

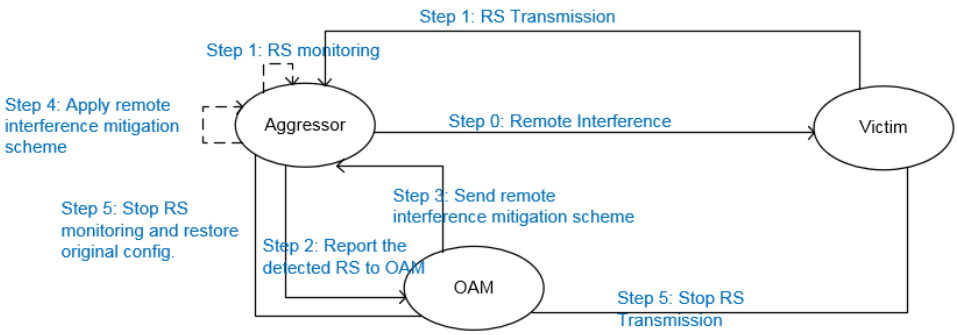
Agreements:

Framework-1, Framework-2.1, Framework-2.2 below are used as starting point for further study, using Framework-0 as basis for comparison.

Note:

- Not all the steps need to be included when making use of a given framework.
- Mechanisms for improving network robustness at both victim and aggressor side can be studied under the NR-RIM frameworks.
  - A victim cell may take actions applying remote mitigation scheme. This detail is FFS
- An aggressor may also be a victim (and vice versa) at least for Scenario #1

0. Framework-0



Workflow of Framework-0

Step 0: Atmospheric ducting phenomenon happens and the remote interference appears

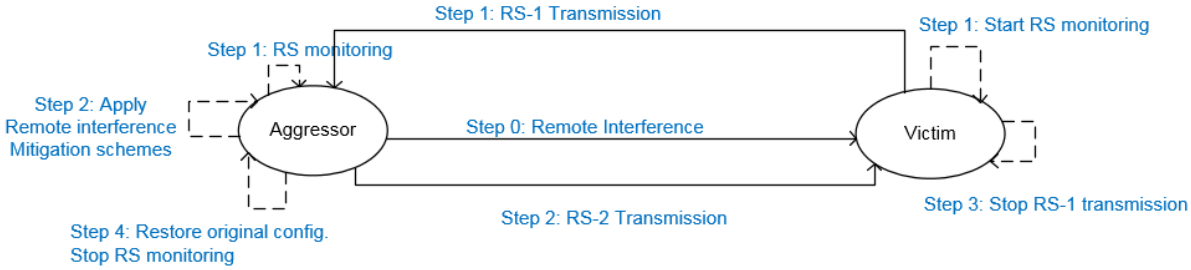
Step 1:

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- Victim experiences "sloping" like IoT increase and start RS transmission
- Aggressor starts monitoring RS as configured by OAM

Step 2: Upon reception of RS, Aggressor reports the detected RS to OAM
Step 3: OAM sends remote interference mitigation scheme to Aggressor
Step 4: Aggressor applies remote interference mitigation scheme
Step 5: OAM stops RS monitoring and restores original config. at aggressor side and stop RS transmission at victim side.

1. Framework-1



Workflow of Framework-1

Step 0: Atmospheric ducting phenomenon happens and the remote interference appears
Step 1:

- Victim experiences "sloping" like IoT increase and start RS transmission/monitoring
  - This RS marked as RS-1 is used to assist aggressor(s) to recognize that they are causing remote interference to the victim and to detect/deduce how many UL resources of the victim are impacted by the aggressors.
- Aggressor starts monitoring RS as configured by OAM or when it experiences remote interference with "sloping" IoT increase.

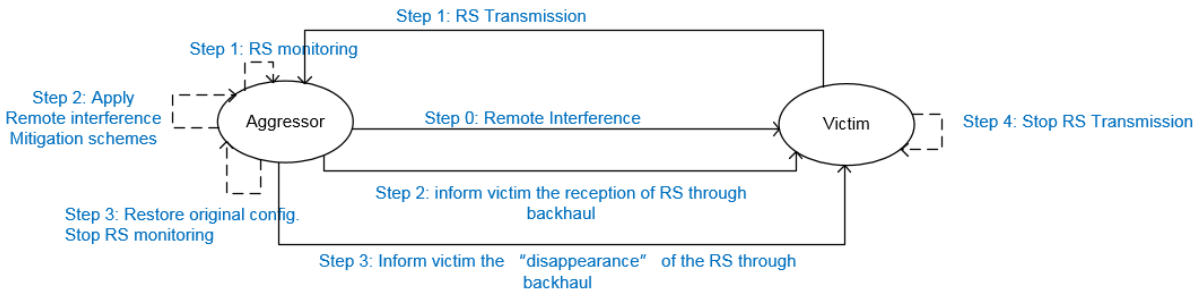
Step 2: Upon reception of RS-1, Aggressor starts remote interference mitigation solutions such as muting some DL transmission symbols and transmits RS to inform victim that the atmospheric ducting phenomenon still exist

- This RS marked as RS-2 is used to assist the victim to decide whether the atmospheric ducting phenomenon still exist.
  - It does not preclude the possibility of using RS-2 for other purposes, pending on further study.

Step 3: Victim continues RS-1 transmission while receiving RS-2. Upon "disappearance" of RS-2, victim stops RS transmission
Step 4: Aggressor continue remote interference mitigation while receiving RS-1. Upon "disappearance" of RS-1, Aggressor restores original configuration when "disappearance" of RS-1.

Note: Although RS-1 and RS-2 carry different functionalities, it might be beneficial to achieve a common design for RS-1 and RS-2.

2. Framework-2.1



Workflow of Framework-2.1

Step 0: Atmospheric ducting phenomenon happens and the remote interference appears
Step 1:

- Victim experiences "sloping" like IoT increase and start RS transmission
  - A set of gNBs might use the same RS, which may carry the set ID.
- Aggressor starts monitoring RS as configured by OAM or when it experiences remote interference with "sloping" IoT increase.

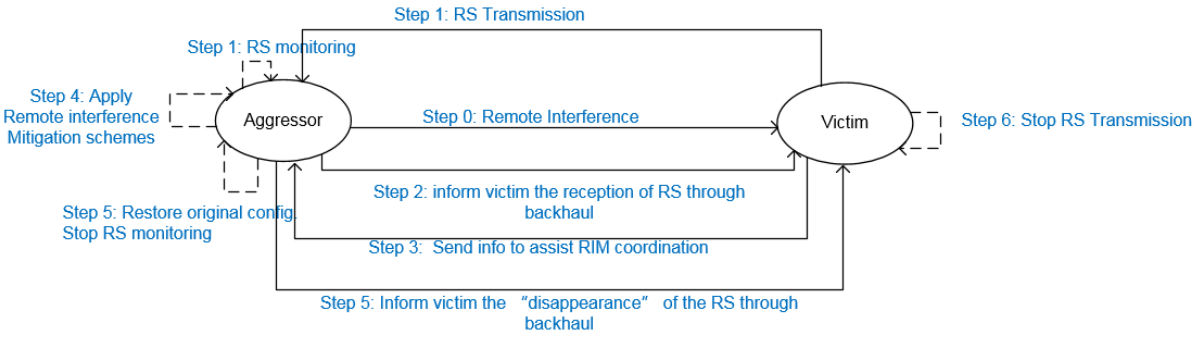
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Step 2: Upon reception of RS, Aggressor informs the set of victim gNB(s) the reception of RS through backhaul and apply interference mitigation scheme
- Message exchange in Step 2 could include other information, pending on further study.

Step 3: Upon "disappearance" of RS, Aggressor informs the set of Victim gNB(s) the "disappearance" of RS through backhaul and restore original configuration.

Step 4: Victim stop RS transmission upon the reception of the "disappearance of RS" info through backhaul

3. Framework-2.2



Workflow of Framework-2.2

Step 0: Atmospheric ducting phenomenon happens and the remote interference appears

Step 1:
- Victim experiences "sloping" like IoT increase and start RS transmission
  - A set of gNBs might use the same RS, which may carry the set ID.
- Aggressor starts monitoring RS as configured by OAM or when it experiences remote interference with "sloping" IoT increase.

Step 2: Upon reception of RS, Aggressor informs the set of victim gNB(s) the reception of RS through backhaul

Step 3: Upon reception of the "reception of RS" info received in the backhaul, victim sends info to assist RIM coordination

Step 4: Aggressor applies remote interference mitigation scheme

Step 5: Upon "disappearance" of RS, Aggressor informs Victim the "disappearance" of RS through backhaul.

Step 6: Victim stop RS transmission upon the reception of the "disappearance of RS" info through backhaul

Agreements:
- Inform RAN3 that three frameworks are used as in RAN1 as a starting point for further study. Following information will also be included is the LS.
  - The distance between gNB aggressor and gNB victim can be up to 300 km.
  - Action to RAN3: to provide feedback regarding feasibility of the frameworks
- Draft LS in R1-1809875

Agreements:
- For RIM SI, the evaluation is to be carried out via link-level simulation to evaluate the performance of the reference signals in the NR-RIM frameworks.

Friday session

R1-1809875 [Draft] LS on NR-RIM frameworks CMCC

Decision: The draft LS is endorsed and final LS is approved in R1-1809987.

R1-1809973 Draft summary on Study on NR-RIM CMCC

Decision: The document is noted.

Agreements:

For simulation evaluation of reference signals in the NR-RIM frameworks
- Following Descriptions of the RS should be provided
  - *RS sequence*
  - *Length of RS sequence*
  - *Time/frequency pattern of RS*

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        - *Time pattern (number of symbols)*
        - *Frequency pattern*
- Following analytical metrics of the RS should be provided
    - *The complexity of reference signal detection at gNB*
    - *Overhead*
    - *Impact on UEs*
    - *Others*
- Simulation
    - *Simulation parameters*
        - *SCS:* 30 kHz (mandatory) / 15 KHz (optional)
        - *Simulation bandwidth:* 20 MHz
        - *gNB MIMO configuration:* 1T1R (mandatory)/1T2R(optional)
        - *Frequency offset:* 0 Hz
        - *FFT size:* to be provided
        - *Length of detection window L_{symbol}:* to be provided
        - *Channel model:*
            - Option1: AWGN with random complex phase
            - Option2: TDL-E (K-factor = [22] dB, DS = [30] ns, Doppler [0] Hz)
            - FFS: whether one of the two options or both options are mandatory.
        - *Delay of received RS:* When multiple RSs arrive in the detection window, the arrival time of the *i*-th RS respect to the start of the detection window, Δ_i , is uniformly distributed within [$-L_{symbol}$, L_{symbol}], where L_{symbol} is the length of UL symbol based on the numerology of RS.
        - *Power of received RS:*
            - Option1: Pi of multiple RSs have a power offset with respect to the reference power P0, where the power offset is randomly selected from [-0.5dB, 0.5dB].
            - Use option1 as starting point for evaluation, FFS other option(s), e.g., different power offset ranges.
    - *Simulation cases and related metrics*
        - *Case 1: Single RS + AWGN (mandatory)*
            - Metric: the minimum SNR where detection probability of [90%] and a false alarm requirement of [1%]
            - FFS: successful detection time, e.g., one-shot.
        - *Case 2: Multiple RS + AWGN (mandatory)*
            - Number of total RSs arrived within one detection window: FFS
                - Number of base sequences arrived within the detection window: FFS
            - Metric: FFS.

Email discussion on additional simulation assumptions for RIM till Sept 7th – Hua (CMCC)

R1-1808927 Design considerations for remote interference management Huawei, HiSilicon

7.2.5.1 Mechanisms for improving network robustness

R1-1808529 Discussion on mechanism for NR RIM support LG Electronics

- Proposal 1: Study characteristics of remote CLI in asymmetric interference scenario.
- Proposal 2: Multiple mitigation techniques are supported in RIM scenario. Mechanisms to identify which technique is proper are supported. For example, victim can recommend mitigation technique based on aggressor's information such as load and the number of gNBs.
- Proposal 3: Existing reference signals can be starting points. It should be further studied the necessary of dedicated reference signal.
- Proposal 4: For backhaul signaling, at least the followings are considered
    - Reference signal configuration
    - Cell/group/cluster ID of aggressor/victim gNB
    - Level of remote CLI
    - Potential RIM techniques

Decision: The document is noted.

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R1-1809162 **Views on remote interference management for NR** **NTT DOCOMO, INC.**

- Observation 1: The number of symbols that may suffer remote interference are related to the following factors:
  - Propagation distance between aggressive gNB and victim gNB
  - Guard period in semi-static TDD configuration
  - Subcarrier spacing configuration
- Observation 2: For remote interference management, both interference mitigation at aggressive gNBs and victim gNBs should be studied.
- Observation 3: For remote interference management, the interference mitigation schemes in TD-LTE network can be used as a starting point.
- Observation 4: For remote interference management, the cross-link interference mitigation techniques in flexible duplex such as power control, advanced receiver, etc. should be studied.

Decision: The document is noted.

R1-1809455 **Mechanisms for improving network robustness** **Qualcomm Incorporated**

Error! Reference source not found.Discussion: Questioning whether the choice should be made by the network side, not the UE
Decision: The document is noted.

Tuesday session conclusion: Discuss further offline - Hua (CMCC)

R1-1808067	Discussion on remote interference mitigation mechanisms	Huawei, HiSilicon
R1-1808325	Consideration on RIM framework and mechanisms for improving network robustness	ZTE
R1-1808342	Considerations on remote interference management	Sony
R1-1808408	Views on remote interference management	CATT
R1-1808703	Remote interference management schemes	Intel Corporation
R1-1808785	Mechanisms for improving network robustness	Samsung
R1-1808822	On mechanism for improving network robustness in the presence of remote interference	Ericsson
R1-1809221	Remote interference management for NR	Nokia, Nokia Shanghai Bell

7.2.5.2 Mechanisms for identifying strong gNB interferers

R1-1808841 **Discussion on framework for RIM** **CMCC**

- Proposal 1. For both Framework-1 (w/o backhaul assistance) and Framework-2 (w/ backhaul assistance), characteristics, functionalities and requirements of RS design should be carefully studied.
- Proposal 2. Select one of the frameworks for NR-RIM.
- Proposal 3. Send LS to RAN3 to study potential additional coordination among gNBs for mitigating remote interference based on the proposed Framework-2.

Decision: The document is noted.

R1-1808823 **On mechanism for identifying strong gNB interferers** **Ericsson**

- Proposal 1: Support some level of gNB/gNB group identification, at least to add observability from OAM of the presence of remote interference in the NW
- Proposal 2: Further study what size of the ID space to enable group or individual gNB victim/aggressor identification is needed
- Proposal 3: The following baseline procedure shall be used for RS transmission/monitoring: i) RI identification (victim); ii) RS Tx (victim); iii) RS monitoring (potential aggressor)
- Proposal 4: Requirements on the reference signal should be: i) not to cause ambiguity with legacy UL transmissions; ii) have low overhead; iii) have acceptable (false) detection performance and complexity; iv) be detectable without OFDM symbol alignment; v) enable (group) gNB identification; vi) enable propagation delay estimation; vii) low cubic metric/PAPR
- Proposal 5: Decide, based on evaluations and gNB complexity, which gNB detection window should be the assumption for the reference signal design
- Proposal 6: Decide how to partition RIM RS sounding resources using TDM, FDM and CDM based on agreed RIM interference characteristics

Decision: The document is noted.

R1-1808326 **Consideration on reference signal design for remote interference management** **ZTE**

- Observation 1: The cyclic prefix of SS/PBCH block is not enough to provide protection against multi-path effect in remote interference management.

