

Source: MCC Support

Title: Final Report of 3GPP TSG RAN WG1 #86 v1.0.0
(Gothenburg, Sweden, 22nd – 26th August 2016)

Document for: Approval



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Main facts summary

3GPP TSG WG RAN1 #86 meeting, hosted by the European Friends of 3GPP, was held at the Gothia Towers Hotel, Gothenburg, Sweden.

The meeting started at 9:00 on Monday 22nd August and finished at 17:00 on Friday 26th August 2016.

The number of attending delegates, having confirmed their participation through the electronic check-in application, was **422**.

Note that the number of registered was a kind of record and reached 599.

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

The number of contribution documents for this meeting was 2432, and those documents were categorized as followed.

Agenda Item	Input Document	Treated Document
All	2432	1075

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

1 Opening of the meeting

Mr Satoshi Nagata (RAN1 Chairman) welcomed the participants of the RAN WG1 86 meeting and opened the meeting at 09:00. Mr Johan Bergman from Ericsson welcomed the delegates on behalf of the European Friends of 3GPP, Alcatel-Lucent, Apple, BlackBerry, Deutsche Telekom, Ericsson, Huawei, Intel, KPN, Motorola, Nokia, Orange, Qualcomm, SIMAlliance, Sony, TeliaSonera, Telefonica, TIM, Telenor, Vodafone 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)**

2 Approval of Agenda

[R1-166055](#) Draft Agenda of RAN1#86 meeting RAN1 Chair

Satoshi Nagata (Chairman) proposed the agenda for the meeting, as well the schedule of the week.

Discussion: No comment.

Decision: The agenda is approved.

3 Approval of Minutes from previous meeting

[R1-166056](#) Final Report of 3GPP TSG RAN1 #85 v1.0.0 ETSI

The document was presented by Patrick Mérias (ETSI Mobile Competence Center) and provides the outcomes of last meeting in China.

Discussion: MCC→ due to the inflation of contributions (>1800 at meeting start), RAN1 will shortly burst the 9999 tdocs per year barrier (4 digits upper limit) – RAN1 was warned that 5 digits numbering might be introduced at the next meeting.
MCC→ rapporteurs of WI/SI chairing sessions during the week are requested to highlight and use the bold type to clearly show the treated contributions in their notes and help MCC recording correct statuses in 3GU.

Decision: The document is approved.

4 Highlights from RAN Plenary

[R1-166057](#) Selected highlights from RAN#72 of relevance to RAN1 RAN1 Chair

The document was presented by RAN1 Chair and feedbacks the decisions made by RAN#72, relevant to RAN1.

Discussion: Chair → regarding the additional ad-hoc meetings for NR, current view is as follows:

- January 2017 – 5days meeting – likely in the US (exact location still to be defined)
- June 2017 – 4days meeting – likely in Asia (Japan, India)

Decision: The document is noted.

5 Incoming Liaison Statements

[R1-166073](#) LS to RAN1 on clarification on MIMO capability RAN2, Huawei

The document was presented by Xia Yuan from Huawei and raises an IOT issue if UE and network have different understanding in the case where, for instance the UE supports following two combinations simultaneously:

- Combination 1: Band A 4*4 layers; Band B 2*2 layers
- Combination 2: Band A 2*2 layers; Band B 4*4 layers;

How can the UE to determine the maximum number of layers for RI bit and Kc? 4*4 layers for band A or 2*2 layers for band A?

Decision: The document is noted.

[R1-167906](#) Reply LS for clarification on MIMO capability Huawei

Discussion: .Qualcomm confirmed solution 2 is the preferred one. Potential UE capability discussion may be needed in RAN2.

Decision: The document is noted and final LS is [agreed in R1-167914](#).

[R1-166086](#) LS on 256QAM support for UE Category 9/10 from Rel-12 RAN, Intel

The document was presented by Seunghye Han from Intel and asks to create the CRs reflecting that:

- For a Rel-12 UE supporting all UE radio access capability parameters for both Cat.9/10 and Cat.13,
 - The UE can report both Cat.9/10 and Cat.13
 - The eNB may understand that the UE supports all UE radio access capability parameters of both Cat.9/10 and Cat.13
 - Therefore either category can be applied individually (but not a combination of parameters of different categories)

Decision: The document is noted.

[R1-166192](#) Discussion on UE reporting both category 9/10 and 13 Huawei, HiSilicon

The document was presented by Xia Yuan from Huawei.

- Proposal: DL UE category 13 could indicate category 9 or 10 if supported

Decision: The document is noted.

[R1-166500](#) Discussion on simultaneous signaling of categories 9/10 and 13 Intel Corporation

The document was presented by Alexei from Davydov and proposes the following principles for deriving rate matching parameters and storing the received soft channel bits for such UEs are as follows:

- No specification change is required for the rate matching procedure in TS 36.212 to support UE simultaneously indicating support of category 9/10 and 13
- To support UE simultaneously indicating support of category 9/10 and 13 the Nsoft for sorting the received soft channel bits in TS 36.213 should be based on UE category 9/10 rather than DL category 13.

Discussion: Qualcomm → not aligned with RAN's agreement

Decision: The document is noted.

[R1-167191](#) Introduction of simultaneous signalling of categories 9/10 and 13 Intel Corporation

[R1-167192](#) Introduction of simultaneous signalling of categories 9/10 and 13 Intel Corporation

[Agreements:](#)

- No specification change is required for the rate matching procedure in TS 36.212 to support UE simultaneously indicating support of category 9/10 and 13
- For TS 36.213, N'_{soft} is the maximum “Total number of soft channel bits” [12] among all the indicated UE categories [11] of this UE.

R1-167398 Correction on storing soft channel bits for different UE categories Huawei, HiSilicon, NTT DOCOMO, SoftBank

- Change the soft channel bits assumption to be suitable for all the UE categories in TS36.213 so that the total number of soft channel bits is based on the maximum “Total number of soft channel bits” of all the UE categories supported by this UE.

Decision: The document is noted and CR0704 to 36.213 is not pursued.

Following LS was received during RAN1#86:

R1-168520 LS on Support of CAT 9/10 and CAT 13 RAN2

RAN2 agrees to use existing IEs i.e the UE indicates both ue-Category-v1170 (= Category 9/10) and ue-CategoryDL-r12 (= Category 13) when it supports both Category 9/10 and Category 13. RAN2 confirms that there is no backward compatibility issue when the UE sends both UE category IEs. Furthermore, the corresponding Rel-12/13 CRs for TS36.306 have been agreed in R2-165855 and R2-165856.

Decision: The document is noted.

LAA

R1-166066 Long Term Evolution in Operation in Unlicensed Spectrum Must Not Interfere with Wi-Fi City of Madison (Office of the Mayor of)

The document was presented by RAN1 Chair.

Decision: The document is noted.

R1-166083 Response to Wi-Fi Alliance comments on “Way forward on coexistence tests for LAA” RAN4, Qualcomm, Ericsson

The document was presented by RAN1 Chair.

Decision: The document is noted.

R1-167928 LS on CSI measurement ambiguity in LAA RAN4, LGE

The document (Incoming LS received in RAN1#86) was presented by Joon Kui Ahn from LGE and asked RAN1 to clarify whether following sentence could be applied in LAA CSI reporting case or not.

“For a non-BL/CE UE, if there is no valid downlink or no valid special subframe for the CSI reference resource in a serving cell, CSI reporting is omitted for the serving cell in uplink subframe n.” (in RAN1 specification TS 36.213 for CSI reporting)

Decision: The document is noted.

R1-166812 Discussion on RAN4 LS on CSI measurement ambiguity in LAA LG Electronics

Decision: The document is noted. Continue offline discussion until Friday – (LGE)

Friday: No progress – continue discussion until the next meeting.

R1-167880 Reply LS on Rel-13 LAA specifications RAN, Qualcomm, NTT DOCOMO

The document was presented by Srinivas Yerramalli from Qualcomm

Decision: The document is noted.

R1-167881 “Response to Liaison Statement on coexistence simulation results for DL only LAA” Wi-Fi Alliance

The document is a response to the liaison statement questions asked in [R1-161396](#), summarizes changes made to the ns-3 simulator, and how such changes affect the results presented in R1-156621.

Decision: The document is noted. Continue offline discussion until Friday, if needed –(Qualcomm)

[R1-167118](#) Draft response LS to WFA regarding LAA Qualcomm Incorporated

Friday Decision: Qualcomm withdrew [R1-167118](#) as there did not seem to be a need identified (in this meeting at least) to respond to the LS.