- Observation 2: On the ability to counter multi-path effect, it seems that CSI-RS is too sparse and the length of CSI-RS sequence is not long enough for remote interference management.
- Observation 3: Considering the detection complexity and ability to counter multi-path delay, PRACH preamble is also inappropriate for RIM.
- Observation 4: The legacy reference signals including SS/PBCH, CSI-RS and PRACH preamble cannot meet all the requirements.
- Proposal 1: The reference signal should provide performance with sufficiently good auto-correlation and cross-correlation, low false alarming rate and miss detection probability and so on.
- Proposal 2: The overhead of reference signal should be taken into consideration to ensure that the impact to the throughput of the network is minimized
- Proposal 3: The impact between reference signal for RIM and existing reference signals should be minimized.
- Proposal 4: The reference signal for RIM should be well designed to counter the serious multi-path delay spread.
- Proposal 5: It is necessary to distinguish the two reference signals in Scheme-1.
- Proposal 6: The RIM RS in Scheme-2 should convey victim gNB ID information for victim identification and inter-gNB communications through backhaul.
- Proposal 7: The reference signal should be able to assist the aggressor gNB to identity how far away the impacted gNB is.
- Proposal 8: A new and dedicated reference signal is needed in remote interference management.
- Proposal 9: Reference signal with a longer cyclic prefix or special structure would be needed to counter the multi-path delay spread in RIM.
- Proposal 10: Reference signal with a configurable periodicity is preferred to satisfy different requirements.
- Proposal 11: The frequency band of RIM reference signal needs further study to balance the overhead and performance requirements.
- Proposal 12: The reference signal for RIM may still reuse the generator, pattern and so on of the legacy reference signals with some necessary modifications.
- Proposal 13: In order to reduce the NR-RIM standardization workload and work out a feasible scheme to mitigate remote interference, we should strive for a unified RS design if multiple reference signals are needed.
- Proposal 14: The simulation assumption and performance metrics in Appendix A1 could be used to evaluate the RIM-RS.

Decision: The document is noted.

Tuesday session conclusion: Discuss further offline - Hua (CMCC)

R1-1808068	Discussion on reference signal design for identifying remote interference	Huawei, HiSilicon
R1-1808409	Discussion on identification of strong gNB interferers	CATT
R1-1808530	Discussion on procedure for NR RIM	LG Electronics
R1-1808704	Mechanism for identifying remote gNB interference	Intel Corporation
R1-1808786	Mechaisms for identifying strong gNB interferers	Samsung
R1-1809222	Considerations on identifying strong gNB interferers	Nokia, Nokia Shanghai Bell
R1-1809252	Some Considerations on Remote Interference Management for NR	China Telecommunications
R1-1809456	Mechanisms for identifying strong gNB interferers	Qualcomm Incorporated
R1-1809463	On remote interference management	CEWiT

7.2.5.3 Other

R1-1808824	Evaluation methodology and assumptions for RIM reference signal evaluations	Ericsson
R1-1808842	Discussion on RS design for RIM	CMCC
R1-1808843	Discussion on evaluation assumption for RIM	CMCC

7.2.6 Study on Physical Layer Enhancements for NR URLLC

FS_NR_L1enh_URLLC; SID in RP-181477. Please refer to the SID for detailed scoping

R1-1808098 Draft skeleton of TR 38.824: Study on physical layer enhancements for NR URLLC Huawei, HiSilicon

Discussion: Annex 2 structure was discussed - Transport industry should be removed acc. to some companies (already covered by V2X).

Decision: The document is noted.

Proposals: The draft skeleton is endorsed with the following updates:

- Removing subsections A.2.1/2/3
- Updating the section # for link level simulation assumptions to A.3
  - Remove the subsections under the link level simulation assumptions

Discuss further offline

Thursday

R1-1809861 **Draft skeleton of TR 38.824: Study on physical layer enhancements for NR URLLC Huawei, HiSilicon**

Decision: The TR 38.824 v0.0.0 is endorsed.

R1-1808943 **Work plan for Rel-16 SI on physical layer enhancements for URLLC Huawei, HiSilicon**

Discussion: Comment from RAN1 chair --> no TUs have been allocated to the Jan 19 ad-hoc meeting

Decision: The document is noted.

7.2.6.1 Layer 1 enhancements

Including necessary evaluations and potential enhancements to PDCCH, UCI, PUSCH, & scheduling/HARQ/CSI processing timeline

R1-1809516 **L1 enhancements for URLLC Huawei, HiSilicon** (R1-1808162)

Proposal 1: Take the requirements in Table 1 as the starting point for Rel-16 NR URLLC evaluation with the following assumptions:

- 1 ms core network delay for factory automation
- 3 ms core network delay for power distribution and transport industry

Proposal 2: The performance metric for Rel-16 NR URLLC evaluation includes at least the percentage of users satisfying reliability and latency requirements. The target percentage should be 100%.

Proposal 3: Take the simulation settings in Table 2 as the starting point for Rel-16 NR URLLC system level evaluation for transport industry.

Proposal 4: Take the simulation settings in Table 3 as the starting point for Rel-16 NR URLLC system level evaluation for electrical power distribution.

Proposal 5: Take the simulation settings in Table 4 as the starting point for Rel-16 NR URLLC system level evaluation for factory automation.

For baseline performance achievable with Rel-15 URLLC,

Observation 1: For 40 MHz bandwidth and 10 vehicles per cell, from downlink transmission perspective about 58% and 85% vehicles could achieve the required 2 ms latency and 99.999% reliability in Urban Macro and Highway deployments respectively.

Observation 2: For 40 MHz bandwidth and 10 vehicles per cell, from uplink transmission perspective about 47% and 80% vehicles could achieve the required 2 ms latency and 99.999% reliability in Urban Macro and Highway deployments respectively.

Observation 3: For 40 MHz bandwidth and 10 UEs per cell for differential protection, from downlink transmission perspective about 77% UEs could achieve the required 2 ms latency and 99.999% reliability in Urban Macro deployment.

For PDCCH enhancements,

Observation 4: The single user reliability of 99.999% can be fulfilled with AL=8 for the payload size of 40 bits without considering any SINR margin.

Observation 5: A large amount of users cannot satisfy the requirement due to PDCCH blocking. PDCCH enhancements are needed for Rel-16 NR URLLC to reduce the PDCCH blocking probability.

Observation 6: PDCCH blocking is decreased significantly by using compact DCI.

Proposal 6: Study mechanism(s) to support compact DCI for Rel-16 URLLC.

Observation 7: PDCCH blocking probability is decreased significantly with PDCCH repetition.

Proposal 7: Study mechanism(s) to support PDCCH repetition with fast feedback for R16 URLLC.

For PUSCH enhancements,

Proposal 8: Study mechanism(s) to support mini-slot based repetition for both grant based PUSCH and grant-free PUSCH.

Proposal 9: Intra-slot and inter-slot frequency hopping pattern for mini-slot based repetition can be studied by taking into account the diversity gain and the DMRS overhead.

For UCI enhancements,

Observation 8: Restricting one PUCCH transmission for HARQ-ACK within one slot as done in Rel-15 would increase latency, which is unacceptable at least for some URLLC use cases with low latency requirement and short packet arrival interval.

Observation 9: The Rel-15 HARQ feedback method with configured semi-static HARQ-ACK codebook is not applied to intra-UE DL multiplexing.

Proposal 10: Study enhanced HARQ feedback for Rel-16 URLLC. Enhancements can include at least the following aspects:

- Support of more than one PUCCH transmission possibilities within one slot.

- HARQ-ACK feedback with semi-static codebook is extended to apply to intra-UE DL multiplexing.

For CSI enhancements,

Proposal 11: Study mechanism(s) to support A-CSI report on short PUCCH triggered by DL DCI for Rel-16 NR URLLC.

- Whether and how to separate the timing/resources for HARQ-ACK feedback and aCSI feedback triggered by the same DL DCI could be studied.
- How to enable fast CSI measurement for URLLC traffic needs to be studied.

For enhancements on processing timeline,

Observation 10: The DL system resource efficiency could be low if the UE is not allowed to receive a new scheduled unicast PDSCH transmission with a HARQ ID before the HARQ-ACK for an earlier transmission with the same HARQ ID is transmitted.

Observation 11: The latency for URLLC UE is too long if the scheduled unicast PDSCH transmission of A comes before the scheduled unicast PDSCH transmission of B, and then the (baseline capability) UE is not allowed to send the HARQ-ACK for A after the HARQ-ACK for B.

Observation 12: The latency for URLLC UE is too large if the DL/UL grant scheduling unicast PDSCH/PUSCH transmission A comes before (in time) the DL/UL grant scheduling unicast PUSCH transmission B, and the UE is not allowed to be scheduled such that PDSCH/PUSCH for B is before the PDSCH/PUSCH for A.

Proposal 12: The scheduling/HARQ scheduling limitation in Release 15 should be removed for Release 16 URLLC, and the UE can have the following behavior:

- For each HARQ process ID, the UE can receive a scheduled unicast PDSCH transmission with the same HARQ process ID before the end of the expected transmission of the HARQ-ACK for an earlier transmission on the same HARQ process ID.
- For any two HARQ process IDs A and B for a given cell, if scheduled unicast PDSCH transmission for A comes before the scheduled unicast PDSCH transmission for B then the (baseline capability) UE can be triggered to send the HARQ-ACK for B before the HARQ-ACK for A.
- For any two HARQ process IDs A and B for a given cell, if the DL/UL grant scheduling unicast PDSCH/PUSCH transmission A comes before (in time) the DL/UL grant scheduling unicast PUSCH transmission B, UE can be scheduled such that PDSCH/PUSCH for B is before the PDSCH/PUSCH for A.

Decision: The document is noted.

R1-1808787 **Layer 1 enhancement for URLLCSamsung**

- Proposal 1: A Rel-16 UE supports the same number of PDCCH candidates and the same number of non-overlapping CCEs per slot as a Rel-15 UE.
- Proposal 2: Study DCI formats for Rel-16 URLLC with configurable field sizes.
- Proposal 3: Study PDSCH receptions without associated DCI formats (DCI format with size 0).
- Proposal 4: Study design of DCI formats for Rel-16 URLLC that enable scheduling of simultaneous PDSCH receptions by multiple UEs.
- Proposal 5: Study a need for PDCCH repetitions while also considering PDSCH coverage, introduction of CCE aggregation levels larger than 16, limit on number of non-overlapping CCEs per slot, and simultaneous configuration of CORESETs with different number of symbols.
- Proposal 6: Study support of multiple PUCCH format 0/2 transmissions for HARQ-ACK in a slot.
- Proposal 7: Study the support of simultaneous PUSCH and PUCCH transmissions.
- Proposal 8: If simultaneous PUSCH and PUCCH transmissions by a UE is not default operation, when a grant-free PUSCH transmission from a UE overlaps in time with a PUCCH transmission with HARQ-ACK from the UE and the UE cannot multiplex the HARQ-ACK in the PUSCH, the UE drops the PUSCH or the PUCCH transmission based on network configuration.
- Proposal 9: If simultaneous PUSCH and PUCCH transmissions by a UE is not default operation, study corrections in determining number of REs for HARQ-ACK (or UCI) multiplexing in a PUSCH. If HARQ-ACK BLER larger than data BLER is allowed, introduce $\beta_{\text{offset}}^{\text{PUSCH}}$ values smaller than 1. If HARQ-ACK multiplexing in one PUSCH of multiple PUSCHs with a same TB is allowed, study increasing the number of REs for multiplexing HARQ-ACK in the PUSCH.
- Proposal 10: If simultaneous PUSCH and PUCCH transmissions by a UE is not default operation and the UE would simultaneously transmit HARQ-ACK and data in a PUSCH that includes only symbols with DMRS, consider transmitting either only data in the PUSCH or only HARQ-ACK in the PUCCH.
- Proposal 11: Consider mini-slot level repetition for grant-free UL transmission.
- Proposal 12: For mini-slot level repetition, further study the hopping methods according to different repetition methods with two hops as a baseline.
- Proposal 13: Consider whether or not it is necessary to satisfy the minimum latency requirement for eRULLC with lower subcarrier spacing for grant-based PDSCH and grant-free PUSCH.
- Proposal 14: If it is necessary to satisfy the minimum latency requirement for eRULLC with lower subcarrier spacing for grant-based PDSCH and grant-free PUSCH, study new scheduling and HARQ processing time.

- Proposal 15: Study new scheduling and HARQ processing time for eURLLC to satisfy latency requirements for grant-based PUSCH.
- Proposal 16: Study whether or not to support out-of-order HARQ procedures.

Decision: The document is noted.

R1-1809457 **Layer 1 enhancements Qualcomm Incorporated**

- Proposal 1: Adopt a PHY-layer signalling for differentiating the channels with different traffic types in Rel. 16 URLLC.
- Proposal 2: To enable fast scheduling for URLLC, the number of non-overlapping CCEs per slot of a serving cell can be revisited.
- Proposal 3: Designing a compact DCI format can be considered for Rel. 16 URLLC.
- Proposal 4: If the PDCCH reliability cannot be satisfied even with the largest defined AL, the gains from PDCCH repetition can be studied for NR URLLC. The starting point could be to evaluate PDCCH repetition (in CC, time, and TRP domain with increased diversity order) that does not require combining across different PDCCH occasions by the UE.
- Proposal 5: To reduce the URLLC latency and improve its PUCCH coverage, multiple HARQ-ACK reporting per slot can be supported.
- Observation 1: The benefit of A-CSI triggering via a DL grant is two-fold: (1) There is no need to spend resources on sending an UL grant to only trigger the A-CSI report, and (2) the up-to-date CSI report can be made available at the gNB to make proper scheduling decisions for TB re-transmissions.
- Proposal 6: For Rel. 16 URLLC, allow for triggering A-CSI reporting via the downlink grant.
- Proposal 7: Study the achievable gains and suitable operating scenarios for enabling mini-slot level repetition and frequency-domain hopping.
- Proposal 8: Reducing the UE's (N1/N2) and gNB's (N3/N4) processing timelines can be considered for Rel. 16 URLLC.
- Proposal 9: Consider reducing the CSI computation timeline and study the possible relaxations needed to achieve it for Rel. 16 URLLC.

Decision: The document is noted.

RAN1 Chair comment: Only 1TU to that meeting makes very difficult looking at more contributions. Companies are encouraged to discuss further offline – Chengyan (Huawei)

Thursday

R1-1809862 **Summary of 7.2.6.1 Layer 1 enhancements Huawei, HiSilicon**

Decision: The document is noted.

R1-1809863 **Text proposal on capturing specific use case and requirements for Rel-16 NR URLLC in TR 38.824 Huawei, HiSilicon**

Decision: The document is noted.

Friday session

R1-1809951 **Offline discussion summary of 7.2.6.1 Layer 1 enhancements Huawei, HiSilicon**

Decision: The document is noted.

Agreements:

- Select one or more representative use case(s) for the prioritized use cases in the SID and/or the Rel-15 enabled use case for evaluation, which use case(s) to evaluate is up to companies.
  - Further discussion how/whether to capture them in the TR
  - Further discussion other detailed simulation assumptions

The following table of representative use cases for selection for evaluation is an example as the starting point for further discussion:

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Use case (Clause #)	Reliability (%)	Latency (ms)	# of UEs (per cell)	Data packet size and traffic model	Description
Transport Industry (22.186: 5.5)	[99.999]	[5] (end to end latency)	[30]	DL: [TBD] byte; ftp model 3 with arrival interval [TBD] s UL: [TBD] byte; Periodic with arrival interval [TBD] s	Remote driving
Power distribution (22.804:5.6.4 &5.6.6)	99.9999	5(end to end latency)	8	[80] byte ftp model 3 with arrival interval 100ms	Power distribution grid fault and outage management
	[99.999]	15(end to end latency)	8	250 byte Periodic and deterministic with arrival interval 0.833 ms	Differential protection
Factory automation (22.804: 5.3.2)	99.9999	[2](end to end latency)	[4, 40]	20 byte, 50 byte Periodic and deterministic traffic model	Motion control
Rel-15 enabled use case (e.g. AR/VR)	99.999	[1ms] (air interface delay)	1, 5, 10, 20	[32, 256] bytes FTP model 2/3 or periodic with different arrival rates	Companies report the combination of the requirement

- All the entries in the above table are subject to further discussion which can be revisited in the next meeting
- Note: The details on above the requirements can refer to R1-1809337.
- Note: 3ms ~ 10ms CN delay for differential protection (i.e. power distribution case 2) could be considered.
- Note: Rel-15 higher layer mechanisms for reliability may be applicable for achieving the reliability requirement
- Note: The reliability and latency are as defined in 22.186.
- Note: For AR/VR, the requirement can refer to section 7.2.3 in TS 22.261.
- Note: FFS whether the packet size is based on application layer or L2/L3. The packet size listed in the table needs to further discussed, especially depending on the outcome of whether the packet size is based on application layer or L2/L3
- Further discussion on how to map the requirements (e.g., reliability, latency, etc.) to RAN-level requirements

Email discussion on additional simulation assumptions till Sept 7th (including proposals 4/5/6 in R1-1809951) – Chengyan (Huawei)

Agreement:
- Further discussion till next meeting regarding whether/how to evaluate the number of users, the % of users, etc., satisfying reliability and latency requirements.

Agreements:
- Companies are encouraged to report the CDF of UE geometry
- Further discussion whether/how to re-use the deployment and channel models in the existing TRs (e.g. 38.802, 37.885 and 38.901)

Agreements:
Further evaluate the potential PDCCH enhancements for NR Rel-16 URLLC.
- Further evaluate PDCCH reliability
- Further evaluate PDCCH blocking
  - Companies describe the resource utilization
- Complexity should be considered
- Latency of the enhancement(s) should be considered

Agreement:

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- Study further how to enable more than one PUCCH for HARQ-ACK transmission within a slot.

Agreements:
Study further whether/how to enable enhanced reporting procedure/feedback for HARQ-ACK.
- Enhanced HARQ-ACK multiplexing on PUSCH and PUCCH
- Finer indication for HARQ feedback timing, e.g. symbol-level, half-slot, etc.
  - Note: this may be related to more than one PUCCH for HARQ-ACK tx within a slot
- Other enablers are not precluded

Agreements:
Study the need for enhanced CSI reporting/measurement mechanisms. E.g.,
- DMRS based CSI
- A-CSI on PUCCH
- Trigger by DL assignment
- Enhanced CSI reporting mode
- Other approaches are not precluded

R1-1808147 Enhancements to Uplink and Downlink Physical Channels for NR URLLC Ericsson
R1-1808161 Achieving ultra-low latency in grant-based URLLC transmission with minimum overhead Idaho National Laboratory
R1-1808191 On compact DCI for URLLC Mitsubishi Electric RCE
R1-1808211 URLLC PHY enhancements ZTE
R1-1808248 Layer 1 enhancements for URLLC vivo
R1-1808255 Discussion on enhanced reliability TCL Communication Ltd.
R1-1808285 Study and evaluations of NR control channels for URLLC MediaTek Inc.
R1-1808301 On improved reliability of UCI piggybacked PUSCH Fujitsu
R1-1808308 HARQ Processing Timeline Enhancements for NR URLLC Fraunhofer HHI
R1-1808343 On Layer 1 enhancement for URLLC Sony
R1-1808410 Discussion on PHY enhancements for Rel-16 URLLC CATT
R1-1808531 Discussion on layer 1 enhancements LG Electronics
R1-1808568 On the L1 enhancements for NR URLLC Nokia, Nokia Shanghai Bell
R1-1808617 Enhancements to PDCCH NEC
R1-1808705 Views on evaluation methodology and Layer 1 enhancements for Rel-16 eURLLC Intel Corporation
R1-1808810 Consideration on URLLC physical layer enhancement Spreadtrum Communications
R1-1808815 Discussion on PDCCH enhancements for URLLC ETRI
R1-1808827 On NR URLLC L1 enhancements Panasonic
R1-1808844 Discussion on out-of-order scheduling and HARQ CMCC
R1-1808854 PDCCH enhancements for URLLC China Telecommunications
R1-1808908 Layer 1 enhancement for URLLC Guangdong OPPO Mobile Telecom
R1-1808919 Discussion on UL pre-emption for URLLC reliability Potevio
R1-1809055 Overview of Physical Layer enhancements for NR URLLC AT&T
R1-1809099 Views on potential physical layer enhancements for URLLC InterDigital, Inc.
R1-1809112 PUCCH enhancements for URLLC HARQ-ACK feedback Sharp
R1-1809125 HARQ enhancement for URLLC III
R1-1809163 Physical Layer Enhancements for NR URLLC NTT DOCOMO, INC.
R1-1809224 PDCCH combining strategy TCL Communication Ltd
Withdrawn
R1-1809288 Considerations on PDCCH enhancements to support URLLC CAICT
R1-1809289 Considerations on UCI transmission enhancements to support URLLC CAICT
R1-1809291 Discussion on the PDCCH repetition for NR URLLC Xiaomi
R1-1809318 Considerations for PDCCH enhancements Sequans Communications
R1-1809320 PUCCH enhancements Sequans Communications
R1-1809400 Layer 1 URLLC Enhancements Motorola Mobility, Lenovo
R1-1809981 Summary of 7.2.6.1 Layer 1 enhancements Huawei, HiSilicon

7.2.6.2 UL inter UE Tx prioritization/multiplexing

R1-1808286 **Evaluation and analysis for UL multiplexing between eMBB and URLLC MediaTek Inc.**

- Proposal 1: Uplink preemption indication should not be considered in Rel-16 unless URLLC performance can be guaranteed to achieve its minimum L1 latency requirement.
- Proposal 2: It is essential to model the following in order to realistically evaluate the performance of uplink preemption schemes in a system-level simulation environment:
  - Accurate eMBB processing timeline modeling (including, at least, PI monitoring periodicity and eMBB processing capability)
  - HARQ re-transmission modeling with soft-combining capability (at least for eMBB UEs).
- Proposal 3: System-level simulation studies for uplink multiplexing should consider the scenario where only some of the eMBB UEs are capable of supporting preemption indication.
- Proposal 4: Further enhancements should be investigated for power control and re-scheduling methods in Rel-16 to improve UL dynamic multiplexing between eMBB and URLLC.

Decision: The document is noted.

R1-1808706 **On inter-UE multiplexing in UL Intel Corporation**

- Proposal 1: Mechanisms for UL inter-UE multiplexing should not be limited to cater to only multiplexing of different service types (eMBB vs. URLLC), but also consider the general problem of multiplexing services with different QoS requirements.
- Proposal 2: NR provides sufficient mechanisms to configure different power control parameters for different services either dynamically or semi-statically
- Observation 1: Dynamic reduction of eMBB power can be better classified as a generalized form of interruption indication and should be discussed in that context rather than power control techniques.
- Proposal 3: Support of interruption or continuation indication can be further studied, subject to application time of interruption indication being at least N2 according to the supported UE minimum processing time capability as a starting point
  - Further studies are needed, taking UE power consumption and monitoring complexity, and reliability of indication into account
  - FFS: Details of UE specific or group-based signaling, implicit/explicit indication, etc.
  - FFS: Feasibility of application time shorter than N2

Decision: The document is noted.

Tuesday session conclusion: Continue offline discussion – Xueming (vivo)

Friday session

R1-1809995 **Offline discussion for UL inter UE Tx prioritization/multiplexing vivo**

Decision: The document is noted.

Agreements:

- RAN1 to study the potential enhancements for UL inter UE Tx prioritization/multiplexing
  - Performance study of the enhanced UL inter UE Tx prioritization/multiplexing mechanisms using Re-15 mechanisms as the performance benchmark
    - The use cases and scenarios adopted in L1 enhancements for URLLC are considered for the evaluation of UL inter UE Tx prioritization/multiplexing
    - Other factors to be considered such as overhead, capability, etc.
  - Study the UE UL cancelation mechanisms, including at least the following aspects
    - The potential mechanisms may include UE UL cancelation/pausing indication, UL continuation indication, UL re-scheduling indication
    - Physical channel/signal used for the UL cancelation indication
    - UE Processing timeline for the UL cancelation indication
    - UE monitoring behaviours for the UL cancelation indication
    - UE PDCCH monitoring capability, if the UL cancelation indication is by PDCCH
    - Methods to ensure the reliability of the indication for UE UL cancelation
  - Study the UL power control enhancements
  - Study other enhancements for the multiplexing between a grant-based UL transmission from a UE and a grant-free UL transmission from another UE

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R1-1808099 UL inter-UE transmission prioritization and multiplexing Huawei, HiSilicon
R1-1808148 Inter-UE Prioritization and Multiplexing of UL Transmissions Ericsson
R1-1808212 On Inter-UE multiplexing between eMBB and URLLC ZTE
R1-1808249 UL inter UE Tx prioritization for URLLC vivo
R1-1808302 Discussion on UL preemption indication Fujitsu
R1-1808306 UL multiplexing for URLLC China Telecommunications
R1-1808344 On UL inter UE pre-emption Sony
R1-1808411 Discussion on inter-UE UL multiplexing CATT
R1-1808447 Discussions on UL inter-UE Tx multiplexing Mitsubishi Electric Co.
R1-1808532 Discussion on UL inter UE Tx prioritization LG Electronics
R1-1808565 UL inter UE Tx prioritization/multiplexing of eMBB and URLLC NEC
R1-1808569 On UL inter-UE multiplexing between eMBB and URLLC Nokia, Nokia Shanghai Bell
R1-1808788 Uplink inter UE multiplexing/prioritization for enhanced URLLC Samsung
R1-1808797 Discussion on UL inter UE Tx prioritization/multiplexing Spreadtrum Communications
R1-1808845 Discussion on UL inter UE Tx prioritization/multiplexing CMCC
R1-1808868 Discussion on Inter UE UL multiplexing III
R1-1808909 Consideration on UL inter UE Tx prioritization and multiplexing Guangdong OPPO Mobile Telecom
R1-1808916 Discussion on UL inter UE Tx multiplexing ASUSTEK COMPUTER (SHANGHAI)
R1-1809100 Discussion on UL inter-UE multiplexing for URLLC InterDigital, Inc.
R1-1809113 Priority handling and multiplexing among PUSCHs with different latency and reliability requirements Sharp
R1-1809164 Uplink transmission prioritization/multiplexing for NR URLLC NTT DOCOMO, INC.
R1-1809327 Considerations for UL multiplexing with different reliability requirements Sequans Communications
R1-1809404 Considerations on UL eMBB/URLLC multiplexing KT Corp.
R1-1809458 UL inter UE Tx prioritization-multiplexingQualcomm Incorporated

7.2.6.3 Enhanced UL grant-free transmissions

R1-1809165 Enhanced UL transmission with configured grant for URLLC NTT DOCOMO, INC.

- Proposal 1: Study multiple configured grant configurations on a serving cell.
  - The initial transmission of a TB shall start at the first transmission occasion of the K transmissions.
  - The initial transmission of a TB for different configured grant configurations is on different TTIs.
  - Different HARQ process IDs are used for different configured grant configurations.
  - The UE shall not transmit PUSCH simultaneously using different configured grant configurations on a serving cell.
- Proposal 2: Study mini-slot repetitions as the promising candidates for URLLC enhancements and capture the benefits and advantages of them in the TR.
  - PUSCH repetitions shorter than one repetition per slot (e.g., repetitions within a slot).
  - PUSCH repetitions with multiple-TRPs.
    - Enabling different QCLs/precoders/beams across repetitions.
- Proposal 3: Study further detailed options of PUSCH repetition.
  - Frequency-hopping
    - E.g., the number of repetitions in the first hop is floor(N/2), the number of repetitions in the 2nd hop is ceiling (N/2) where N is the number of repetitions within a slot
  - Time-domain allocation taking into account slot boundary
    - the resources for repetition are in consecutive available UL or flexible symbols within one slot; if one repetition is about to cross the slot boundary, it is postponed to the earliest available symbol for PUSCH transmission in the next slot

Observation 1:

- Unless strong benefit is identified, explicit positive HARQ-ACK feedback from gNB to UE is not supported.
  - UL grant scrambled by C-RNTI or new-RNTI scheduling the new TB transmission of the same HARQ process can indicate "ACK"
  - UL grant scrambled by CS-RNTI scheduling the same TB initially transmitted without grant can indicate "NACK"
    - Above UL grant scheduling the new transmission or retransmission can be used during and after the K repetition
- If strong benefit is identified, explicit positive HARQ-ACK feedback from gNB to UE is realized by a PDCCH.

Decision: The document is noted.

R1-1808910 **Grant free transmission enhancement** **Guangdong OPPO Mobile Telecom**

- Proposal 1: Explicit HARQ-ACK can improve transmission reliability due to it can recognize miss-detection of PUSCH.
- Proposal 2: Physical channel design for explicit HARQ-ACK should be considered. Group-common DCI and Sequence based channel can be studied to support explicit HARQ-ACK feedback.
- Proposal 3:Mini-slot repetition can reduce latency.
- Proposal 4: Mini-slot hopping enhancement can reduce collision.
- Proposal 5: Restriction on piggybacked UCI type and bit number in grant free is necessary for URLLC.

Decision: The document is noted.

Thursday conclusion: Continue offline discussion – Lihui (NTT DOCOMO)

Friday session

R1-1809979 **Summary of 7.2.6.3 Enhanced UL grant-free transmissions** **NTT DOCOMO**

Decision: The document is noted.

Agreements:

- Study further whether/how multiple active configured grants for a BWP of a serving cell.
  - Identify potential specification impacts and options for both type 1 and type 2
    - At least Activation/deactivation mechanism for Type2
      - E.g., whether each configuration is activated/deactivated or multiple configurations are activated/deactivated
    - Study how to support repetitions with multiple configurations for a BWP of a serving cell
    - FFS HARQ process ID determination for both type 1 and type 2
    - FFS other specification impacts for both type 1 and type 2
  - Study the performance impacts

Agreements:

- Study further whether/how on ensuring K repetitions.
- Study further on PUSCH repetitions within a slot for configured grant.