R1-167908 Review of 3GPP LAA Specification Rel. 13 IEEE 802 LMSC

The document states that some of the comments in IEEE 802’s Liaison Statement to 3GPP RAN1 dated 18 March 2016 (802.19-16-0037-09) have been resolved satisfactorily and represents a great success for the consensus process that started with the 3GPP LAA Workshop back in August 2015. However, there are a number of important outstanding issues, for which IEEE requests RAN1 to continue to look for satisfactory compromises with IEEE 802 and other interested stakeholders..

Decision: The document is noted. Continue offline discussion until Friday – (Qualcomm)

Friday Decision:

R1-166666 Draft response LS to 802dot11 regarding LAA Qualcomm Incorporated

The document is noted.

eMTC

R1-166069 LS on HARQ process selection for UL asynchronous HARQ RAN2, Huawei

The document was presented by Matthew Webb from Huawei.

- In asynchronous HARQ operation, HARQ process is associated with TTI based on the received UL grant except for UL grant in RAR. Each asynchronous HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RAR, HARQ process identifier “0” is used.

Discussion: No action to RAN1 – no impact to spec

Decision: The document is noted.

R1-166081 LS on continuous uplink transmission in eMTC RAN4, Intel

The document was presented by Debdeep Chatterjee from Intel and asks RAN1 to specify UL compensation gaps, including related UE behaviour.

Discussion: No action to RAN1.

Decision: The document is noted.

NB-IoT

R1-166061 Reply LS on questions on NB-IOT CT1, Nokia

The document was presented by Rapeepat Ratasuk from Nokia.

Discussion: No action to RAN1.

Decision: The document is noted.

R1-166070 LS to RAN1 on WLAN RSSI RAN2, Nokia

The document was presented by Klaus Hugl from Nokia and asks RAN1 to correct the definition of WLAN RSSI.

Decision: The document is noted.

R1-167547 Correction to the Beacon RSSI definition Nokia, Intel, Alcatel-Lucent Shanghai Bell, Qualcomm Incorporated, Ericsson

Decision: The document is noted and CR0034 to 36.214 (Rel-12) is agreed.

R1-167549 Correction to the WLAN RSSI definition Nokia, Intel, Alcatel-Lucent Shanghai Bell, Qualcomm Incorporated, Ericsson

Decision: The document is noted and CR0035 to 36.214 (Rel-13) is agreed.

Latency reduction

R1-166071 LS to RAN1 on RAN2 agreements on skipping Uplink transmission RAN2, Nokia

The document was presented by Timo Lunttila from Nokia and asks RAN1

- to confirm the RAN2 assumption that non-adaptive retransmissions on SPS resource are done based on RV 0 and to provide feedback if any concern,
- to align RAN1 specifications if needed regarding the assumption that the UCI should be sent on PUCCH even if there is a valid PUSCH allocation on that subframe

Decision: The document is noted.

R1-167507 Addition of LTE_LATRED_L2-Core Ericsson LM

Add that PUSCH is not transmitted if not high layers generates a MAC entity for the corresponding HARQ process

Decision: The document is noted and **CR0709 of 36.213 is for email approval until Sept 12th (Spec editor – Motorola Mobility)**

R1-167023 On skipping uplink transmission Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by Timo Lunttila from Nokia.

- Proposal #1: The RAN2 working assumption on using RV0 with non-adaptive retransmissions on SPS resources can be confirmed.
- Proposal #2: In the case of UL skipping, UCI consisting of HARQ-ACK, periodic CSI and/or scheduling request indicator is transmitted on PUCCH following the legacy rules for the case when there is no PUSCH transmission.
- Proposal #3: An UL grant triggering Aperiodic CSI transmission is considered as a regular dynamic UL grant. UL skipping does not apply in this case.

Decision: The document is noted.

R1-167506 Discussion on skipping Uplink transmission Ericsson

The document was presented by Daniel Larsson from Ericsson and proposes to:

- Agree to the LS to RAN2 in [R1-167505](#)
- Agree to the CR in [R1-167507](#)

Decision: The document is noted.

[R1-167505](#) [DRAFT] LS on RAN2 agreements on skipping Uplink transmission Ericsson

[R1-166665](#) Discussion of LS from RAN2 on skipping uplink transmission Qualcomm Incorporated

Decision: The document is noted.

Agreements:

- In the case of UL skipping, UCI consisting of HARQ-ACK, periodic CSI and/or scheduling request indicator is transmitted on PUCCH following the legacy rules for the case when there is no PUSCH transmission.
- An UL grant triggering Aperiodic CSI transmission is considered as a regular dynamic UL grant. UL skipping does not apply in this case

Continue discussion until Friday – (Nokia)

Friday:

[R1-168527](#) [DRAFT] Reply LS on RAN2 Agreements on Skipping Uplink Transmission Nokia

Decision: The document is noted and **final LS is agreed in R1-168528.**

[R1-166084](#) Reply LS on SRS carrier switching interruption time RAN4, Huawei

The document was presented by Weimin Xiao from Huawei.

Decision: The document is noted and acknowledged by RAN1.

V2X

[R1-166060](#) LS to RAN1 on RAN2 agreements related to V2X RAN2, LGE

The document was presented by Hanbyul Seo from LGE and provides RAN2 TP (R2-163650) capturing agreements of RAN2#93bis – already included in the TR 36.885.

Decision: The document is noted.

[R1-166062](#) LS to RAN1 on SPS RAN2, LGE

The document was presented by Hanbyul Seo from LGE and informs RAN1 that for UL SPS, the majority of companies agree that from a RAN2 point of view, it is not necessary to send an indication to the eNB that an SPS grant will not be used. Therefore, the working assumption on “the UE can indicate to the eNB that it does not intend to transmit data before a transmission associated to an SPS configuration” is not needed.

Decision: The document is noted.

[R1-166068](#) Reply LS on EPC procedures for providing eNB with V2X authorization information RAN2, LGE

The document was presented by Hanbyul Seo from LGE and provides answers to SA2.

Discussion: No action to RAN1.

Decision: The document is noted.

[R1-166072](#) LS to RAN1 on agreed TPs RAN2, LGE

The document was presented by Hanbyul Seo from LGE and provides RAN2 TPs (R2-164495, R2-164497, R2-164553) capturing agreements of RAN2#94 – already included in the TR 36.885.

Decision: The document is noted.

V2V

[R1-166063](#) LS on V2V transmission path selection RAN2, Huawei

The document was presented by Philippe Sartori from Huawei and provides the following RAN2's agreements:

- The following configurations are allowed by eNB for transmission of V2V: 1) Uu only, 2) PC5 only and 3) both Uu and PC5 for V2V transmissions in different carriers.
- If both Uu and PC5 are configured for V2V transmissions, it is left up to UE upper layers which path is selected. FFS whether any additional AS information is provide to upper layers.
- The eNB can configure the V2V transmission configuration in SIB and/or dedicated signalling.

Decision: The document is noted.

[R1-166082](#) Reply LS on V2V multicarrier configuration RAN4, LGE, Ericsson

The document was presented by Stefano Sorrentino from Ericsson and shows RAN4 conclusion to scenarios supporting multiple component carrier (MCC) operation for V2V services based on LTE sidelink functionality:

- Analysis and specification of transmission and reception requirements for single component carrier (CC) operation will be completed as a first priority (e.g. for both licensed LTE bands and ITS spectrum at 5.9GHz).
 - The analysis and specification of transmission and reception requirements for MCC V2V operation will be completed in RAN4 as second priority as part of the V2V WI.

- If the MCC operation for V2V service can't be completed within V2V WI time line, RAN4 suggests to further study in Rel-14 pending agreement in the RAN plenary. Therefore MCC operation for V2V operation will be supported in Rel-14.
- Note that MCC V2V operation will depend on the V2V UE RF architecture and RAN4 needs further time to study support of MCC V2V operation and LTE operation with intra UE capabilities.

Decision: The document is noted.

R1-167878 LS on V2V Authorization RAN3, Huawei

RAN3 believes that the V2V authorization information needs to be provided to the eNB from a trusted node (i.e. the MME or another eNB), and to be extensible in the future (i.e. further considering the possible outcome of the RAN V2X SI). RAN3 has technically endorsed the attached CRs which introduce a *Vehicular Services Authorized IE*.

Discussion: No action to RAN1.

Decision: The document is noted.