R1-1808100	Enhanced UL configured grant transmissions	Huawei, HiSilicon
R1-1808149	Enhancements to UL Grant-free Transmission for NR URLLC	Ericsson
R1-1808213	Enhanced UL grant-free transmissions	ZTE
R1-1808250	Enhanced UL grant-free transmissions for URLLC	vivo
R1-1808287	Evaluation of configured-grant for NR URLLC	MediaTek Inc.
R1-1808304	Discussion on the Reliability Enhancement for Grant-free Transmission	China Telecommunications
R1-1808345	On Enhancement of UL grant-free transmissions	Sony
R1-1808412	On enhancements to configured UL grant operation	CATT
R1-1808533	Discussion on enhancement for grant-free transmission	LG Electronics
R1-1808570	On Configured Grant enhancements for NR URLLC	Nokia, Nokia Shanghai Bell
R1-1808621	Discussion on enhanced UL grant-free transmissions	Panasonic Corporation
R1-1808707	Enhancements to configured grant PUSCH	Intel Corporation
R1-1808789	Potential enhancement for UL grant-free transmission	Samsung
R1-1808809	Consideration on enhanced UL grant-free transmissions	Spreadtrum Communications
R1-1809101	Views on enhanced UL grant-free transmissions for URLLC	InterDigital, Inc.
R1-1809114	Reliability enhancements for UL configured grant	Sharp
R1-1809294	Discussion on Configured Grant Enhancements	III
R1-1809319	Enhancements for grant free transmissions	Sequans Communications
R1-1809459	Enhanced SPS and grant-free transmissions	Qualcomm Incorporated
R1-1809464	Discussion on enhanced UL grant-free transmissions	KDDI Corporation

7.2.6.4 Other

R1-1808251 Other enhancements for URLLC vivo
R1-1808256 Discussion on two stage feedback for URLLC TCL Communication Ltd.
R1-1808346 Multiple active BWPs Sony
R1-1808534 Discussion on differentiation of eMBB and URLLC services LG Electronics
R1-1808571 On compact DCI for NR URLLC Nokia, Nokia Shanghai Bell
R1-1808572 On PDCCH repetition for NR URLLC Nokia, Nokia Shanghai Bell
R1-1808573 On the PDCCH limits on the number of CCEs for channel estimation and BDs for URLLC Nokia, Nokia Shanghai Bell
R1-1808574 On enhanced HARQ-ACK feedback for URLLC Nokia, Nokia Shanghai Bell
R1-1808575 CQI reporting mode enhancements for URLLC Nokia, Nokia Shanghai Bell
R1-1808576 On scheduled PUSCH (& PDSCH) repetition enhancements for NR URLLC Nokia, Nokia Shanghai Bell
R1-1808577 On the out-of-order HARQ-ACK support for URLLC Nokia, Nokia Shanghai Bell
R1-1808596 HARQ-ACK feedback for URLLC InterDigital, Inc.
R1-1808598 URLLC UCI prioritization InterDigital, Inc.
R1-1808828 On BWP hopping for repetitions and retransmission in NR URLLC Panasonic
R1-1808846 Discussion on remaining issues of new RNTI for URLLC CMCC
R1-1808888 Resource allocation enhancements for NR URLLC Guangdong OPPO Mobile Telecom
R1-1808889 On eMBB and URLLC data differentiation Guangdong OPPO Mobile Telecom
R1-1808911 Consideration on UL intra UE Tx prioritization and multiplexing Guangdong OPPO Mobile Telecom
R1-1808973 Enhancements for eMBB/URLLC multiplexing in DL Sequans Communications
R1-1809040 Latency Evaluation of Rel-15 URLLC Ericsson
R1-1809041 Reliability Evaluation of Rel-15 URLLC Ericsson
R1-1809251 Discussion on HARQ-ACK enhancement for URLLC LG Electronics Inc.
R1-1809317 Considerations for DL automatic repetitionSequans Communications
R1-1809337 Evaluation assumptions and methodology for Rel-16 NR URLLC Huawei,China Southern Power Grid, HiSilicon
R1-1809338 Simulation results on the baseline performance achievable with Rel-15 URLLC for the identified use cases Huawei, HiSilicon
R1-1809339 PDCCH enhancements for URLLC Huawei, HiSilicon
R1-1809340 Compact DCI for URLLCHuawei, HiSilicon
R1-1809341 PDCCH repetition for URLLC Huawei, HiSilicon
R1-1809342 HARQ-ACK enhancements for URLLC Huawei, HiSilicon
R1-1809343 CSI enhancements for URLLC Huawei, HiSilicon
R1-1809344 PUSCH enhancements for URLLCHuawei, HiSilicon
R1-1809345 Enhancements to scheduling/HARQ/CSI processing timeline for URLLC Huawei, HiSilicon
R1-1809346 Discussion on time synchronization impact in physical layerHuawei, China Southern Power Grid, HiSilicon
R1-1809347 Potential RAN1 impacts on intra-UE prioritization Huawei, HiSilicon
R1-1809413 UL Intra-UE Pre-emption for Rel-16 Ericsson
R1-1809414 Time synchronization Ericsson
R1-1809460 eURLLC Considerations for Factory Automation Qualcomm Incorporated

7.2.7 Study on Self Evaluation towards IMT-2020 Submission

FS_5G_eval; SID in RP-181318. Please refer to the SID for detailed scoping

Friday

R1-1809917 Chairman's notes of AI 7.2.7 Study on Self Evaluation towards IMT-2020 Submission Ad-hoc chair (Ericsson)

Decision: The document is endorsed, content is incorporated below.

R1-1808861 Evaluation results and observations of DL spectral efficiency for IMT2020 self evaluation MediaTek Inc.

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R1-1808862 Evaluation results and observations of UL spectral efficiency for IMT2020 self evaluation MediaTek Inc.

R1-1809940 Summary on discussion on IMT-2020 evaluation for reliability Huawei

Agreement:
- The evaluation results in R1-1809940 are endorsed by RAN1.
- Text proposal to TR37.910 is developed based on the results in R1-1809940 that fulfill ITU-R requirements.

R1-1809939 Summary on discussion on IMT-2020 evaluation for mMTC connection density Huawei

Agreement:
- The evaluation results in R1-1809939 are endorsed by RAN1.
- Text proposal to TR37.910 is developed based on the results in R1-1809939 that fulfill ITU-R requirements.
- For non-full buffer SLS, early data transmission and RRC Resume procedure will be captured as two transmission schemes.

R1-1809938 Summary on discussion on IMT-2020 evaluation for energy efficiency Huawei
The text proposal in R1-1809938 is endorsed.

R1-1809937 Summary on discussion on IMT-2020 evaluation for eMBB mobility evaluation Huawei

Agreement:
- The evaluation results in R1-1809937 are endorsed by RAN1.
- Text proposal to TR37.910 is developed based on the results in R1-1809937 that fulfill ITU-R requirements.

R1-1809936 Summary on discussion on IMT-2020 evaluation for eMBB user experienced data rate Huawei

Agreement:
- The evaluation results in R1-1809936 are endorsed by RAN1.
- Text proposal to TR37.910 is developed based on the results in R1-1809936 as well as the evaluation of 5%-tile user spectral efficiency (for single band) that fulfill ITU-R requirements.

R1-1809935 Summary on discussion on IMT-2020 evaluation for eMBB spectral efficiency Huawei

Agreement:
- The results will be based on the following overhead assumptions for simulation bandwidth:
  - For DL: 2 OFDM symbols for PDCCH; other components are based on companies' schemes.
  - For UL: PUCCH format 4 for CSI feedback and format 0 for ACK/NACK feedback; other components are based on companies' schemes.
  - GP will be taken into account in overhead; 50% of GP symbols are considered as DL overhead; 50% of GP symbols are considered as UL overhead.
- The DL spectral efficiency will be further scaled up to larger than simulation bandwidth by using the agreed guard band ratio scaling method in R1-1803386 and the PDCCH overhead reduction model agreed in Section 2.4 in R1-1807758.

Email approval to compile and endorse the eMBB spectral efficiency results submitted by August 24th, 2018, until August 29th, 2018 (Wu Yong)

R1-1809934 Summary on discussion on IMT-2020 evaluation for peak data rate and peak spectral efficiency Huawei

Agreement:
The NR parts (Section 5.1.1, Section 5.2.1, and Section B.x.1) of the text proposal in R1-1809934 are endorsed by RAN1.

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Email approval to derive the LTE peak spectral efficiency and peak data rate results with the text proposals in R1-1809934 as the starting point, August 29th, 2018 (Wu Yong)

R1-1809947 **Summary on discussion on IMT-2020 evaluation for CP and UP latency** **Huawei**

Agreement:
The text proposal on user plane latency in R1-1809947 is endorsed by RAN1.

Email approval to derive the NR control plane latency evaluation results, based on the summary of CP latency evaluation parameters in R1-1809947, August 29, 2018 (Wu Yong).

7.2.7.1 Evaluation methodology

R1-1808072	Consideration on IMT-2020 self evaluation	Huawei, HiSilicon
R1-1808413	Remaining issues on evaluation methodology for self-evaluation	CATT
R1-1808535	Discussion on evaluation methodology for reliability	LG Electronics
R1-1808708	Evaluation Methodology for IMT-2020 Self-Evaluation	Intel Corporation
R1-1808790	Evaluation methodology for IMT-2020 self-evaluation	Samsung
R1-1808863	IMT-2020 Mobility Evaluation Results	Nokia, Nokia Shanghai Bell
R1-1809259	IMT-2020 self-evaluation: Evaluation Methodology for Mobility	Ericsson
R1-1809728	Consideration on Evaluation methodology of IMT-2020 self-evaluation	ZTE (rev of R1-1809728)

7.2.7.2 Other

Including evaluation results

R1-1808057	LTE evaluation parameters and configurations for Rural-eMBB test environment	Huawei, HiSilicon
R1-1809508	Considerations and evaluation results for IMT-2020 for eMBB spectral efficiency	Huawei, HiSilicon
Revision of R1-1808073		
R1-1809509	Considerations and evaluation results for IMT-2020 for user experienced data rate	Huawei, HiSilicon
Revision of R1-1808074		
R1-1808075	Considerations and evaluation results for IMT-2020 for area traffic capacity	Huawei, HiSilicon
R1-1808076	Considerations and evaluation results for IMT-2020 for high mobility	Huawei, HiSilicon
R1-1808077	Considerations and evaluation results for IMT-2020 for peak spectral efficiency and peak data rate	Huawei, HiSilicon
R1-1808078	Considerations and evaluation results for IMT-2020 for network energy efficiency	Huawei, HiSilicon
R1-1808079	Considerations and evaluation results for IMT-2020 for UE energy efficiency	Huawei, HiSilicon
R1-1808080	Considerations and evaluation results for IMT-2020 for mMTC connection density	Huawei, HiSilicon
R1-1809510	Considerations and evaluation results for IMT-2020 for reliability	Huawei, HiSilicon
Revision of R1-1808081		
R1-1808082	Considerations and evaluation results for IMT-2020 for control plane latency	Huawei, HiSilicon
R1-1808083	Considerations and evaluation results for IMT-2020 for user plane latency	Huawei, HiSilicon
R1-1809511	Consideration on self evaluation of IMT-2020 for link budget	Huawei, HiSilicon
Revision of R1-1808084		
R1-1808182	Updated UMi calibration results for user experience data rate in the multi-layer network deployment	ZTE
R1-1808183	Updated DL spectral efficiency in the eMBB usage scenario for IMT-2020 self evaluation	ZTE
R1-1808184	Link curve performance of LDPC coding in IMT-2020 self evaluation	ZTE
R1-1808185	Updated UL spectral efficiency in the eMBB usage scenario for IMT-2020 self evaluation	ZTE
R1-1808187	Consideration on Evaluation of mobility of IMT-2020 self-evaluation	ZTE
R1-1808188	Consideration on Evaluation of reliability of IMT-2020 self-evaluation	ZTE
R1-1808189	Consideration on Evaluation of connection density of IMT-2020 self-evaluation	ZTE
R1-1808364	Evaluation results for eMBB spectrum efficiency in TDD	NEC
R1-1808365	Evaluation results for eMBB spectrum efficiency in FDD	NEC
R1-1808414	Discussions on detailed link budget evaluation methodology	CATT
R1-1808415	Discussions on calculation of shadow fading margin for link budget	CATT

R1-1808416 Discussions on penetration margin and SD for link budget CATT
R1-1808417 Discussions on overhead for spectrum efficiency CATT
R1-1808418 Self-evaluation on Peak Data Rate and Peak Spectrum Efficiency for NR CATT
R1-1809719 Self-evaluation on Peak Data Rate and Peak Spectrum Efficiency for LTE CATT
Revision of R1-1808419
R1-1808420 Self-evaluation on Spectrum Efficiency and Area Traffic Capacity in Indoor Hotspot-eMBB CATT
R1-1808421 Self-evaluation on Spectrum Efficiency and User Experienced Data Rate in Dense Urban-eMBB CATT
R1-1808422 Self-evaluation on NR Spectrum Efficiency in Rural-eMBB CATT
R1-1808423 Self-evaluation on LTE Spectrum Efficiency in Rural-eMBBCATT
R1-1808424 Self-evaluation on CP latency CATT
R1-1809717 Self-evaluation on UP latency for NR CATT
Revision of R1-1808425
R1-1809718 Self-evaluation on UP latency for LTE CATT
Revision of R1-1808426
R1-1808427 Self-evaluation on Energy Efficiency CATT
R1-1809715 Self-evaluation on Mobility CATT
Revision of R1-1808428
R1-1809716 Self-evaluation on Reliability CATT
Revision of R1-1808429
R1-1808448 IMT-2020 self-evaluation: UP latency analysis for FDD and dynamic TDD with UE processing capability 1 (eMBB) Nokia, Nokia Shanghai Bell
R1-1808449 IMT-2020 self-evaluation: UP latency analysis for FDD and dynamic TDD with UE processing capability 2 (URLLC) Nokia, Nokia Shanghai Bell
R1-1808450 IMT-2020 self-evaluation: UP latency analysis for static TDD with UE processing capability 1 (eMBB) Nokia, Nokia Shanghai Bell
R1-1808451 IMT-2020 self-evaluation: UP latency analysis for static TDD with UE processing capability 2 (URLLC) Nokia, Nokia Shanghai Bell
R1-1808452 IMT-2020 Self Evaluation: CP latency Nokia, Nokia Shanghai Bell
R1-1808453 IMT-2020 self evaluation: Network energy efficiency Nokia, Nokia Shanghai Bell
R1-1808536 Evaluation results of Dense Urban-eMBB for IMT-2020 self-evaluation LG Electronics
R1-1808537 Evaluation results of Rural-eMBB for IMT-2020 self-evaluation LG Electronics
R1-1808538 Evaluation results of Indoor Hotspot-eMBB for IMT-2020 self-evaluation LG Electronics
R1-1808539 Initial evaluation results of IMT-2020 self-evaluation for high mobility LG Electronics
R1-1808546 Initial self evaluation results for Dense Urban-eMBB UL spectrum efficiency Lenovo, Motorola Mobility
R1-1808709 Peak Data Rate and Peak Spectral Efficiency Evaluations for NR Intel Corporation
R1-1808710 Spectral Efficiency Evaluation for NR eMBB Intel Corporation
R1-1808711 Mobility Evaluation for NR eMBB Intel Corporation
R1-1808712 Area Traffic Capacity Evaluation for NR Indoor Hotspot eMBB Intel Corporation
R1-1808713 User Experienced Data Rate Evaluation for NR Dense Urban eMBB Intel Corporation
R1-1808714 Summary of Email Discussion on NR SLS Overhead Calculation for IMT-2020 Self-Evaluation Intel Corporation
R1-1808715 Link Budget for NR Intel Corporation
R1-1808716 Connection Density Evaluation for mMTC Intel Corporation
R1-1809708 Reliability Evaluation for URLLC Intel Corporation
Revision of R1-1808717
R1-1808791 Evaluation results of peak spectral efficiency and peak data rate for IMT-2020 submission Samsung
R1-1808792 Evaluation results of Indoor Hotspot-eMBB for IMT-2020 self-evaluation Samsung
R1-1808793 Evaluation results of Dense Urban-eMBB for IMT-2020 self-evaluation Samsung
R1-1808794 Evaluation results of Rural-eMBB for IMT-2020 self-evaluation Samsung
R1-1808795 Evaluation results of mobility for IMT-2020 submission Samsung
R1-1808847 Initial evaluation results for downlink eMBB spectrum efficiency CMCC
R1-1808848 Initial system evaluation results for mobility in eMBB scenario CMCC
R1-1808849 Initial system evaluation results for reliability in URLLC scenario CMCC

R1-1808850 Initial evaluation results for uplink eMBB spectrum efficiency CMCC
R1-1808851 Initial link-level self evaluation results for reliability in URLLC scenario CMCC
R1-1808852 Initial link-level self evaluation results for mobility in eMBB scenario CMCC
R1-1808855 Initial results of Dense Urban-eMBB for IMT-2020 self-evaluation China Telecommunications
R1-1808856 Initial results of Rural-eMBB for IMT-2020 self-evaluation China Telecommunications
R1-1808857 Updated results of Indoor Hotspot-eMBB for IMT-2020 self-evaluation China Telecommunications
R1-1808858 Link level performance for LDPC coding with BP decoder China Telecommunications
R1-1808864 Spectral Efficiency Results for the IMT-2020 Self-Evaluation Nokia, Nokia Shanghai Bell
R1-1808865 IMT-2020 Reliability Evaluation Results (URLLC) Nokia, Nokia Shanghai Bell
R1-1808866 IMT-2020 Connection Density Evaluation Results (mMTC) Nokia, Nokia Shanghai Bell
R1-1808867 IMT-2020 Link Budgets Nokia, Nokia Shanghai Bell
R1-1808883 Initial evaluation results for eMBB spectral efficiency for IMT-2020 Guangdong OPPO Mobile Telecom
R1-1808931 Summary of offline discussion on IMT-2020 self evaluation for peak spectral efficiency and peak data rate Huawei
R1-1808932 Summary of offline discussion on IMT-2020 self evaluation for network energy efficiency Huawei
R1-1808933 Summary of offline discussion on IMT-2020 self evaluation for UE energy efficiency Huawei
R1-1808934 Summary of offline discussion on IMT-2020 self evaluation for control plane latency Huawei
R1-1808935 Summary of offline discussion on IMT-2020 self evaluation for user plane latency Huawei
R1-1808936 Summary of offline discussion on IMT-2020 self evaluation for link budget Huawei
R1-1809514 Initial evaluation results for IMT2020 self-evaluation Reliability Sharp
Revision of R1-1809115
R1-1809166 Updated evaluation results of Indoor Hotspot-eMBB for IMT-2020 self-evaluation NTT DOCOMO, INC.
R1-1809167 Updated evaluation results of dense urban-eMBB for IMT-2020 self-evaluation NTT DOCOMO, INC.
R1-1809168 Updated evaluation results of rural-eMBB for IMT-2020 self-evaluation NTT DOCOMO, INC.
R1-1809169 Preliminary evaluation results of mobility for IMT-2020 self-evaluation NTT DOCOMO, INC.
R1-1809170 Preliminary evaluation results of connection density for IMT-2020 self-evaluation NTT DOCOMO, INC.
R1-1809171 Preliminary evaluation results of reliability for IMT-2020 self-evaluation NTT DOCOMO, INC.
R1-1809176 Discussion on NR link budget evaluation CHTTL
R1-1809497 Evaluation results of Indoor Hotspot-eMBB spectral efficiency for IMT-2020 self-evaluation ITRI
Revision of R1-1809187
R1-1809188 Evaluation results of Dense Urban-eMBB spectral efficiency for IMT-2020 self-evaluation ITRI
R1-1809189 Evaluation results of Rural-eMBB spectral efficiency for IMT-2020 self-evaluation ITRI
R1-1809260 An overview of the IMT-2020 Evaluations - LTE Ericsson
R1-1809261 An overview of the IMT-2020 Evaluations - NR Ericsson
R1-1809262 IMT-2020 self-evaluation: mMTC full buffer connection density Ericsson
R1-1809263 IMT-2020 self-evaluation: mMTC non-full buffer connection density for LTE-MTC and NB-IoT Ericsson
R1-1809264 IMT-2020 self-evaluation: Mobility evaluations for LTE Ericsson
R1-1809265 IMT-2020 self-evaluation: Mobility evaluations for NR Ericsson
R1-1809266 IMT-2020 Self-Evaluation: NR Link Budgets Ericsson
R1-1809267 IMT-2020 self-evaluation: On eMBB spectral efficiency - LTE Ericsson
R1-1809268 IMT-2020 self-evaluation: On eMBB spectral efficiency - NR Ericsson
R1-1809269 IMT-2020 self-evaluation: On eMBB user experienced data rate - NR Ericsson
R1-1809270 IMT-2020 self-evaluation: On eMBB area traffic capacity - NR Ericsson
R1-1809271 IMT-2020 self-evaluation: Peak data rate and peak spectrum efficiency evaluations for LTE Ericsson
R1-1809272 IMT-2020 self-evaluation: Peak data rate and peak spectrum efficiency evaluations for NR Ericsson
R1-1809273 IMT-2020 self-evaluation: Radio Network Energy Performance - LTE Ericsson
R1-1809274 IMT-2020 self-evaluation: Radio Network Energy Performance - NR Ericsson
R1-1809275 IMT-2020 self-evaluation: Reliability in NR Ericsson
R1-1809276 IMT-2020 self-evaluation: Reliability in LTE Ericsson
R1-1809277 IMT-2020 self-evaluation: UP latency in NR Ericsson

R1-1809278 IMT-2020 self-evaluation: UP latency in LTE Ericsson
R1-1809279 IMT-2020 self-evaluation: CP latency in NR Ericsson
R1-1809290 Self evaluation on peak spectral efficiency of FR1 towards IMT-2020 CAICT
R1-1809495 IMT-2020 Indoor Downlink Spectral Efficiency Results Motorola Mobility, Lenovo
Revision of R1-1809401
R1-1809461 IMT-2020 eMBB spectral efficiency evaluations Qualcomm Incorporated
R1-1809465 Rural-eMBB results for IMT-2020 self-evaluation CEWiT

7.2.8 Other

R1-1808252 On NR UE power saving vivo
R1-1808615 Power model for evaluating UE power saving techniques Apple Inc.
R1-1808718 On RS Enhancement to Support Multi-TRP Transmission Intel Corporation
R1-1808719 On UL/DL Beam Management Latency and Overhead Reduction Intel Corporation
R1-1808720 On SCell Beam Failure Recovery Intel Corporation
R1-1808721 On Interference-aware Beam Measurement and Reporting Intel Corporation
R1-1808853 Discussion on scenarios and enhancements for NR positioning CMCC
R1-1808949 Enhancements on CSI reporting and codebook design Huawei, HiSilicon
R1-1808950 Enhancements on Type II CSI for more than 2 layers Huawei, HiSilicon
R1-1809117 Enhancements on multi-TRP/panel transmission in NR Huawei, HiSilicon
R1-1809118 Discussion on multi-TRP/panel transmission for reliability and robustness in NR Huawei, HiSilicon
R1-1809119 Beam management enhancements for latency and overhead reduction Huawei, HiSilicon
R1-1809120 Discussion on BFR for Scell Huawei, HiSilicon
R1-1809121 Discussion on reciprocity based CSI acquisition to reduce CSI overhead Huawei, HiSilicon
R1-1809122 Discussion on panel-based UL beam selection Huawei, HiSilicon
R1-1809123 Beam measurement and reporting using L1-RSRQ and SINR Huawei, HiSilicon
R1-1809211 Why PAPR is important for BS transmitters Ericsson
R1-1809212 On PAPR issue for CSI-RS Ericsson
R1-1809213 On PAPR issue for DMRS Ericsson
R1-1809214 On signalling reduction for beam management Ericsson
R1-1809333 General considerations on UE power saving in Rel-16 Huawei, HiSilicon
R1-1809348 Considerations on NR positioning Huawei, HiSilicon
R1-1809415 On fast SRS precoder updation CEWiT
R1-1809462 Views on UE power saving Qualcomm Incorporated
R1-1809470 On BWP configuration for efficient spectrum utilization CEWiT

7.3 Other

R1-1808278 Modelling power consumption in NR modems MediaTek Inc.
R1-1808279 UE power consumption adaptation based on traffic type MediaTek Inc.
R1-1808284 View on NR positioning MediaTek Inc.
R1-1809416 Link and system level performance evaluation for NR-NTN THALES

8 Closing of the meeting

RAN1 chair commented that the number of CRs at RAN1#94 was higher than he expected, and thanked all the group for the efforts improving the quality of RAN1 specs.
Thanks to Vice-chairmen, including Kazuaki-san and Xiaoyi for chairing the parallel sessions, MCC for support and EF3 for hosting facilities.
Meeting was closed at 17:07.
See you all in Chengdu.

Annex A: List of Tdocs at RAN1 #94

Please see excel file attached to this report

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Annex B: List of CRs agreed at RAN1 #94

TS/TR	CR	rev	Rel	Title	Cat	Vsn	@ Mtg	TD#	Source to WG	Work Item
36.211	451	-	Rel-15	Introduction of eV2X	B	15.2.0	R1#94	R1-1808328	Ericsson	LTE_eV2X-Core
36.211	452	-	Rel-14	Correction for interference randomization for NB-IoT	F	14.7.0	R1#94	R1-1809535	Qualcomm Incorporated	NB_IOTenh-Core
36.211	453	-	Rel-15	Correction for interference randomization for NB-IoT	A	15.2.0	R1#94	R1-1809536	Qualcomm Incorporated	NB_IOTenh-Core
36.211	454	-	Rel-14	Correction to NPRS mapping	F	14.7.0	R1#94	R1-1809605	Huawei, HiSilicon, Qualcomm, Ericsson	NB_IOTenh-Core
36.211	455	-	Rel-15	Correction to NPRS mapping	A	15.2.0	R1#94	R1-1809606	Huawei, HiSilicon, Qualcomm, Ericsson	NB_IOTenh-Core
36.211	456	-	Rel-15	Correction on DL CP extension for FeLAA in 36.211	F	15.2.0	R1#94	R1-1809650	Huawei, HiSilicon	LTE_unlic-Core
36.211	457	-	Rel-15	Correction to determination of ending symbol for AUL transmissions	F	15.2.0	R1#94	R1-1809651	Nokia, Nokia Shanghai Bell, Ericsson, Huawei, HiSilicon	LTE_unlic-Core
36.211	458		Rel-14	Rate matching for aperiodic CSI-RS	F	14.7.0	R1#94	R1-1810015	Qualcomm Incorporated	LTE_eFDMIMO-Core
36.211	459		Rel-15	Rate matching for aperiodic CSI-RS	A	15.2.0	R1#94	R1-1810016	Qualcomm Incorporated	LTE_eFDMIMO-Core
36.211	460	-	Rel-15	Corrections to sTTI and SPT implementation	F	15.2.0	R1#94	R1-1810023	Ericsson	LTE_sTTIandPT-Core
36.211	461	-	Rel-15	Corrections to eMTC	F	15.2.0	R1#94	R1-1810030	Ericsson	LTE_eMTC4-Core
36.211	462	-	Rel-15	Corrections to NB-IoT	F	15.2.0	R1#94	R1-1810035	Ericsson	NB_IOTenh2-Core
36.211	463	-	Rel-15	Corrections to LTE HRLLC implementation	F	15.2.0	R1#94	R1-1810040	Ericsson	LTE_HRLLC-Core
36.212	297	1	Rel-15	Correction on the interpretation of HARQ-ACK bitmap for FeLAA in 36.212	F	15.2.1	R1#94	R1-1809577	Huawei, HiSilicon	LTE_unlic-Core
36.212	298	-	Rel-14	Correction on DCI for HARQ-ACK bundling	F	14.6.0	R1#94	R1-1809540	Qualcomm Incorporated	LTE_feMTC-Core
36.212	299	-	Rel-15	Correction on DCI for HARQ-ACK bundling	A	15.2.1	R1#94	R1-1809541	Qualcomm Incorporated	LTE_feMTC-Core
36.212	300	-	Rel-15	Correction on the partial PUSCH mode field for FeLAA in 36.212	F	15.2.1	R1#94	1-1809576	Huawei, HiSilicon	LTE_unlic-Core
36.212	301	-	Rel-15	Correction of RRC parameter name for 1024QAM rate matching	F	15.2.1	R1#94	R1-1809588	Qualcomm Incorporated	LTE_1024QAM_DL-Core
36.212	302	-	Rel-14	Corrections to modulation signalling in MUST	F	14.6.0	R1#94	R1-1809636	Intel Corporation	LTE_MUST-Core
36.212	303	-	Rel-15	Corrections to modulation signalling in MUST	A	15.2.1	R1#94	R1-1809637	Intel Corporation	LTE_MUST-Core
36.212	304	-	Rel-15	Corrections on shortened processing time and shortened TTI in 36.212	F	15.2.1	R1#94	R1-1810024	Huawei	LTE_sTTIandPT-Core
36.212	305	-	Rel-15	Corrections to Even further enhanced MTC for LTE	F	15.2.1	R1#94	R1-1810031	Huawei	LTE_eMTC4-Core
36.212	306	-	Rel-15	Corrections to Further Enhancements of NB-IoT	F	15.2.1	R1#94	R1-1810036	Huawei	NB_IOTenh2-Core
36.212	307	-	Rel-15	Corrections on HRLLC in 36.212	D	15.2.1	R1#94	R1-1810041	Huawei	LTE_HRLLC-Core
36.213	1118	-	Rel-15	Correction on CRI definition in 36.213	F	15.2.0	R1#94	R1-1808141	Huawei, HiSilicon	feCOMP_LTE-Core
36.213	1120	-	Rel-13	Correction on PUCCH format 4 HARQ-ACK procedure without adaptive codebook	F	13.10.0	R1#94	R1-1808594	Huawei, HiSilicon	LTE_CA_enh_b5C-Core
36.213	1121		Rel-13	PRG for eMTC	F	13.10.0	R1#94	R1-1809537	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.213	1122		Rel-14	PRG for eMTC	A	14.7.0	R1#94	R1-1809538	Qualcomm Incorporated	LTE_MTCe2_L1-Core