Network Assistance for Network Synchronization in LTE

R1-166085 LS on Network Assistance for Network Synchronization in LTE RAN, Huawei

The document was presented by Elean Fan from Huawei and asks RAN1 clarifying the feasibility on standardization of the time-stamps T1 and T2 for received RACH preamble in case of Solution 1 (network based solution reusing the existing signaling during handover).

Decision: The document is noted.

R1-167177 Feasibility on standardization of the time-stamps for received RACH preamble Huawei

- UE transmitting RACH upon handover is an existing procedure in LTE
- To get the time stamps T1 and T2 upon receiving the RACH preamble, no UE changes are required
- To get the time stamps T1 and T2 upon receiving the RACH preamble, no additional physical layer signalling is required

Decision: The document is noted.

R1-166198 Reply LS on Network Assistance for Network Synchronization in LTE Huawei

Agreements:

- UE transmitting RACH upon handover is an existing procedure in LTE
- RAN1 does not need to specify eNB measurements to support this feature (if specified)

R1-167216 Reply LS on Network Assistance for Network Synchronization in LTE RAN1

Decision: The document is agreed.

Mobility enhancements

R1-166074 LS on the evaluation of simultaneous transmission and reception RAN2, ZTE

Decision: The document is noted.

R1-166078 Response LS on the feasibility of mobility enhancement solutions RAN3, ZTE

There is no information exchanged, today, related to timing offset, between source and target eNBs in asynchronous case over any RAN3 interfaces.

Decision: The document is noted.

R1-166080 Reply LS on the feasibility of mobility enhancement solutions RAN4, ZTE

Decision: The document is noted.

R1-167810 Summary of email discussion on replying LS for mobility enhancement solutions ZTE Corporation

Decision: The document is noted.

VoLTE

R1-166075 LS on VoLTE and video quality related enhancements RAN2, Ericsson

The document was presented by Johan Bergman from Ericsson and asks RAN1 to investigate the trade-off between packet delay budget and achievable coverage to assess the benefits of VoLTE/video quality related enhancements, and provide feedback.

Decision: The document is noted.

R1-168136 [DRAFT] Reply LS on VoLTE and video quality related enhancements CMCC

Decision: The document is noted and final LS is **agreed in R1-168256**

HSPA (see AI6.3)

R1-166067 LS on RAN2 aspects on MC enhancements RAN2, Huawei

R1-166076 LS on Multi-carrier enhancements RAN3, Huawei

NR

R1-166058 Updated characteristics of terrestrial IMT systems for frequency sharing / interference analysis in the frequency range between 24.25 GHz and 86 GHz ITU-R WP5D

The document was presented by RAN1 Chair en behalf of ITU-R and the following updates from the previous version:

1. Three parameters (access technique, modulation parameters and channel spacing) were removed.
2. Two new parameters (Duplex Method and SINR operating range) were added. However, the relevance of Duplex Method parameter for sharing studies is still being considered.

Decision: The document is noted.

R1-167375 [Draft] LS on Parameters for WP5D sharing and compatibility studies NTT DOCOMO, INC.

The document was presented by Kazuaki Takeda from NTT DOCOMO.

Discussion: Qualcomm → 1024QAM should be mentioned – to be considered at the same level as the others

Samsung → concern of introducing 1024QAM (no proposal yet available)

Decision: The document is noted and agreed with updated Note 2 in R1-167917 as follows:

Note 2: There is no agreement in RAN1, but the use of QPSK, 16QAM, 64QAM, 256QAM, and possibly 1024QAM constellations are at least considered, while details, e.g., mapping of bits to constellation points, are under study. Accordingly, SINR operating range includes at least the SINR values for which QPSK, 16QAM, 64QAM, 256QAM, and possibly 1024QAM can be used.

R1-166059 MODELLING AND SIMULATION OF IMT NETWORKS FOR USE IN SHARING AND COMPATIBILITY STUDIES ITU-R WP5D

The document was presented by RAN1 Chair en behalf of ITU-R and describes detailed IMT system parameters needed for modelling, their implementation in the simulations, and the methodology to calculate the aggregate effect of potential interference generated by an IMT system.

Decision: The document is noted.

R1-167882 Proposal for Improved RMa model and upgraded open source channel simulator NYU Wireless
The document shares the results of recent modelling and measurements that will correct errors in the existing 3GPP RMa model as it appears in TR 38.900, and offers recently published results that may help in system and link-level simulations, as well as highlighting the use of these results in an improved version of an open source simulator discussed in a July 2016 IEEE T-MTT paper and in the upcoming October 2016 “All Things Cellular” paper.

Decision: The document is noted.

R1-166064 INCREASING LEVELS OF RF NOISE IN THE ENVIRONMENT AND CONSEQUENT INTERFERENCE TO RADIOCOMMUNICATION SERVICES ITU-R WP 1A

The document was presented by RAN1 Chair en behalf of ITU-R and deals with increasing levels of RF noise radiated or superimposed along the electrical mains supply and the consequent increase in instances of EMI.

Decision: The document is noted.

R1-166077 Reply LS on Formation of IEEE 1914 Next Generation Fronthaul Interface Working Group RAN3, Intel

The document was presented by ... from Intel and informs IEEE 1914 that in the context of the NR SI, RAN architecture and functional splits are being studied by RAN3.

Discussion: No action to RAN1.

Decision: The document is noted.

R1-166079 LS on Characteristics of terrestrial IMT systems for frequency sharing/interference analysis in the frequency range between 24.25 GHz and 86 GHz RAN4, Nokia

The document was presented by Tuomo Säynäjäkangas from Nokia.

Discussion: No action to RAN1.

Decision: The document is noted.

R1-167879 Reply LS to ITU-R WP5D/TEMP/39(Rev.2) = RP-160508 on Characteristics of terrestrial IMT systems for frequency sharing/interference analysis in the frequency range between 24.25 GHz and 86 GHz RAN, Nokia

The document was presented by Tuomo Säynäjäkangas from Nokia and confirms the following schedule agreed RAN:

RAN#72 (June 2016): RAN send LS to ITU-R WP5D including time plan and expected future LSs from 3GPP to WP5D

RAN#73 (Sep 2016): RAN send LS to ITU-R WP5D on initial system characteristics based on RAN1&RAN4 input

RAN#74 (Dec 2016): RAN send LS to ITU-R WP5D on final system characteristics based on RAN1&RAN4 input

Note: Dependent on the ITU-R WP5D deadline (which is not yet published in RP-160508), RAN may approve the output by correspondence after the Dec. 2016 meeting.

Decision: The document is noted.

R1-166087 LS on 5G NR study – mMTC use case RAN, MediaTek

The document was presented by ... from MediaTek and informs RAN1 that within the scope of the NR Study, NB-IoT and eMTC should be used as the reference benchmark for assessing the performance of new proposals according to mMTC use case.

Decision: The document is noted.

R1-167534 Discussion on benchmark mMTC with NB-IoT/eMTC MediaTek Inc.

- Proposal #1: The new techniques for mMTC should provide significant gain compared with NB-IoT/eMTC.
- Proposal #2: Building penetration loss is added in channel model in system level evaluation for mMTC.
- Proposal #3: Performance in coverage extension (i.e., 154dB, 164dB) should be evaluated and benchmarked with NB-IoT/eMTC. Data rate v.s. MCL curve can be used as a metric.
- Proposal #4: Spectral efficiency in both normal coverage and extended coverage level should both be evaluated and benchmarked with NB-IoT/eMTC. Sum throughput v.s. MCL can be used as a metric.
- Proposal # 5: PAPR and CM of NR for mMTC should not be higher than NB-IoT, especially in extended coverage.
- Proposal #6: The BOM cost of low-end mMTC device in NR needs to be benchmarked with NB-IoT/eMTC.
- Proposal #7: Single solution is strived for all the scenarios (e.g., normal coverage and extended coverage) and operation modes (e.g., standalone and inband deployed with eMBB/ URLLC).

Decision: The document is noted.

R1-166065 LS on 5G millimeter wave channel simulator NYU WIRELESS

The document was presented by RAN1 Chair en behalf of NYW and shares the results of the recent July 2016 IEEE T-MTT paper, and provides information about a new public resources useful for 5G air interface and system design work.

Decision: The document is noted.

6 UTRA

R1-168038 Chairpersons' summary of the UMTS sessions UMTS Session Chairpersons (Huawei, Ericsson)

The document was presented by Carmela Cozzo from Huawei and Gerardo Medina from Ericsson.

Decision: The document is endorsed and incorporated as follows.

Incoming Liaison Statements related to AI 6.3.

R1-166067 LS on RAN2 aspects on MC enhancements RAN2, Huawei

Decision: The document (RAN2 agreed TP) is noted.

R1-166076 LS on Multi-carrier enhancements RAN3, Huawei

Decision: The document (RAN3 agreed TP) is noted.

Both TPs have already been included in TR25.707.

6.1 Maintenance of UTRA Releases 4 – 13

6.1.1 FDD

R1-166495 Clarifications on UL Discontinuous Transmission with DCH enhancements Qualcomm Europe Inc.(France)

Decision: CR0749 to 25.214 (Rel-12, F) is agreed.

R1-166496 Clarifications on UL Discontinuous Transmission with DCH enhancements (Rel. 13) Qualcomm Europe Inc.(France)

Decision: CR0750 to 25.214 (Rel-12, A) is agreed.

R1-167681 Discussion on power scaling for R13 DC HSUPA with CS Huawei, HiSilicon

R1-167711 25.214 CR (Rel-13, F) Correction of Dual Carrier HSUPA enhancements for UTRAN CS Huawei, HiSilicon

Decision: The document is revised and CR0753r1 to 25.214 (Rel-13, F) is agreed in [R1-168031](#)

R1-167709 25.214 CR (Rel-13, F) Correction of DCH enhancements Huawei, HiSilicon

Discussion: CR category should be A

Decision: The document is noted, revised and CR0751r1 to 25.214 (Rel-13, A) is agreed in [R1-168032](#)

R1-167710 25.214 CR (Rel-12, A) Correction of DCH enhancements Huawei, HiSilicon

Discussion: CR category should be F

Decision: The document is noted, revised and CR0752r1 to 25.214 (Rel-12, F) is agreed in [R1-168033](#)

R1-167758 On incorporating the definition of “UL DPCH 20ms Mode” in TS 25.212 Ericsson

Decision: The document is noted and CR is not pursued.

R1-167759 On incorporating the definition of “UL DPCH 20ms Mode” in TS 25.212 Ericsson

Decision: The document is noted and CR is not pursued.

R1-167760 Editorial clarification on the definitions of “UL DPCH 10ms Mode” and “UL DPCH 20ms Mode” of DCH enhancements for UMTS Ericsson

Decision: CR0754 to 25.214 (Rel-12, D) is agreed.

R1-167761 Editorial clarification on the definitions of “UL DPCCH 10ms Mode” and “UL DPCCH 20ms Mode” of DCH enhancements for UMTS Ericsson
Decision: CR0755 to 25.214 (Rel-13, A) is agreed.

R1-167762 On incorporating the definition of “UL DPCCH 20ms Mode” and adding the TS 25.321 in the list of references of TS 25.211 Ericsson
Decision: The document is noted, revised and CR0323r1 to 25.211 (Rel-12, D) is agreed in **R1-168035** (without the change: addition of the definition)

R1-167763 On incorporating the definition of “UL DPCCH 20ms Mode” and adding the TS 25.321 in the list of references of TS 25.211 Ericsson
Decision: The document is noted, revised and CR0324r1 to 25.211 (Rel-13, F) is agreed in **R1-168036** (without the change: addition of the definition)

6.1.2 TDD

None.

6.2 DTX/DRX enhancements in CELL_FACH - WID in **RP-160185**

6.2.1 DRX improvements

R1-167682 Considerations on DRX in CELL_FACH Huawei, HiSilicon

R1-167764 On incorporating the DL scheduling notification based on regular HS-SCCH control information to the new power saving mechanism in CELL_FACH Ericsson

R1-167765 DL scheduling notification based on regular HS-SCCH control information as part of the new power saving mechanism in CELL_FACH Ericsson

R1-167813 Discussions on HS-SCCH DRX in CELL_FACH design Qualcomm Europe Inc.(France)

R1-167814 Introduction of HS-SCCH Order for HS-SCCH DRx feature in enhanced Cell FACH Qualcomm Europe Inc.(France)

R1-167815 UE Procedures for HS-SCCH DRx feature in enhanced Cell FACH Qualcomm Europe Inc.(France)

Conclusions for 6.2.1:

RAN1 recommends a Rx Burst duration of 1 subframe or 2 subframes in the HS-DSCH receiving formula specified in TS 25.331 (LS to be sent to RAN2)

R1-168030 LS on Updates on HS-SCCH DRx Feature in Cell FACH RAN1, Qualcomm

Decision: The document is noted and LS is agreed.

HS-SCCH order is to be used to signal a UE wake-up trigger.

Email discussion until next plenary submission deadline (Sept 9th on Qualcomm CRs.

6.2.2 DTX improvements

R1-167683 Considerations and evaluation of DTX in CELL_FACH Huawei, HiSilicon

R1-167684 DTX solution in CELL_FACH Huawei, HiSilicon

R1-167766 A complementary assessment on the potential gains associated to the introduction of DTX in CELL_FACH Ericsson

R1-167767 Technical findings on introducing DTX in CELL_FACH Ericsson

Conclusions:

Based on **R1-167766** findings, the average gains from DTX in cell FACH range from 0.02 to 0.10 (10 resources) and from 0.07 to 0.34dB for the case of 25 common E-DCH resources configured in the cell. The following table summarizes the gains from DTX in CELL_FACH

Summary of the potential gains that can be obtained by fully applying DTX on the stand alone UL DPCCCH in CELL_FACH without severely impacting the cell's capacity

	Back-off timer configurations	10 Common E-DCH resources configured in the Cell		25 Common E-DCH resources configured in the Cell	

Average Blocking Target		Range of the Percentile Gain (90-99% Percentile)	Range of the Average Gain	Range of the Percentile Gain (90-99% Percentile)	Range of the Average Gain
5%	4TTIs – 24TTIs (8ms-48ms)	0.11508dB – 0.2333 dB	0.0206dB – 0.1028 dB	0.2333dB – 0.6085 dB	0.0745dB – 0.3419dB

6.3 Multi-Carrier enhancements for UMTS - WID in [RP-161259](#).

[R1-168089](#) LS on Multi-Carrier enhancements

W.r.t configuring Multi-Carrier enhancements in combination with legacy features, RAN2 would like to understand, in case that primary and secondary uplink frequency is configured with different TTIs, whether it is feasible to configure uplink DTX on either primary frequency or secondary frequency or both.

Decision: The document is noted.

6.3.1 2ms+10ms and 10ms+10ms configurations for (DB)-DC-HSUPA

[R1-167685](#) Overview of multicarrier enhancements Huawei, HiSilicon

[R1-167686](#) Initial considerations on power scaling Huawei, HiSilicon

Agreement: The legacy power scaling can be reused for DB-DC/DC 10ms+10ms TTI configurations.

[R1-167687](#) Initial considerations on TTI switching Huawei, HiSilicon

[R1-167768](#) TTI Switching for Multicarrier Enhancements in UMTS Ericsson

Agreement: It is RAN1 opinion that the TTI switching mechanism should be introduced in Multicarrier Enhancements for HSUPA.

[R1-168037](#) Ls to RAN2/3 on RAN1 progress on MC Enhancements, Huawei

Decision: The document is noted and the LS is agreed.

6.4 Other

[R1-167755](#) PRACH optimization for latency reduction during uplink signalling traffic Nokia, Alcatel-Lucent
Shanghai Bell

7 E-UTRA

7.1 Maintenance of E-UTRA Releases 8 – 13

Only essential corrections.

Note that individual companies can submit draft CRs to this agenda item for Rel-13 items.

[R1-166190](#) Introduction of 1.2Gbps and 1.6Gbps UE categories in Rel-13 Huawei, HiSilicon, SoftBank

Proposal 1: Introduce DL UE categories 18 and 19 to support DL peak data rate of 1.2Gbps and 1.6Gbps respectively

Proposal 2: Reuse UL cat 3, 5, 7 and 13 for DL cat 18 and 19 as corresponding UL categories

The specification impacts on TS36.212 can be found in a companion contribution [\[R1-167401\]](#).

Decision: The document is noted.

[R1-167401](#) Introduction of 1.2Gbps and 1.6Gbps UE categories in Rel-13 Huawei, HiSilicon, NTT DOCOMO, SoftBank

The document was presented by Xia Yuan from Huawei.

Assuming 1.2Gbps and 1.6Gbps UE categories in Rel-13 also support 8*8 MIMO deployment, the CR defines the soft buffer assumption for 8-layer encoding for 1.2Gbps and 1.6Gbps UE categories in Rel-13.

Discussion: CR not needed if 8*8 MIMO is not supported in the two new UE categories.