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36.213	1123		Rel-15	PRG for eMTC	A	15.2.0	R1#94	R1-1809539	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.213	1124	-	Rel-13	Correction on TDD HARQ-ACK reporting procedure for different UL/DL configurations	F	13.10.0	R1#94	R1-1809542	Huawei, HiSilicon	LTE_CA_enh_b5C-Core
36.213	1125	-	Rel-14	Correction on TDD HARQ-ACK reporting procedure for different UL/DL configurations	A	14.7.0	R1#94	R1-1809543	Huawei, HiSilicon	LTE_CA_enh_b5C-Core
36.213	1126	-	Rel-15	Correction on TDD HARQ-ACK reporting procedure for different UL/DL configurations	A	15.2.0	R1#94	R1-1809544	Huawei, HiSilicon	LTE_CA_enh_b5C-Core
36.213	1127	-	Rel-14	Correction on PUCCH format 4 HARQ-ACK procedure without adaptive codebook	A	14.7.0	R1#94	R1-1809545	Huawei, HiSilicon	LTE_CA_enh_b5C-Core
36.213	1128	-	Rel-15	Correction on PUCCH format 4 HARQ-ACK procedure without adaptive codebook	A	15.2.0	R1#94	R1-1809546	Huawei, HiSilicon	LTE_CA_enh_b5C-Core
36.213	1129	-	Rel-13	Correction to PDSCH RE mapping in TM10	F	13.10.0	R1#94	R1-1809547	Intel Corporation	LTE_EBF_FDMIMO-Core
36.213	1130	-	Rel-14	Correction to PDSCH RE mapping in TM10	A	14.7.0	R1#94	R1-1809548	Intel Corporation	LTE_EBF_FDMIMO-Core
36.213	1131	-	Rel-15	Correction to PDSCH RE mapping in TM10	A	15.2.0	R1#94	R1-1809549	Intel Corporation	LTE_EBF_FDMIMO-Core
36.213	1132		Rel-14	Correction on advanced CSI codebook	F	14.7.0	R1#94	R1-1809550	Qualcomm Incorporated	LTE_eFDMIMO-Core
36.213	1133		Rel-15	Correction on advanced CSI codebook	A	15.2.0	R1#94	R1-1809551	Qualcomm Incorporated	LTE_eFDMIMO-Core
36.213	1136	-	Rel-14	Corrections related to capabilities for SRS Carrier Switching	F	14.7.0	R1#94	R1-1809554	Qualcomm Incorporated	LTE_SRS_switch-Core
36.213	1137	-	Rel-15	Corrections related to capabilities for SRS Carrier Switching	A	15.2.0	R1#94	R1-1809555	Qualcomm Incorporated	LTE_SRS_switch-Core
36.213	1138	-	Rel-14	Capability for FeMBMS	F	14.7.0	R1#94	R1-1809556	Qualcomm Incorporated	MBMS_LTE_enh2-Core
36.213	1139	-	Rel-15	Capability for FeMBMS	A	15.2.0	R1#94	R1-1809557	Qualcomm Incorporated	MBMS_LTE_enh2-Core
36.213	1140	-	Rel-14	SRS transmission in UpPTS for special subframe configuration 10	F	14.7.0	R1#94	R1-1809558	Qualcomm Incorporated, Huawei, HiSilicon	LTE_UL_CAP_enh-Core
36.213	1141	-	Rel-15	SRS transmission in UpPTS for special subframe configuration 10	A	15.2.0	R1#94	R1-1809559	Qualcomm Incorporated, Huawei, HiSilicon	LTE_UL_CAP_enh-Core
36.213	1142	-	Rel-14	HARQ-ACK payload size determination for crs-less special subframe configuration 10	F	14.7.0	R1#94	R1-1809560	Qualcomm Incorporated	LTE_UL_CAP_enh-Core
36.213	1143	-	Rel-15	HARQ-ACK payload size determination for crs-less special subframe configuration 10	A	15.2.0	R1#94	R1-1809561	Qualcomm Incorporated	LTE_UL_CAP_enh-Core
36.213	1144	-	Rel-15	Correction on aperiodic CSI triggering for feCoMP in 36.213	F	15.2.0	R1#94	R1-1809586	Huawei, HiSilicon	feCOMP_LTE-Core
36.213	1145	1	Rel-15	Corrections related to modulation enhancements	F	15.2.0	R1#94	R1-1809608	Qualcomm Incorporated	TEI15
36.213	1146	-	Rel-15	Applicability of 1024QAM to SPS C-RNTI	F	15.2.0	R1#94	R1-1809589	Qualcomm Incorporated	LTE_1024QAM_DL-Core
36.213	1147	-	Rel-15	Removal of R_CSI from 1024QAM CQI table	F	15.2.0	R1#94	R1-1809590	Qualcomm Incorporated	LTE_1024QAM_DL-Core
36.213	1148	-	Rel-14	Clarification for antenna selection	F	14.7.0	R1#94	R1-1809638	Qualcomm incorporated	LTE-Phys, TEI14
36.213	1149	-	Rel-15	Clarification for antenna selection	A	15.2.0	R1#94	R1-1809639	Qualcomm incorporated	LTE-Phys, TEI14

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36.213	1150	-	Rel-12	Change request on UE transmit antenna selection	F	12.12.0	R1#94	R1-1809640	CMCC	LTE_UL_MIMO-Core, TEI12
36.213	1151	-	Rel-13	Change request on UE transmit antenna selection	A	13.10.0	R1#94	R1-1809641	CMCC	LTE_UL_MIMO-Core, TEI12
36.213	1152	-	Rel-14	Change request on UE transmit antenna selection	A	14.7.0	R1#94	R1-1809642	CMCC	LTE_UL_MIMO-Core, TEI12
36.213	1153	-	Rel-15	Change request on UE transmit antenna selection	A	15.2.0	R1#94	R1-1809643	CMCC	LTE_UL_MIMO-Core, TEI12
36.213	1154	-	Rel-15	Change request on 1T2R antenna switching of SRS	B	15.2.0	R1#94	R1-1809644	CMCC	TEI15
36.213	1155	-	Rel-15	Correction to AUL-UCI resource allocation in 36.213	F	15.2.0	R1#94	R1-1809652	Nokia, Nokia Shanghai Bell	LTE_unlic-Core
36.213	1156	-	Rel-15	Correction for HARQ-ACK delay in eMTC	F	14.7.0	R1#94	R1-1809653	Qualcomm Incorporated, Ericsson	LTE_feMTC-Core
36.213	1157	-	Rel-15	Correction for HARQ-ACK delay in eMTC	A	15.2.0	R1#94	R1-1809654	Qualcomm Incorporated, Ericsson	LTE_feMTC-Core
36.213	1158	-	Rel-15	Corrections for shortened processing time and shortened TTI in 36.213, s00-s05	F	15.2.0	R1#94	R1-1810025	Motorola Mobility	LTE_sTTIandPT-Core
36.213	1159	-	Rel-15	Corrections for shortened processing time and shortened TTI in 36.213, s06-s07	F	15.2.0	R1#94	R1-1810026	Motorola Mobility	LTE_sTTIandPT-Core
36.213	1160	-	Rel-15	Corrections for shortened processing time and shortened TTI in 36.213, s08-s09	F	15.2.0	R1#94	R1-1810027	Motorola Mobility	LTE_sTTIandPT-Core
36.213	1161	-	Rel-15	Corrections for shortened processing time and shortened TTI in 36.213, s10-s13	F	15.2.0	R1#94	R1-1810028	Motorola Mobility	LTE_sTTIandPT-Core
36.213	1162	-	Rel-15	Correction to V2X Phase 2 based on LTE in 36.213, s14	F	15.2.0	R1#94	R1-1810029	Motorola Mobility	LTE_eV2X-Core
36.213	1163	-	Rel-15	Corrections to even further enhanced MTC for LTE in 36.213, s00-s05	F	15.2.0	R1#94	R1-1810032	Motorola Mobility	LTE_eMTC4-Core
36.213	1164	-	Rel-15	Corrections to even further enhanced MTC for LTE in 36.213, s06-s07	F	15.2.0	R1#94	R1-1810033	Motorola Mobility	LTE_eMTC4-Core
36.213	1165	-	Rel-15	Corrections to even further enhanced MTC for LTE in 36.213, s08-s09	F	15.2.0	R1#94	R1-1810034	Motorola Mobility	LTE_eMTC4-Core
36.213	1166	-	Rel-15	Editorial corrections to Rel-15 Further NB-IoT enhancements in 36.213, s2	D	15.2.0	R1#94	R1-1810037	Motorola Mobility	NB_IOTenh2-Core
36.213	1167	-	Rel-15	Corrections to Rel-15 Further NB-IoT enhancements in 36.213, s14	F	15.2.0	R1#94	R1-1810038	Motorola Mobility	NB_IOTenh2-Core
36.213	1168	-	Rel-15	Corrections to HRLLC in 36.213, s00-s05	F	15.2.0	R1#94	R1-1810042	Motorola Mobility	LTE_HRLLC-Core
36.213	1169	-	Rel-15	Corrections to HRLLC in 36.213, s06-s07	F	15.2.0	R1#94	R1-1810043	Motorola Mobility	LTE_HRLLC-Core
36.213	1170	-	Rel-15	Corrections to HRLLC in 36.213, s08-s09	F	15.2.0	R1#94	R1-1810044	Motorola Mobility	LTE_HRLLC-Core
36.213	1171	-	Rel-15	Corrections to even further enhanced MTC for LTE in 36.213, s14-sxx	F	15.2.0	R1#94	R1-1810045	Motorola Mobility	LTE_eMTC4-Core
36.214	51	-	Rel-15	Introduction of NR-SS-SINR	B	15.2.0	R1#94	R1-1809249	Ericsson	NR_newRAT-Core
36.214	52	-	Rel-15	Introduction of NPBCH based NRSRP measurement	F	15.2.0	R1#94	R1-1810039	Ericsson	NB_IOTenh2-Core

TS/TR	CR	rev	Rel	Title	Cat	Vsn	@ Mtg	TD#	Source to WG	Work Item
37.213	1	1	Rel-15	Correction on RRC parameters for FeLAA in 37.213	F	15.0.0	R1#94	R1-1809622	Huawei, HiSilicon, Nokia, Nokia Shanghai Bell, Ericsson	LTE_unlic-Core
37.213	2	-	Rel-15	Correction on starting position of Partial PUSCH Mode 1 for FeLAA in 37.213	F	15.0.0	R1#94	R1-1809647	Huawei, HiSilicon, Ericsson	LTE_unlic-Core
37.213	3	-	Rel-15	Correction on COT length for AUL transmission	F	15.0.0	R1#94	R1-1809648	LG Electronics	LTE_unlic-Core
37.885	1	2	Rel-15	Correction of optional antenna element patterns for vehicular UEs	F	15.0.0	R1#94	R1-1809924	Fraunhofer HHI, Fraunhofer IIS, General Motors, Nokia, Nokia Shanghai Bell, LG Electronics	FS_LTE_NR_V2X_eval
37.885	2	1	Rel-15	Correction and confirmation of some evaluation assumption parameters	F	15.0.0	R1#94	R1-1810007	LG Electronics	FS_LTE_NR_V2X_eval
38.202	4	-	Rel-15	CR to 38.202 capturing the RAN1#94 meeting agreements	F	15.2.0	R1#94	R1-1810017	Qualcomm	NR_newRAT-Core
38.211	3	-	Rel-15	CR to 38.211 capturing the RAN1#94 meeting agreements	F	15.2.0	R1#94	R1-1810018	Ericsson	NR_newRAT-Core
38.212	4	-	Rel-15	CR to 38.212 capturing the RAN1#94 meeting agreements	F	15.2.0	R1#94	R1-1810019	Huawei	NR_newRAT-Core
38.213	5	-	Rel-15	CR to 38.213 capturing the RAN1#94 meeting agreements	F	15.2.0	R1#94	R1-1810020	Samsung	NR_newRAT-Core
38.214	5	-	Rel-15	CR to 38.214 capturing the RAN1#94 meeting agreements	F	15.2.0	R1#94	R1-1810021	Nokia	NR_newRAT-Core
38.215	4	-	Rel-15	CR to 38.215 capturing the RAN1#94 meeting agreements	F	15.2.0	R1#94	R1-1810022	Intel	NR_newRAT-Core

Annex C-1: List of Outgoing LSs from RAN1 #94

TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-1809609	LS on Restriction of 1024QAM CSI reporting	RAN1, Nokia, Nokia Shanghai Bell	Rel-15	LTE_1024QAM_DL-Core, LTE_sTTIandPT-Core		RAN2			
R1-1809617	LS on UE feature list	RAN1, NTT DOCOMO, INC	Rel-15	TEI15		RAN2, RAN4	RAN3		
R1-1809679	LS on additional RRC parameters for Rel-15 NB-IoT	RAN1, Huawei, HiSilicon	Rel-15	NB_IOTenh2-Core		RAN2			
R1-1809681	LS on UL PRB to DL PRB center offset for TDD NB-IoT	RAN1, Ericsson	Rel-15	NB_IOTenh2-Core		RAN4	RAN2		
R1-1809687	LS on sTTI	RAN1, Ericsson	Rel-15	LTE_sTTIandPT-Core		RAN2			
R1-1809689	LS on RRC parameter for NPBCH based measurements	RAN1, Qualcomm	Rel-15	NB_IOTenh2-Core		RAN2			
R1-1809691	LS on HRLLC	RAN1, Ericsson	Rel-15	LTE_HRLLC-Core		RAN2			
R1-1809760	Reply LS on short message transmission using DCI	RAN1, Huawei	Rel-15	NR_newRAT-Core	R2-1810937	RAN2			
R1-1809774	LS on search space configuration for DCI format 2_0	RAN1, Qualcomm	Rel-15	NR_newRAT-Core		RAN2			
R1-1809810	Reply LS on active DL BWPs overlapping/non-overlapping with initial DL BWP	RAN1, MediaTek	Rel-15	NR_newRAT-Core	R2-1810968	RAN2			
R1-1809812	Response LS on additional TDD configuration periodicities	RAN1, Nokia, Nokia Shanghai Bell, SPRINT Corporation	Rel-15	NR_newRAT-Core	R2-1810963	RAN2	RAN4		
R1-1809850	LS response on overlapping SIB1 and SI messages	RAN1, Samsung	Rel-15	NR_newRAT-Core	R2-1810936	RAN2			
R1-1809853	LS on second BLER pair for RLM	RAN1, Ericsson	Rel-15	NR_newRAT-Core		RAN4			
R1-1809886	LS on power control for NR(FR1) - NR(FR2) dual connectivity	RAN1, Ericsson	Rel-15	NR_newRAT-Core		RAN4			
R1-1809887	Reply LS on termination of contention-free BFR	RAN1, MediaTek	Rel-15	NR_newRAT-Core	R2-1810807	RAN2			
R1-1809888	LS on maximum number of TCI states	RAN1, Ericsson	Rel-15	NR_newRAT-Core		RAN2			
R1-1809889	Reply LS on UE power class and UE capability on SRS carrier switch	RAN1, Huawei	Rel-15	NR_newRAT-Core	R2-1809180	RAN2, RAN4			
R1-1809890	LS on UE behaviour on reception of channels or RS in the same OFDM symbol	RAN1, Intel	Rel-15	NR_newRAT-Core		RAN4			
R1-1809907	LS on support of unicast, groupcast, and broadcast	RAN1, LG Electronics	Rel-16	FS_NR_V2X		RAN2, SA2			
R1-1809958	Reply LS on ssb-PositionsInBurst mismatch in SIB1 and ServingcellConfigCommon	RAN1, Ericsson	Rel-15	NR_newRAT-Core	R2-1810976	RAN2			

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TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-1809960	LS on density parameter for CSI-RS-ResourceConfigMobility	RAN1, Intel	Rel-15	NR_newRAT-Core		RAN2			
R1-1809965	Reply LS on Further Agreements on Paging Occasions	RAN1, Huawei	Rel-15	NR_newRAT-Core	R2-1810954	RAN2			
R1-1809966	LS on DCI format 2_3	RAN1, NTT DOCOMO	Rel-15	NR_newRAT-Core		RAN2			
R1-1809971	Reply LS on PDCCH common search space configurations	RAN1, NTT DOCOMO	Rel-15	NR_newRAT-Core	R2-1808992	RAN2			
R1-1809982	LS on K1 Slot Offset	RAN1, Qualcomm	Rel-15	NR_newRAT-Core		RAN2			
R1-1809987	LS on NR-RIM frameworks	RAN1, CMCC	Rel-16	FS_NR_RIM		RAN3			
R1-1809991	LS on Text Proposal to 38.300 for URLLC	RAN1, Ericsson	Rel-15	NR_newRAT-Core		RAN2			
R1-1809992	LS on NR-LTE coexistence	RAN1, Intel, LG Electronics	Rel-15	NR_newRAT-Core		RAN2, RAN4			
R1-1809993	LS on the number of CQI reports	RAN1, Intel	Rel-15	NR_newRAT-Core		RAN2			
R1-1810002	LS on bandwidth configuration for initial BWP	RAN1, MediaTek	Rel-15	NR_newRAT-Core		RAN2			
R1-1810004	LS on UE capability for simultaneousTxSUL-NonSUL	RAN1, Huawei	Rel-15	NR_newRAT-Core		RAN2	RAN4		
R1-1810005	LS on new UE features list for NR	RAN1, NTT DOCOMO, AT&T	Rel-15	NR_newRAT-Core		RAN, RAN2, RAN4			
R1-1810006	LS on IBE model for V2X	RAN1, Ericsson	Rel-16	FS_NR_V2X		RAN4			
R1-1810008	LS on collision of RRM measurement resources with uplink transmissions in FR1 TDD	RAN1, vivo	Rel-15	NR_newRAT-Core		RAN4			
R1-1810009	LS on cross-carrier scheduling	RAN1, NTT DOCOMO	Rel-15	NR_newRAT-Core		RAN2			
R1-1810010	LS on higher layer configuration for search space monitoring	RAN1, NTT DOCOMO	Rel-15	NR_newRAT-Core		RAN2			