If 8*8 MIMO is supported, CR is needed and RAN1 should let RAN knows about it

Decision: The document is noted and revised as a draft CR in

[R1-168311](#) Introduction of 1.2Gbps and 1.6Gbps UE categories in Rel-13 Huawei, HiSilicon, NTT DOCOMO, SoftBank

Decision: The document is noted and the draft CR is technically endorsed by RAN1.

[R1-168312](#) [Draft] LS on introducing 1.2Gbps and 1.6Gbps UE categories in Rel-13 Huawei

Decision: The document is noted and final LS is agreed in [R1-168377](#)

[R1-167398](#) Correction on storing soft channel bits for different UE categories in Rel-11 Huawei, HiSilicon, NTT DOCOMO, SoftBank

Decision: The document is noted, revised and **CR0704r1 (Rel-11, F) is agreed in [R1-168313](#)**. Also supported by Intel.

[R1-167399](#) Correction on storing soft channel bits for different UE categories in Rel-12 Huawei, HiSilicon, NTT DOCOMO, SoftBank

Decision: The document is revised and **CR0705r1 (Rel-12, A) is agreed in [R1-168314](#)**. Also supported by Intel.

[R1-167400](#) Correction on storing soft channel bits for different UE categories in Rel-13 Huawei, HiSilicon, NTT DOCOMO, SoftBank

Decision: The document is revised and **CR0706r1 (Rel-13, A) is agreed in [R1-168315](#)**. Also supported by Intel.

[R1-167902](#) Introductions of new UE categories Qualcomm Incorporated

[R1-168356](#) Way Forward on introduction of new UL categories Qualcomm

- Choose Alternative 2
 - Send an LS to RAN2 recommending developing the necessary CRs and sending them to RAN #73
- Note: This doesn't mean approving any of these categories – that would be decided at the Plenary

Decision: The document is noted.

[R1-168357](#) [Draft] LS on introduction of new UL categories Qualcomm

[R1-168431](#) Way Forward on introduction of new UL categories Qualcomm

- Choose Alternative 1
- Send two separate LSs to RAN2 recommending developing the necessary CRs and sending them to RAN#73
 - Introducing UL Category 19-20 with *TEI13*

UE UL Category	Maximum number of UL-SCH transport block bits transmitted within a TTI	Maximum number of bits of an UL-SCH transport block transmitted within a TTI	Support for 64QAM in UL	Support for 256QAM in UL
UL Category 19 – Rel-13	226128	75376	Yes	No
UL Category 20 – Rel-13	301504	75376	Yes	No

◦ Introducing UL Category 21-22 with *LTE UL CAP enh-Core*

UE UL Category	Maximum number of UL-SCH transport block bits transmitted within a TTI	Maximum number of bits of an UL-SCH transport block transmitted within a TTI	Support for 64QAM in UL	Support for 256QAM in UL
UL Category 21 – Rel-14	316584	105528	Yes	Yes
UL Category 22 – Rel-14	422112	105528	Yes	Yes

- Note: This doesn't mean approving any of these categories – that would be decided at the Plenary

Decision: The document is noted and the WF is agreed. Qualcomm requested to take a note that their preference remains Alt. 2.

[R1-168432](#) [Draft] LS on introduction of new UL categories in Rel-13 Qualcomm

Decision: The document is noted and final LS is **agreed in [R1-168459](#)**.

[R1-168433](#) [Draft] LS on introduction of new UL categories in Rel-14 Qualcomm

Decision: The document is noted and final LS is **agreed in [R1-168460](#)**.

7.1.1 Maintenance of E-UTRA Release 8 – 12

[R1-166194](#) Discussion on the understanding of maximum code rate Huawei, HiSilicon

The document was presented by Xia Yuan from Huawei.

For Rel-12 DL UE categories and onwards, they shall NOT skip decoding a transport block in an initial transmission if the effective channel code rate is lower than or equal to 0.931, no matter whether they have 256QAM capability or not.

Decision: The document is noted.

[R1-166229](#) Clarification on HARQ feedback under TDD-FDD CA in Rel-12 Qualcomm Incorporated

The document was presented by Wanshi Chen from Qualcomm and deals with one particular issue in TDD/FDD CA, where an FDD CC is configured as Pcell and with one of the DL MIMO transmission modes, while one or two TDD CCs are configured as Scell. In a subframe when a Pcell PUCCH or a PUSCH is transmitted and when the corresponding subframe in the TDD Scell(s) is an UL subframe, the following intended behavior is recommended to be confirmed by RAN1:

- If only one single codeword is detected on the FDD Pcell,
 - If PUCCH is transmitted, PUCCH format 1a is used;
 - If PUSCH is transmitted, 2-bit HARQ is assumed.

Discussion: Intel → format 1b should be feedback

Decision: The document is noted. Continue offline discussion until Friday (Qualcomm)

Friday

[R1-168501](#) Offline summary on Clarification on HARQ feedback under TDD-FDD CA in Rel-12 ([R1-166229](#))

Qualcomm

- The conclusion for the issue discussed in [R1-166229](#) is aligned with RAN1 understanding, with the clarification that “PUCCH format 1a is *effectively* used” for the case of PUCCH format 1b with channel selection, due to the codepoints (ACK, ACK) or (NAK, NAK) for PUCCH format 1b when only one TB is detected for the MIMO Pcell

- No CR is necessary

[R1-167432](#) draft CR on the correction from SC-FDFMA to SC-FDMA Panasonic Corporation

The document was presented by Alex Golitschek from Panasonic.

Decision: The document is noted and **agreed as CR0279 to 36.211 in [R1-167933](#).**

7.1.2 Maintenance of Release 13 LTE carrier aggregation enhancement beyond 5 carriers

[R1-166600](#) Draft 36.213 CR Clarification on HARQ-ACK transmission CATT

The document was presented by Fang Chen Cheng from CATT.

Decision: The document is noted and **agreed as CR0719 to 36.213 in [R1-167936](#).**

7.1.3 Maintenance of Release 13 licensed-assisted access to unlicensed spectrum

[R1-166138](#) Correction on "special subframe" for frame structure type 3 in 36.213 for Rel-13 LAA Huawei, HiSilicon

The document was presented by Xia Yuan from Huawei.

Decision: The document is noted and **agreed as CR0718 to 36.213 in [R1-167934](#).**

[R1-166813](#) Correction on CSI reference resource definition in LAA LG Electronics

The document was presented by Joon Kui Ahn from LGE.

Decision: The document is noted. Continue offline discussion until Friday.

Friday: Not pursued.

[R1-167180](#) Correction for energy detection threshold for multi-carrier LBT operation in 36.213 for Rel-13 LAA Huawei, HiSilicon

Decision: The document is not pursued.

[R1-167181](#) Correction for PHICH resource reservation on the LAA cell in 36.211 for Rel-13 LAA Huawei, HiSilicon

The document was presented by Xia Yuan from Huawei.

Decision: The document is noted and **agreed as CR0280 to 36.211 in [R1-167935](#).**

[R1-167402](#) Correction on the determination of EPDCCH starting position ITRI

The document was presented by Chien-min Lee from ITRI.

Decision: The document is noted. Continue offline discussion until Friday.

Friday: CR0264 to 36.211 is agreed.

[R1-167785](#) Draft CR on LAA post transmission backoff BROADCOM LIMITED

The document was presented by Sindhu Verma from Broadcom.

Decision: The document is noted. Continue offline discussion until Friday.

Friday:

[R1-168546](#) CR on LAA post transmission backoff BROADCOM LIMITED

Decision: The document is noted. Typo in CR number. CR is revised and **agreed as CR0741r1 in [R1-168555](#).**

MCC: post meeting to correct wrong revision number.

7.1.4 Maintenance of Release 13 elevation beamforming/full-dimension MIMO for LTE

[R1-166230](#) Draft CR on FD-MIMO codebooks Qualcomm Incorporated

Decision: The document is noted. Continue offline discussion until Friday – Chao (Qualcomm)

Friday: revised in [R1-167937](#) and **agreed as CR0740 to 36.213 in [R1-168544](#).**

MCC: post meeting to add the missing WI code LTE_EBF_FDMIMO_Core and correct wrong revision number.

[R1-166337](#) Correction on FD-MIMO Codebooks in 36.213 Nokia, Alcatel-Lucent Shanghai Bell, Samsung

The document was presented by Min Zhang from Nokia.

Decision: The document is noted and **CR0693 to 36.213 is agreed.**

MCC: post meeting to add the missing WI code LTE_EBF_FDMIMO_Core.

[R1-166502](#) Correction on class B codebook Intel Corporation

Decision: The document is not pursued.

[R1-166338](#) Correction on RRC Parameters for SRS Enhancement in 36.213 Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by Min Zhang from Nokia.

Decision: The document is noted and **CR0694 to 36.213 is agreed.**

MCC: post meeting to add the missing WI code LTE_EBF_FDMIMO_Core.

[R1-166501](#) Quasi co-location assumptions for DM-RS antenna ports in MU-MIMO Intel Corporation

The document was presented by Alexei Davidov from Intel.

Discussion: .

Decision: The document is noted. Continue offline discussion until Friday.

Friday

[R1-168365](#) Quasi co-location assumptions for DM-RS antenna ports in MU-MIMO Intel Corporation

Decision: The document is not pursued.

[R1-166503](#) Correction on bitwidth of class A codebook Intel Corporation

Decision: The document is noted and [CR0213 to 36.212 is agreed in R1-167938](#).

MCC: Post meeting CR revision shall be corrected (rev 1 to be replaced by rev -) and WI code is LTE_EBF_FDMIMO-Core.

[R1-167168](#) Corrections on CRI bit width in 36.212 Huawei, HiSilicon

Decision: The document is noted and [CR0214 to 36.212 is agreed in R1-167939](#).

MCC: Post meeting CR revision shall be corrected (rev 1 to be replaced by rev -).

[R1-167678](#) Corrections on Codebooks in 36.213 Huawei, HiSilicon

Decision: The document is noted and [CR0710 to 36.213 is agreed](#).

MCC: Post meeting CR WI code shall be corrected to LTE_EBF_FDMIMO-Core.

[R1-167404](#) Correction on the citation of table indexes for mapping of ICRI to MCRIITRI

Decision: The document is noted and [CR0708 to 36.213 is agreed](#).

7.1.5 Maintenance of Release 13 further LTE physical layer enhancements for MTC

[R1-168400](#) Chairman's notes of AI 7.1.5 on Maintenance of Release 13 further LTE physical layer enhancements for MTC Ad-Hoc chair (Qualcomm)

The document was presented by Wanshi Chen from Qualcomm.

Decision: The document is endorsed and content is incorporated as follows.

UL compensation gaps

[R1-166655](#) Considerations on UL compensation gaps Sony

Valid subframes

[R1-166237](#) On valid MBSFN subframes and SIB2 decoding for eMTC Qualcomm Incorporated

[R1-166238](#) Draft LS for valid MBSFN subframes for eMTC Qualcomm Incorporated

Conclusion: Continue offline discussion coming up a suggested text for changing 36.331 (Qualcomm), as part of the LS.

Friday:

[R1-167959](#) Draft LS to RAN2 regarding valid MBSFN subframes for eMTC Qualcomm

Decision: The document is noted. The LS in [R1-167959](#) is [endorsed](#) with “MBSFN subframes are given by (2)” changed to “MBSFN subframes are given by (1)”. LS is revised and final version is agreed [in R1-168425](#).

[R1-167945](#) Draft CR for MBSFN subframes and SIB2 decoding Qualcomm Incorporated

Decision: The document is noted. The CR is [R1-167945](#) is [endorsed](#), and final CR is [agreed as CR0721r2 to 36.213 \(Rel-13, F\) in R1-168437](#).

[R1-167433](#) Clarification of valid subframe in eMTC Panasonic Corporation

Decision: The document is noted. The CR in [R1-167433](#) is [endorsed](#) with the update [non-BL/CE](#), and final CR is [agreed as CR0283 to 36.211 \(Rel-13, F\) in R1-168234](#).

[R1-167434](#) Clarification of valid subframe in eMTC Panasonic Corporation

Decision: The document is noted. The CR in [R1-167434](#) is [endorsed](#) with potential parameter name update (for offline discussion), and final CR to be prepared in [R1-168235](#)

Note: this CR is also to be included part of the offline discussion for the LS to RAN2 to be drafted by Alberto (Qualcomm)

Friday:

[R1-168235](#) Clarification of valid subframe in eMTC Panasonic Corporation

Decision: The document is not presented (different content). [Email discussion/approval based on R1-167434 until Sept 1st \(Panasonic\)](#)

[R1-167854](#) MBSFN subframes are invalid DL BL/CE subframes for BL/CE UE Ericsson

Not pursued.

DCI

[R1-166236](#) CR for SRS bit in DCI Qualcomm Incorporated
[R1-166622](#) Presence of SRS bit in DCI 6-0A and 6-1A Sequans Communications
[R1-166624](#) eMTC corrections for RAN1 specifications Sequans Communications (Section 6)
Decision: The CR in [R1-166236](#) is endorsed, and agreed as CR0738 to 36.213 (Rel-13, F) in [R1-168535](#).

[R1-167155](#) On the mapping of TPC command field to power correction values in TS 36.213 Huawei, HiSilicon
Decision: The CR in [R1-167155](#) is endorsed with the following update “0/3/4/[6-0A](#)”, and agreed as CR0723 to 36.213 (Rel-13, F) in [R1-168156](#).

[R1-167737](#) Draft CR for clarification of DCI sizes for format 6-1A (TM6 and TM9) in TS 36.212 Virtuosys Limited
Decision: Discuss further offline

Friday:
[R1-168161](#) Draft CR for clarification of DCI sizes for format 6-1A (TM6 and TM9) in TS 36.212 Virtuosys Limited
Decision: The CR in [R1-168161](#) is agreed in principle, and final CR is agreed in [R1-168452](#).

Post meeting: MCC noticed that wrong CR number was provided and revised [R1-168452](#) in [R1-168212](#) (CR0216r1 to 36.212)

MPDCCH

[R1-167941](#) Draft CR for clarification on MPDCCH monitoring on SFN rollover and search space overlap Qualcomm Incorporated

Decision: Continue offline discussion, including [R1-167862](#)

[R1-167862](#) Overlapping MPDCCH search spaces for BL/CE UE Ericsson

Friday:

[R1-168509](#) Clarification on MPDCCH monitoring on SFN rollover and search space overlap Qualcomm Incorporated
Decision: CR0736 to 36.213 (Rel-13, F) is agreed.

[R1-166621](#) MPDCCH search-space with Temporary C-RNTI Sequans Communications

Decision: CR0259 to 36.211 (Rel-13, F) is agreed.

[R1-166624](#) eMTC corrections for RAN1 specifications Sequans Communications (Section 3)

[R1-167154](#) Correction on MPDCCH in the special subframe for CEModeB in TS 36.211 Huawei, HiSilicon

Decision: The CR in [R1-167154](#) is endorsed in principle (further check offline about 36.213 text). Final CR is agreed as CR0281 to 36.211 in [R1-168153](#).

[R1-167184](#) Correction on the reference of narrowband definition in TS 36.213 Huawei, HiSilicon

Decision: CR0698 to 36.213 (Rel-13, F) is agreed.

[R1-167187](#) Correction on the MPDCCH scheduling Paging in special subframe in TS 36.213 Huawei, HiSilicon

Decision: The CR in [R1-167187](#) is endorsed with the following update (final CR to be prepared in [R1-168158](#))

- For TDD, in special subframes, and for MPDCCH in Type-1 -common search space

[R1-167403](#) Correction on the determination of DL narrowbands for MPDCCH candidates ITRI

[R1-167679](#) Correction on Type0-common search space monitoring in TS 36.213 Huawei, HiSilicon

[R1-167680](#) Correction on indentation in TS 36.211 Huawei, HiSilicon

Continue discussion offline.

Friday

[R1-168158](#) Correction on the MPDCCH scheduling Paging in special subframe in TS 36.213 Huawei, HiSilicon

Decision: CR0724 to 36.213 (Rel-13, F) is agreed.

PDSCH

[R1-166234](#) CR for PDSCH scrambling for SI Qualcomm Incorporated

[R1-167186](#) Correction on the scrambling initialization for SIB1-BR/SI for eMTC in TS 36.213 Huawei, HiSilicon

Decision: The CR in [R1-167186](#) is endorsed in principle (further discuss offline about the wording), and final CR is agreed as CR0700 to 36.213 (Rel-13, F) in [R1-168157](#).

[R1-166235](#) Draft CR for P-RNTI PDSCH hopping Qualcomm Incorporated

[R1-167849](#) Frequency hopping for PDSCH for SI and paging messages for BL/CE UE Ericsson

Decision: The CR in [R1-167849](#) is agreed, along with the CR in [R1-166235](#). Revised CR (using [R1-167849](#)) to be revisited in [R1-167953](#)

Decision: CR0272 to 36.211 (Rel-13, F) is agreed in [R1-167953](#).