Annex C-2: List of Incoming LSs from RAN1 #94

TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-1808003	LS on the feasibility of 1 symbol GP for 60KHz in FR1 and 120KHz in FR2	RAN4, MediaTek	Rel-15	NR_newRAT-Core		RAN1	RAN2	R4-1806541	
R1-1808004	LS on RMSI CORESET configuration for a band with 15kHz SSB SCS and 10MHz minimum channel bandwidth	RAN4, CATT, Samsung	Rel-15	NR_newRAT-Core		RAN1	RAN2	R4-1808263	
R1-1808005	LS response on NB-IoT downlink channel quality determination and report	RAN4, Ericsson	Rel-14	NB_IOT-Core, TEI14	R1-1803163	RAN1, RAN2		R4-1807937	
R1-1808006	Reply LS on updates for TS 36.300	RAN3, Huawei	Rel-15	NB_IOTenh2-Core, LTE_eMTC4-Core	R2-1808848	RAN2	RAN1	R3-183572	
R1-1808007	LS on NR Cell Information signalled over X2 for EN-DC	RAN3, Ericsson	Rel-15	5GS_Ph1		RAN1, RAN2, RAN4		R3-183569	
R1-1808008	Additional Reply LS on eV2X evaluation methodology	SAE C-V2X TC Advanced Applications Task-Force, AT&T	Rel-15	FS_LTE_NR_V2X_eval	R1-1719239	RAN, RAN1, SA1		SAE C-V2X AA TF additional Reply LS 05282018	
R1-1808009	LS reply on UL timing difference in EN-DC	RAN4, Intel Corporation	Rel-15	NR_newRAT-Core	R2-1804102	RAN2	RAN1	R4-1806315	
R1-1808011	Reply LS on Narrowband measurement accuracy improvements	RAN4, Huawei	Rel-15	NB_IOTenh2-Core	R1-1805434	RAN1	RAN2	R4-1807328	
R1-1808013	LS on eFeMTC CRS muting	RAN4, Huawei	Rel-15	LTE_eMTC4-Core		RAN2	RAN1	R4-1808032	
R1-1808014	LS on 2RX requirements for vehicle mounted NR UE	RAN4, LG Electronics	Rel-15	NR_newRAT-Core		RAN	RAN1	R4-1808188	
R1-1808015	RAN4 response LS on Coexistence of NR-NR and NR-LTE networks	RAN4, Qualcomm Incorporated	Rel-15	NR_newRAT-Core	R4-1806116	RAN	RAN1	R4-1808253	
R1-1808017	LS on UE feature list	RAN4, NTT DOCOMO, Intel	Rel-15	NR_newRAT-Core		RAN1, RAN2	RAN3	R4-1808535	
R1-1808018	LS reply on Coexistence of NR-NR and NR-LTE networks with synchronised, unsynchronised and	RAN, Huawei	Rel-15	NR_newRAT	CEPT_ECC_PT1_LS_180420	CEPT ECC PT1	RAN1, RAN4	RP-181389	

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TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
	semi-synchronised operation in 3400-3800 MHz								
R1-1808019	LS reply on minimum number of RX antennae for NR vehicular Ues	RAN, Samsung (Harman)	Rel-15	NR_newRAT	5GAA_A-180148	5GAA, 5GAA WG2	RAN1, RAN4	RP-181468	
R1-1808020	LS on NR UE feature list	RAN, NTT DOCOMO	Rel-15	NR_newRAT-Core	R1-1807896, R2-1809153, R4-1808552	RAN1, RAN2, RAN4	RAN3	RP-181484	
R1-1808021	LS on L2 measurement specification for NR in R15	SA5, Ericsson	Rel-15	NETSLICE-ADPM5G		RAN2, RAN3	RAN1	S5-184337	
R1-1808022	Wi-Fi Alliance Coexistence Test Plan for LTE-LAA Version 1.1.10	Wi-Fi Alliance	Rel-13	LTE_LAA	RP-172843	RAN, RAN4, RAN1	IEEE 802.11 WG	20180615 Wi-Fi Alliance Coexistence Test Plan for LTE-LAA v1.1.10	
R1-1808023	Reply LS on PSCCH/PSSCH subframe numbering issue in partial network coverage	RAN2, Ericsson	Rel-14	LTE_V2X-Core	R1-1803078	RAN1		R2-1808901	
R1-1808024	Reply LS on narrowband measurement	RAN2, Huawei	Rel-15	NB_IOTenh2-Core	R4-1805950	RAN4, RAN1		R2-1809096	
R1-1808025	Reply LS on RMSI CORESET configuration for a band with 15kHz SSB SCS and 10MHz minimum channel bandwidth	RAN2, CATT	Rel-15	NR_newRAT-Core	R1-1805712	RAN1	RAN4	R2-1809134	
R1-1808026	Reply LS on PC5 transmission mechanism selection	RAN2, LG Electronics	Rel-15	LTE_eV2X-Core	S2-183968	SA2	RAN1	R2-1809166	
R1-1808027	Reply LS to RAN1 on RRC parameters for V2X Phase 2	RAN2, LG Electronics	Rel-15	LTE_eV2X-Core	R1-1805620	RAN1	SA2	R2-1809167	
R1-1808028	Reply LS on Agreements on Paging	RAN2, Qualcomm	Rel-15	NR_newRAT-Core	R1-1801280	RAN1		R2-1809174	
R1-1808029	Reply LS on UE power class and UE capability on SRS carrier switch	RAN2, NTT DOCOMO	Rel-15	NR_newRAT-Core	R4-1805929, R4-1805660	RAN4, RAN1		R2-1809180	
R1-1808030	LS on RAN2 progress on ANR	RAN2, vivo	Rel-15	NR_newRAT-Core		RAN3, RAN4	RAN1, SA5	R2-1809226	
R1-1808031	Reply LS on CP latency reduction	RAN2, Ericsson	Rel-15	TEI15	RP-172840	RAN	RAN1	R2-1809244	
R1-1808032	LS on final RAN2 agreements for euCA	RAN2, Nokia	Rel-15	LTE_euCA-Core		RAN1, RAN4		R2-1809271	
R1-1808166	LS on termination of contention-free BFR	RAN2, Intel	Rel-15	NR_newRAT-Core		RAN1		R2-1810807	

TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-1808167	Reply LS on numberOfRA-PreamblesGroupA	RAN2, Nokia	Rel-15	NR_newRAT-Core	R1-1807764	RAN1		R2-1810894	
R1-1808168	LS on overlapping SIB1 and SI messages	RAN2, Ericsson	Rel-15	NR_newRAT-Core		RAN1		R2-1810936	
R1-1808169	LS on short message transmission using DCI	RAN2, Ericsson	Rel-15	NR_newRAT-Core		RAN1		R2-1810937	
R1-1808170	Reply LS on NR Cell Information signalled over X2 for EN-DC	RAN2, Ericsson	Rel-15	NR_newRAT-Core	R3-183569	RAN3	RAN1, RAN4	R2-1810942	
R1-1808171	Reply LS on Bandwidth configuration for initial BWP	RAN2, NTT DOCOMO	Rel-15	NR_newRAT-Core	R1-1807873	RAN1	RAN4	R2-1810943	
R1-1808172	LS on Further Agreements on Paging Occasions	RAN2, Qualcomm	Rel-15	NR_newRAT-Core		RAN1		R2-1810954	
R1-1808173	LS on additional TDD configuration periodicities	RAN2, Nokia	Rel-15	NR_newRAT-Core		RAN1	RAN4	R2-1810963	
R1-1808174	LS on Active DL BWPs overlapping/non-overlapping with Initial DL BWP	RAN2, ZTE	Rel-15	NR_newRAT-Core	R1-1807893	RAN1	RAN4	R2-1810968	
R1-1808175	LS on RA preambles mapping to SSBs	RAN2, ZTE	Rel-15	NR_newRAT-Core		RAN1		R2-1810969	
R1-1808176	LS on clarification of useServingCellTimingForSync	RAN4, MediaTek	Rel-15	NR_newRAT-Core		RAN1, RAN2		R4-1809409	
R1-1808177	LS on potential enhancement of DR-mode of operation	SA2, Intel	Rel-16			RAN2	RAN1, RAN4	S2-187629	
R1-1808178	LS on the transmission of video over PC5 interface	SA4, Samsung	Rel-15	FS_mV2X		RAN2	RAN1, SA1	S4-180980	
R1-1808179	LS on Joint ETSI - OSA Workshop: Open Implementations & Standardization	ETSI				RAN, RAN1, RAN2, RAN3, RAN4, RAN5, CT, CT1, CT3, CT4, CT6, SA, SA3, SA5, SA6		ETSI_CL18_3463	
R1-1808180	IEEE 802.11 WG LS to 3GPP RAN4 on certain channel combinations for LAA in 5GHz	IEEE 802.11 Working Group	Rel-13	LTE_LAA		RAN4	RAN1	2018-07-13-LS from IEEE	

TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
								802.11 to 3GPP RAN4	
R1-1808181	IEEE 802.11 WG LS to 3GPP RAN in relation to a proposed joint Coexistence Workshop	IEEE 802.11 Working Group	Rel-15	FS_NR_unlic		RAN	RAN1	2018-07-13-LiS from IEEE 802.11 to 3GPP-coex-workshop	
R1-1808303	Liaison ESOA (EMEA Satellite Operators Association) on 5G for Satellite Systems	ESOA, Thales	Rel-16			SA1, SA2, RAN1, RAN2, RAN3	SA, RAN	ESOA-LS-2018-1	
R1-1808859	LS on fallback interpretation of UE FeatureSetDown(Up)LinkPerCC capability fields	RAN2, Intel	Rel-15	NR_newRAT-Core		RAN1, RAN4		R2-1810975	
R1-1808860	LS on ssb-PositionsInBurst mismatch in SIB1 and ServingcellConfigCommon	RAN2, vivo	Rel-15	NR_newRAT-Core		RAN1		R2-1810976	
R1-1809720	LS on Prioritised Use Cases and Requirements for consideration in Rel-16 NR-V2X	5GAA WG1	Rel-16	FS_NR_V2X		RAN1, RAN2, SA1	5GAA WG2, 5GAA WG4, RAN, RAN3, SA2	5GAA_T-180181	
R1-1809876	LS on OSI acquisition	RAN2, Qualcomm	Rel-15	NR_newRAT-Core		RAN1		R2-1813326	
R1-1809892	LS on default configuration for L1 parameter	RAN2, NTT DOCOMO	Rel-15	NR_newRAT-Core		RAN1		R2-1813319	
R1-1809942	LS on UE capability for simultaneousTxSUL-NonSUL	RAN2, Huawei	Rel-15	NR_newRAT-Core		RAN1	RAN4	R2-1813366	
R1-1809948	LS response on NPBCH-based RRM measurement for FeNB-IoT UE	RAN4, Qualcomm	Rel-15	NB_IOTenh2-Core		RAN1, RAN2			
R1-1810001	Reply LS on SRS carrier switching	RAN4, Huawei	Rel-15	NR_newRAT-Core		RAN1, RAN2			

Annex D: **List of Approved updated WIDs**

None

Annex E: List of draft TSs/TRs agreed at RAN1 #94

Tdoc Number	Title	Source	Conclusion/Decision
R1-1808150	Text proposal to capture agreements made in RAN1#93 to TR 38.812 (NOMA)	ZTE	Endorsed as v0.0.3
R1-1808942	TR for Study on NR V2X	Huawei, HiSilicon	Endorsed as v0.0.0
R1-1809795	TR 38.889 v0.0.3 Study on NR-based access to unlicensed spectrum	Qualcomm	Endorsed as v0.0.3
R1-1809861	Draft skeleton of TR 38.824: Study on physical layer enhancements for NR URLLC	Huawei, HiSilicon	Endorsed as v0.0.0
R1-1809872	Draft skeleton of TR 38.866 Study on remote interference management for NR	CMCC	Endorsed as v0.0.0
R1-1810046	TR 38.812 (NOMA) v0.1.0	ZTE	Created by MCC as baseline for further updates - aiming at one step approval in RAN#82 (Dec. 2018)
R1-1810047	TR 38.889 v0.1.0 Study on NR-based access to unlicensed spectrum	Qualcomm	Created by MCC as baseline for further updates - aiming at one step approval in RAN#82 (Dec. 2018)

Annex F: List of actions

- **Outgoing LS**
- **CR approval**

[94-LTE-01-spec#] for 6.1.2 Maintenance of Release 15 Shortened TTI and processing time for LTE LTE_sTTIandPT-Core
Done: According to the decision posted on Sept 5th, the following CRs are agreed:

R1-1810023	Corrections to sTTI and SPT implementation	Ericsson	36.211	15.2.0	CR0460, F			
R1-1810024	Corrections on shortened processing time and shortened TTI in 36.212	Huawei	36.212	15.2.0	CR0304, F			
R1-1810025	Corrections for shortened processing time and shortened TTI in 36.213, s00-s05	Motorola Mobility	36.213	15.2.0	CR1158, F			
R1-1810026	Corrections for shortened processing time and shortened TTI in 36.213, s06-s07	Motorola Mobility	36.213	15.2.0	CR1159, F			
R1-1810027	Corrections for shortened processing time and shortened TTI in 36.213, s08-s09	Motorola Mobility	36.213	15.2.0	CR1160, F			
R1-1810028	Corrections for shortened processing time and shortened TTI in 36.213, s10-s13	Motorola Mobility	36.213	15.2.0	CR1161, F			

[94-LTE-02-spec#] for 6.1.3 Maintenance of Release 15 3GPP V2X Phase 2 LTE_eV2X-Core
Done: According to the decision posted on Sept 5th, the following CR is agreed:

R1-1810029	Correction to V2X Phase 2 based on LTE in 36.213, s14	Motorola Mobility	36.213	15.2.0	CR1162, F			

[94-LTE-03-spec#] for 6.1.4 Maintenance of Release 15 Even further enhanced MTC for LTE LTE_eMTC4-Core
Done: According to the decision posted on Sept 5th, the following CRs are agreed:

R1-1810030	Corrections to eMTC	Ericsson	36.211	15.2.0	CR0461, F			
R1-1810031	Corrections to Even further enhanced MTC for LTE	Huawei	36.212	15.2.0	CR0305, F			
R1-1810032	Corrections to even further enhanced MTC for LTE in 36.213, s00-s05	Motorola Mobility	36.213	15.2.0	CR1163, D			
R1-1810033	Corrections to even further enhanced MTC for LTE in 36.213, s06-s07	Motorola Mobility	36.213	15.2.0	CR1164, F			
R1-1810034	Corrections to even further enhanced MTC for LTE in 36.213, s08-s09	Motorola Mobility	36.213	15.2.0	CR1165, F			
R1-1810045	Corrections to even further enhanced MTC for LTE in 36.213, s14-sxx	Motorola Mobility	36.213	15.2.0	CR1171, F			

[94-LTE-04-spec#] for 6.1.5 Maintenance of Release 15 Further enhancements of NB-IoT NB_IOTenh2-Core
Done: According to the decision posted on Sept 5th, the following CRs are agreed:

R1-1810035	Corrections to NB-IoT	Ericsson	Rel-15	36.211	15.2.0	CR0462, F		
R1-1810036	Corrections to Further Enhancements of NB-IoT	Huawei	Rel-15	36.212	15.2.0	CR0306, F		
R1-1810037	Editorial corrections to Rel-15 Further NB-IoT enhancements in 36.213, s2	Motorola Mobility	Rel-15	36.213	15.2.0	CR1166, D		

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R1-1810038	Corrections to Rel-15 Further NB-IoT enhancements in 36.213, s14	Motorola Mobility	Rel-15	36.213	15.2.0	CR1167, F
R1-1810039	Introduction of NPBCH based NRSRP measurement	Ericsson	Rel-15	36.214	15.2.0	CR0052, F

[94-LTE-05-spec#] for 6.1.6 Maintenance of Release 15 Ultra Reliable Low Latency Communication for LTE LTE_HRLLC-Core

Done: According to the decision posted on Sept 5th, the following CRs are agreed:

R1-1810040	Corrections to LTE HRLLC implementation	Ericsson	Rel-15	36.211	15.2.0	CR0463, F
R1-1810041	Corrections on HRLLC in 36.212	Huawei	Rel-15	36.212	15.2.0	CR0307, D
R1-1810042	Corrections to HRLLC in 36.213, s00-s05	Motorola Mobility	Rel-15	36.213	15.2.0	CR1168, F
R1-1810043	Corrections to HRLLC in 36.213, s06-s07	Motorola Mobility	Rel-15	36.213	15.2.0	CR1169, F
R1-1810044	Corrections to HRLLC in 36.213, s08-s09	Motorola Mobility	Rel-15	36.213	15.2.0	CR1170, F

[94-LTE-06] – Alberto (Qualcomm)

R1-1808997 **Rate matching for A-CSI-RS** **Qualcomm Incorporated**

Email approval till August 31st

Done: According to the decision posted on Sept 1st, the following is agreed:

Agreements

- The draft CR in R1-1808997 is endorsed. Final CRs are agreed in R1-1810015 (36.211 CR0458, Rel-14, F) and R1-1810016 (36.211 CR0459, Rel-15, A).
- NOTE: For the scenario treated in R1-1808997, the UE may not perform puncturing (e.g. zero out LLRs) in REs that are not covered by the ZP CSI-RS ~~in the downlink DCI~~ but are indicated to be used for aperiodic NZP CSI-RS in the uplink DCI.