[R1-166428](#) Remaining issues on eMTC CATT (Proposal 1)

[R1-167185](#) Correction on the relationship between IMCS and ITBS for DCI format 6-1A in TS 36.213 Huawei, HiSilicon
Decision: CR0699 to 36.213 (Rel-13, F) is agreed.

[R1-167714](#) RV version for PDSCH carrying paging Nokia, Alcatel-Lucent Shanghai Bell
Decision: Continue offline discussion

Friday:

[R1-168359](#) RV version for PDSCH carrying paging Nokia, Alcatel-Lucent Shanghai Bell
Decision: The CR in [R1-168359](#) is endorsed. Provide a revision with the change tracking on the cover sheet removed in [R1-168399](#) agreed as CR0729r1 to 36.213 (Rel-13, F).

[R1-167856](#) PDSCH start subframe in TDD for BL/CE UE Ericsson
Decision: The CR in [R1-167856](#) is endorsed by adding a space in between “DL” and “subframe”. Final CR is agreed as CR0714r1 to 36.213 (Rel-13, F) in [R1-168462](#).

DL reference signals

[R1-167153](#) Correction on scrambling sequence initialization for reference signals associated with PDSCH and MPDCCH in TS 36.211 Huawei, HiSilicon

[R1-167852](#) Scrambling of DL DMRS for BL/CE UE Ericsson
Decision: CR0275 to 36.211 (Rel-13, F) is agreed.

[R1-167861](#) Enable cross-subframe channel estimation for BL/CE UE Ericsson
Decision: CR0276 to 36.211 (Rel-13, F) is agreed.

CSI

[R1-166240](#) Draft CR for subband CQI report without hopping Qualcomm Incorporated
Decision: Continue offline discussion
Friday: No progress – continue discussion at next meeting.

[R1-166241](#) Draft CR for subband CQI report and TM6 Qualcomm Incorporated
Decision: The CR in [R1-166241](#) is endorsed, and final CR is agreed as CR0215 to 36.212 (Rel-13, F) in [R1-168287](#).

[R1-167857](#) Repetition with aperiodic CSI for BL/CE UE Ericsson
Decision: Continue offline discussion especially regarding whether or not UCI is transmitted in the same set of subframes for PUSCH transmission. Finally CR0715 to 36.213 (Rel-13, F) is agreed.
MCC: Post meeting CR number 0714 shall be replaced by 0715.

PUSCH

[R1-166683](#) Draft CR on RV Cycling for PUSCH Samsung
Decision: Further discussion offline, including PDSCH aspects
The CR in [R1-168161](#) is endorsed with the superscript PUSCH corrected to PDSCH, and final CR is agreed as CR0732 to 36.213 (Rel-13, F) in [R1-168450](#) (NOTE: MCC will take care of removing “DRAFT” on the cover page)

[R1-167311](#) Draft CR for PUSCH rate matching and SRS dropping Qualcomm Incorporated
Decision: Further discussion offline
Conclusion:

- The principle in [R1-167311](#) is aligned with RAN1 understanding. No CR is necessary.

PUCCH

[R1-166242](#) Draft CR for PUCCH transmission and invalid subframes Qualcomm Incorporated
Decision: Further discussion offline. Finally CR is agreed as CR0737 to 36.213 (Rel-13, F) in [R1-168521](#).

[R1-166243](#) Draft CR for aperiodic CSI with repetitions Qualcomm Incorporated

[R1-166244](#) Draft CR for PUCCH resource allocation Qualcomm Incorporated
Decision: The CR in [R1-166244](#) is endorsed, and final CR is agreed as CR0728 to 36.213 (Rel-13, F) in [R1-168519](#).

[R1-167858](#) PUCCH resource start offset in RRC_CONNECTED for BL/CE UE Ericsson
[R1-166428](#) Remaining issues on eMTC CATT (Proposal 2)

[R1-167677](#) Correction on the PUCCH transmission in TS 36.211 Huawei, HiSilicon

[R1-167864](#) Default UL frequency hopping interval for PUCCH for BL/CE UE Ericsson
Decision: Further discussion offline

UL frequency retuning

[R1-166498](#) On timeline issues with shortened PUCCH format Qualcomm Incorporated
[R1-166630](#) Simulation results for PUCCH frequency retuning NEC

[R1-166684](#) PUCCH Structure for Frequency Retuning Samsung

[R1-167848](#) PUCCH frequency retuning for BL/CE UE Ericsson

Further discussion offline

Further in the week:

[R1-168461](#) **WF on PUCCH retuning for BL/CE UE** Ericsson
[R1-168465](#) **Operation Alternatives for PUCCH Retuning** Samsung
[R1-168514](#) **WF on PUCCH retuning for BL/CE UE** Ericsson, Samsung, NEC, Qualcomm, Virtuosys, Sony, Sierra Wireless, NTT DoCoMo, AT&T, Intel
Also supported by Verizon

Agreements:

- PUCCH retuning gap for BL/CE UEs is created through puncturing
- RAN1 would discuss the possibility to have 1-bit signalling for PUCCH puncturing vs. PUCCH rate matching for PUCCH retuning in Rel-14

The corresponding CR to be drafted for email approval until 9/2 – (Ericsson)

Random access

[R1-166232](#) **Draft CR for clarification on PRACH system frame number** Qualcomm Incorporated

Decision: Further discussion offline. Finally CR is **agreed as CR0285 to 36.211 (Rel-13, F) in [R1-168508](#)**.

[R1-166233](#) **Draft CR for overriding of valid-invalid mask for msg3** Qualcomm Incorporated

[R1-166523](#) **Transport block size determination for Msg2** Sequans Communications

Decision: CR0695 to 36.213 (Rel-13, F) is agreed.

[R1-167855](#) **Msg2 TBS determination for BL/CE UE** Ericsson

[R1-166624](#) **eMTC corrections for RAN1 specifications** Sequans Communications (Sections 5 and 7)

[R1-167157](#) **Correction on the determining PRACH starting subframe in TS 36.211** Huawei, HiSilicon

Decision: Further discussion offline

[R1-167718](#) **Overriding of invalid subframe for msg3 PUSCH when R=1** Nokia, Alcatel-Lucent Shanghai Bell

Decision: CR in [R1-167718](#) is **endorsed** with the following update (final CR to be prepared in [R1-168424](#)).

- When **value of** is the number of Msg3 PUSCH repetitions

Decision: **CR0722r1 to 36.213 (Rel-13, F) is agreed in [R1-168424](#)**.

[R1-167853](#) **Default max number of PUSCH repetitions for Msg3 for BL/CE UE** Ericsson

Decision: Further discussion offline. Finally CR0711 to 36.213 (Rel-13, F) is agreed.

[R1-167940](#) **Correction for UL grant size in RAR** Sequans Communications

Late submission

Decision: Further discussion offline.

The CR in [R1-167940](#) is **agreed in principle** but should be based on 36.213 V13.2.0. Revised and **agreed [R1-168513](#) (CR0720r1 to 36.213)**.

[R1-167909](#) **Frequency hopping interval for MPDCCH during random access for BL/CE UE** Ericsson

Late submission

Decision: Further discussion offline. Finally CR0278 to 36.211 (Rel-13, F) is agreed.

Collisions

[R1-166619](#) **MPDCCH collision with PSS/SSS** Sequans Communications

Conclusion:

- The principle in [R1-166619](#) is aligned with RAN1 understanding. No CR is necessary

[R1-166620](#) **MPDCCH mapping over reserved CRS tones in PBCH subframes** Sequans Communications

Decision: Further discussion offline.

Conclusion:

- The principle in [R1-166620](#) is aligned with RAN1 understanding. No CR is necessary.

[R1-166624](#) **eMTC corrections for RAN1 specifications** Sequans Communications (Sections 2 and 4)

[R1-166659](#) **Simultaneous transmission & reception in HD-FDD** Sony

Conclusion:

- Proposal 1 in [R1-166659](#) is aligned with RAN1 understanding. No CR is necessary.

[R1-167156](#) **Clarification on collision between SR and PDSCH with repetitions in TS 36.213** Huawei, HiSilicon

Decision: Further discussion offline.

7.1.6 Maintenance of Release 13 NB-IoT

[R1-168401](#) **Chairman's notes of AI 7.1.6 on Maintenance of Release 13 NB-IoT Ad-Hoc chair (Qualcomm)**

The document was presented by Wanshi Chen from Qualcomm.