[94-NR-01-spec#]

Editors to prepare CRs incorporating the TPs/agreements/work assumptions by August 30th , to be commented and endorsed by Sept. 4th

Done: According to the decision posted on Sept 5th, the following CRs are agreed:

R1-1810017	CR to 38.202 capturing the RAN1#94 meeting agreements	Qualcomm	Rel-15	38.202	15.2.0	NR_newRAT-Core	CR0004, F
R1-1810018	CR to 38.211 capturing the RAN1#94 meeting agreements	Ericsson	Rel-15	38.211	15.2.0	NR_newRAT-Core	CR0003, F
R1-1810019	CR to 38.212 capturing the RAN1#94 meeting agreements	Huawei	Rel-15	38.212	15.2.0	NR_newRAT-Core	CR0004, F
R1-1810020	CR to 38.213 capturing the RAN1#94 meeting agreements	Samsung	Rel-15	38.213	15.2.0	NR_newRAT-Core	CR0005, F
R1-1810021	CR to 38.214 capturing the RAN1#94 meeting agreements	Nokia	Rel-15	38.214	15.2.0	NR_newRAT-Core	CR0005, F
R1-1810022	CR to 38.215 capturing the RAN1#94 meeting agreements	Intel	Rel-15	38.215	15.2.0	NR_newRAT-Core	CR0004, F

- **Miscellaneous**

[94-NR-02] – Li (ZTE)

NOMA: Companies to provide more detailed description of the proposed scheme (to the extent that solid simulations can be performed) by email by 8/28, and to be commented by 8/31. These schemes are to be captured in R1-1809844

Done: According to decision posted on Sept.6th, simulations can be carried out based on the proposed NOMA schemes in:
R1-1809844 Email discussion to collect detailed description of the NOMA schemes ZTE

[94-NR-03] – Li (ZTE)
NOMA: Email discussion on SLS calibration and templates for collecting the SLS evaluation results, by 09/07
Done: According to decision posted on Sept.18th, the following is agreed:
Agreements:

- **Adopt the calibration results in Section 2 (as in R1-1810048), to be captured in TR38.812.**
  - **Calibration results can be further updated as necessary.**
- **Adopt the companion spreadsheet (as in R1-1810048) as the template for the collection of SLS evaluation results.**

Agreements:

- **Companies are encouraged to report the PDF of multiplexed UEs per transmission duration (e.g. duration of a slot/mini-slot) at the PAR corresponding to the target system operation point, i.e.,**
  - **For mMTC and eMBB scenarios:**
    - **PDF of multiplexed UEs per transmission duration at the system PAR corresponding to the 1% system PDR.**
  - **For URLLC scenario:**
    - **PDF of multiplexed UEs per transmission duration at the per UE PAR corresponding to the 95% satisfied ratio.**
  - **FFS how to use the PDF for performance evaluations**
  - **Other evaluation methodologies for studying the practical number of NOMA UEs multiplexed in the same PRBs taking inter-cell interference and per UE performance into account are not precluded.**

[94-NR-04] – Hanbyul (LGE)
V2X: RAN1 to have an email discussion until the next meeting to complement the existing simulation assumptions, using R1-1809950 and R1-1809944 (traffic model) at a starting point
Done: Progress to be checked in RAN1#94bis meeting.

[94-NR-05] – Hua (CMCC)
RIM: Email discussion on additional simulation assumption for RIM till 9/7
Done: According to decision posted on Sept.18th, a summary (R1-1810049) captures the following agreements:
Agreements:

- For channel model: Option 1 is mandatory for RS comparison. Companies are also encouraged to provide results using Option 2 with K_factor = 22 dB, DS=30 ns, Doppler 0 Hz.
- For delay of received RS: Clarify that the arrival time of each RS is generated at least in the resolution of sample duration of the OFDM symbol.

Agreement: For power of received RS, Option1(as in last RAN1 agreement): Pi of multiple RSs have a power offset with respect to the reference power P0, where the power offset is randomly selected from [-0.5dB, 0.5dB] is used as starting point for multiple RS evaluation. The SNR for each RS is defined based on P0.

Agreements:
For Case 1 single RS+AWGN, the metric is the minimum SNR required for one-shot detection with 90% detection probability and 1% false alarm requirement. The assumptions for Case 1 are summarized as follows:

	Total number of sequences used in the network (N_seq)	Number of sequences arriving within the window (n)	Number of total RSs arriving within the window (N)
Case 1	1	1	1

Note: This case is mainly used to compare and calibrate performance of same RS design. The above figures will be used for simulations to 94bis and determine whether further refinement is needed.

Agreements: At least Case 2-1 and Case 2-2A are evaluated for the next meeting. Evaluation of Case 2-2B depending on further agreements whether to support gNB group for Framework 2.1 and 2.2, and whether Case 2-1 and 2-2A is sufficient to cover Case 2-2B in terms of error detection, wherein,

- Case 2-1 (Single sequence): All RSs received within the detection window correspond to the same sequence. Number of total RS base sequence is only 1
- Case 2-2A (Multiple sequences): Each RS received by the detector corresponds to a different sequence.
- Case 2-2B (Multiple sequences): The number of distinctive sequences is smaller than the number of RSs received by the detector. Multiple RSs may correspond to the same sequence.

Agreements:
For Case 2-1, the number of RS arrived within the detection window is N=10 as starting point. Companies are also encouraged to provide results under more values of N. The assumptions for Case 2-1 are summarized as follows:

	Total number of sequences used in the network (N_seq)	Number of sequences arriving within the window (n)	Number of total RSs arriving within the window (N)
Case 2-1	1	1	10 as starting point

Agreements: The assumptions for Case 2-2A and Case 2-2B are summarized as follows:

Case 2-2A: Each RS received by the detector corresponds to a different sequence.

	Number of sequences used in the network (N_seq)	Number of sequences within the detection window (n)	Number of total RSs arriving within one detection window (N*n)
Case 2-2A	8 as starting point	1,2,4,8 [1]	n
Case 2-2B	8 as starting point	1,2,4,8 [1]	10*n as starting point
NOTE 1: Separate simulation runs NOTE 2: Evaluation of Case 2-2B depending on further agreements whether to support gNB group for Framework 2.1 and 2.2, and whether Case 2-1 and 2-2A is sufficient to cover Case 2-2B in terms of error detection.			

Agreements:

At least detection probability of option 1 and 2 will be evaluated for next meeting, wherein,

- **Detection probability of option 1: Worst case detection probability of all sequences as $\min_k P_{d,k}$, where $P_{d,k}$ = Prob{sequence *i* is detected in a detection window | sequence *k* is present the detection window}**
- **Detection probability of option 2: Average detection probability of all the sequences $P_{d,k}$**

For the options of error detection probability or miss detection probability, companies are encouraged to provide evaluation results and report exact definition of the corresponding metric in the next meeting, so as to determine the final aligned metric(s).

Agreements:

- **For single sequence case (Case 2-1), gNB attempts to detect only one sequence per detection window.**
- **For multiple sequence case (Case 2-2A and Case 2-2B) The RS detector should attempt to detect all possible RS sequences arriving in the detection window, where no advanced receiver algorithm is adopted for RS detection.**

Agreement:

- **False detection rate of RS is evaluated by only AWGN input to the receiver, i.e. modelling thermal noise, and should be no larger than 1% for all evaluation cases.**

[94-NR-06] – Chengyan (Huawei)

URLLC: Email discussion on additional simuliation assumptions till 9/7 (including proposals 4/5/6 in R1-1809951)

Done: According to decision posted on Sept.20th, the following is agreed. Note that these agreements are by no means to limit further discussion. RAN1 will further discuss and try to complete evaluation assumptions in RAN1#94bis.

Agreements:

- **Additional assumptions for evaluation:**
  - **Companies describe overhead modeling (e.g. PDCCH overhead) used by companies in the simulation**
  - **Companies describe modification to channel models if any**
  - **Companies describe power control mechanisms**
- **1 ms air interface latency is assumed for evaluation for factory automation, with the assumption of 1 ms CN delay in 2 ms end-to-end latency.**
  - **Other values for evaluation are not precluded**
- **In evaluations, it is assumed that the packet size is based on L2/L3 SDU in the evaluation**
  - **FFS header overhead**
- **FFS whether to describe the following assumptions:**
  - **Duplex mode: FDD or TDD (DL/UL configuration)**
  - **Re-dropping or discarding UEs which do not satisfy certain channel quality if any**
  - **Blockage due to moving metal parts for channel model for factory automation**
  - **Other assumptions like TTI size, gNB/UE processing time, CSI measurement and reporting**
- **Companies are encouraged to provide evaluation on baseline performance achievable with Rel-15 NR URLLC, for the prioritized URLLC use cases identified in the Rel-16 URLLC SID.**
- **Take the simulation settings in the following table as the starting point for Rel-16 NR URLLC system level evaluation for urban macro for power distribution:**

Parameters	Value
Layout	Single layer - Macro layer: Hex. Grid
Inter-BS distance	500m Note: Other value (e.g. 150 m) is not precluded
Carrier frequency	4 GHz
Channel model	UMa in TR 38.901
UE Tx power	23dBm
BS antenna configurations	FFS antenna ports (e.g., 4 Tx/4 Rx antenna, etc.) (M, N, P, Mg, Ng) = (8, 8, 2, 1, 1); dH = 0.5λ, dV = 0.8λ; 102 degree for 500m ISD
BS antenna height	25m
BS antenna element gain + connector loss	8 dBi
BS receiver noise figure	5dB
UE antenna configuration	FFS antenna ports (e.g., 2 Tx/4 Rx antenna ports, etc) Panel model 1: Mg=1, Ng=1, P=2, d_H=0.5

UE antenna height	Follow the modelling of TR 38.901 (e.g. 1.5m)
UE antenna gain	0dBi as starting point
UE receiver noise figure	9 dB
Total transmit power per TRxP	49 dBm
BS receiver	MMSE-IRC as the baseline receiver Note: Advanced receiver is not precluded.
Parameters with the value not defined in 38.802	
Number of UEs per cell	Up to 10
Simulation bandwidth	40 MHz
SCS	30 kHz Note: Other values for evaluation are not precluded.
UE distribution	100% of users are outdoors
UE power control	Companies report the PC mechanisms used for URLLC.
HARQ/repetition	Companies report (including HARQ mechanisms).
Channel estimation	Realistic

- **Take the simulation settings in the following table as the starting point for Rel-16 NR URLLC system level evaluation for indoor hot-spot for factory automation:**

Parameters	Value
Inter-BS distance	20m
Carrier frequency	4 GHz
UE Tx power	23dBm
BS antenna element gain + connector loss	5 dBi
BS receiver noise figure	5dB
BS antenna configurations	FFS antenna ports (e.g., 4 Tx/4 Rx antenna ports, etc) (M, N, P, Mg, Ng) = (4, 4, 2, 1, 1), dH = dV = 0.5 λ for 4GHz
BS antenna height	[3] m

	Note: Companies report the modification of the layout
UE antenna configuration	FFS antenna ports (e.g., 2 Tx/4 Rx antenna ports, etc.) Panel model 1: Mg = 1, Ng = 1, P = 2, dH = 0.5
UE antenna height	Follow the modelling of TR 38.901 (e.g. 1.5m) Note: Companies report the modification of the layout
UE antenna gain	0dBi as starting point
BS Tx power	24 dBm per 20 MHz
BS receiver	MMSE-IRC as the baseline receiver Note: Advanced receiver is not precluded.
UE receiver noise figure	9 dB
Parameters with the value not defined directly for factory automation in 38.802	
SCS	30 kHz Note: Other values for evaluation are not precluded.
Simulation bandwidth	40 MHz
Layout	Single layer as defined in 38.802 Indoor floor: [(3, 6, 12) BSs per 120 m x 50 m] Note: Companies report the modification of the layout
Channel model	ITU InH for 4 GHz Companies report the modification of the channel model
Number of UEs per cell	Up to [40]
UE distribution	100% of users are indoor: 3 km/h and/or 30 km/h UE-speed Note: which one to use is up to companies and other value(s) are not precluded
UE power control	Companies report the PC mechanisms used for URLLC.
HARQ/repetition	Companies report (including HARQ mechanisms).
Channel estimation	Realistic

- **Evaluation of 30 GHz carrier frequency is not precluded.**

[94-NR-07] – Wu Yong (Huawei)
ITU: Email approval to compile and endorse the eMBB spectral efficiency results submitted by August 24, 2018, until August 29, 2018
Done: According to decision posted on Sept.6th, the evaluation results are endorsed in:
R1-1810014 Summary of IMT-2020 evaluation results of eMBB spectral efficiency Huawei

[94-NR-08] – Wu Yong (Huawei)
ITU: Email approval to derive the LTE peak spectral efficiency and peak data rate results with the text proposals in R1-1809934 as the starting point, by August 29th , 2018
Done: According to decision posted on August 30th, the TP is endorsed as:
R1-1810012 Text proposal to TR37.910 for LTE peak data rate and peak spectral efficiency Huawei

[94-NR-09] – Wu Yong (Huawei)
ITU: Email approval to derive the NR control plane latency evaluation results, based on the summary of CP latency evaluation parameters in R1-1809947
, by August 29th, 2018.
Done: According to decision posted on August 30th, the TP is endorsed as:
R1-1810013 Text proposal to TR37.910 for NR control plane latency Huawei

Annex G: List of participants at RAN1 #94

Please see excel file attached to this report