Decision: The document is endorsed and content is incorporated as follows.

DL Common Channels

[R1-166247](#) Draft CR for N_SF value for SI Qualcomm Incorporated

[R1-166197](#) Corrections on NPDSCH related procedure in TS 36.213 Huawei, HiSilicon

Decision: The CR in [R1-166197](#) is endorsed in principle. Refined text for the last change. Revised and agreed as CR0692r1 to 36.213 (Rel-13, F) in [R1-167990](#).

[R1-166642](#) Missing definition of higher layer parameter eutra-CRS-SequenceInfo NEC

[R1-167783](#) Corrections on Narrowband reference signal (NRS) in TS 36.211 Ericsson

Decision: Agree in principle to capture eutra-CRS-SequenceInfo related information in 36.213. Further discussion offline on the details. To be revisited in final CR in [R1-168319](#) (NEC)

Friday:

[R1-168319](#) Missing definition of higher layer parameter eutra-CRS-SequenceInfo NEC

Decision: Final CR is agreed as CR0730 to 36.213 (Rel-13, F) in [R1-168374](#).

[R1-167178](#) Corrections on the presence of NRS for standalone and guard band operation mode in TS 36.211
Huawei, HiSilicon

Also supported by Qualcomm, Intel

[R1-167437](#) Clarification of NRS assumption Panasonic Corporation

Also supported by ZTE, Ericsson, DCM, Nokia, ASB, Samsung, LGE

Decision: Continue discussion offline

[R1-168444](#) Corrections on the presence of NRS for standalone and guard band operation mode in TS 36.211
Huawei, HiSilicon

Decision: CR0263 to 36.211 (Rel-13, F) is agreed.

[R1-168238](#) Clarification of valid NB-IoT DL subframe configuration Samsung, Panasonic

[R1-168516](#) Clarification of NB-IoT DL subframe configuration Huawei, HiSilicon

Decision: The CR in [R1-168516](#) is endorsed, revised in:

[R1-168539](#) Clarification of NB-IoT DL subframe configuration Huawei, HiSilicon

Decision: CR0739 to 36.213 (Rel-13, F) is agreed.

[R1-167166](#) Correction on NPBCH in TS 36.211 Huawei, HiSilicon

Decision: CR0260 to 36.211 (Rel-13, F) is agreed.

[R1-167183](#) Correction on BCH rate matching in TS 36.212 Huawei, HiSilicon

Decision: CR0211 to 36.212 (Rel-13, F) is agreed.

[R1-167174](#) Correction on NPSS mapping in TS 36.211 Huawei, HiSilicon, Rohde & Schwarz

Decision: Continue discussion offline

Friday:

[R1-168293](#) Correction on NPSS mapping in TS 36.211 Huawei, HiSilicon, Rohde & Schwarz

Decision: CR0262r1 to 36.211 (Rel-13, F) is agreed.

LS received during RAN1#86

[R1-168340](#) LS on applicability of NRSRQ measurement RAN4, Huawei

[R1-168296](#) Correction on NRSRQ applicability Huawei, HiSilicon

Decision: CR0037 to 36.214 (Rel-13, F) is agreed.

Antenna Ports

[R1-167435](#) Correction of NB-IoT antenna port mapping Panasonic, Huawei, HiSilicon, NEC, MediaTek

Decision: The CR in [R1-167435](#) is endorsed in principle. Further re-wording offline. Final CR is agreed as CR0284 to 36.211 (Rel-13, F) in [R1-168236](#).

[R1-167436](#) Quasi-colocation of NB-IoT antenna ports Panasonic, Huawei, HiSilicon

Decision: The CR in [R1-167436](#) is endorsed with change from section 16.6 to 16.7. Further re-wording offline. Final CR is agreed as CR0726 to 36.213 (Rel-13, F) in [R1-168237](#).

Further discussion offline whether antenna port in 36.214 needs to be clarified or not (Panasonic)

Friday:

[R1-168199](#) Correction on NRS port number mapping Huawei, HiSilicon, Panasonic, Samsung

Decision: CR0036 to 36.214 (Rel-13, F) is agreed.

NPDCCH

[R1-166184](#) Correction on NPDCCH related procedure on TS 36.213 Huawei, HiSilicon

Decision: CR0690 to 36.213 (Rel-13, F) is agreed.

- Note: the gap includes the one under the sentence “If NPUSCH UL Gap is inserted at the end of NPUSCH transmission”

[R1-166499](#) Draft CR on parameters for NPDCCH order Qualcomm Incorporated

Decision: Further discussion offline, including the change from N0 to N1, whether or not N-PDCCH order is used or not, whether or not a mapping table is used, and “repetition level” to “repetition #”, whether or not the necessity of last sentence

Decision: No CR is necessary.

[R1-167312](#) Draft CR about Correction on PDCCH order related description ZTE

[R1-167176](#) On NPDCCH scrambling Huawei, HiSilicon

[R1-167179](#) Corrections on NPDCCH scrambling in TS 36.211 Huawei, HiSilicon

Withdrawn

[R1-167419](#) Corrections on NPDCCH scrambling in TS 36.211 Huawei, HiSilicon, Intel, Neul, Qualcomm

Also supported by MTK

Decision: CR0265 to 36.211 (Rel-13, F) is agreed.

[R1-167188](#) Corrections on NPDCCH search space for random access in connected mode in TS 36.213 Huawei, HiSilicon

Decision: CR0701 to 36.213 (Rel-13, F) is agreed.

NPDSCH

[R1-167313](#) Draft CR on clarification of scheduling delay ZTE

Decision: The CR of the first change of 16.3.3 in [R1-167313](#) is endorsed. Final CR is agreed as CR0734 to 36.213 (Rel-13, F) in [R1-168496](#).

[R1-167782](#) Corrections on DL Gap on NPDSCH TS 36.211 Ericsson

Decision: Further discussion offline

[R1-167438](#) Clarification of valid NB-IoT DL subframe configuration Panasonic Corporation

Decision: Further discussion offline

PUSCH

[R1-166180](#) Correction on DMRS for NB-IoT in TS 36.211 Huawei, HiSilicon

[R1-167314](#) Draft CR on clarification of DM RS ZTE

Decision: Further discussion offline on [R1-166180](#) and [R1-167314](#).

CR0253 to 36.211 (Rel-13, F) is agreed in [R1-166180](#).

[R1-166182](#) Correction on SC-FDMA signal generation for NB-IoT in TS 36.211 Huawei, HiSilicon

Decision: CR0255 to 36.211 (Rel-13, F) is agreed.

[R1-166641](#) Correction to SC-FDMA baseband signal generation for NB-IoT NEC

[R1-166245](#) Draft CR for PUSCH timing delay for NB-IoT Qualcomm Incorporated

Decision: Further discussion offline.

The CR in [R1-166245](#) is endorsed. Final CR is agreed as CR0731 to 36.213 (Rel-13, F) in [R1-168375](#).

[R1-167172](#) Correction on NPUSCH related procedure on TS 36.213 Huawei, HiSilicon

Decision: CR0696 to 36.213 (Rel-13, F) is agreed.

[R1-167316](#) Remaining issue on collision of NPUSCH and NPRACH ZTE

[R1-167173](#) Correction on UL collisions in TS 36.211 Huawei, HiSilicon

Decision: The CR in [R1-167173](#) is endorsed in principle. Offline discussion on refined wording (including whether possible LS to RAN2 and RAN4). Revised and agreed as CR0261r1 to 36.211 (Rel-13, F) in [R1-167991](#).

NPRACH

[R1-166181](#) Correction on NPRACH in TS 36.211 Huawei, HiSilicon

Decision: Revised and agreed as CR0254r1 to 36.211 (Rel-13, F) in [R1-168364](#).

[R1-166248](#) Draft CR for NPRACH generation Qualcomm Incorporated

[R1-167315](#) Draft CR on clarification of random access signal generation ZTE

[R1-167838](#) Corrections on NPRACH generation TS 36.211 Ericsson

Decision: Offline discussion for the above 4 CRs. To have a single final CR to be revisited in [R1-168364](#).

[R1-166183](#) Correction on random access procedure for NB-IoT on TS 36.213 Huawei, HiSilicon

Decision: The CR in [R1-166183](#) regarding section 16.3.2 is endorsed. Final CR is agreed as CR0689r1 to 36.213 (Rel-13, F) in [R1-167989](#).

[R1-168172](#) Introduction of a reserved range of NPRACH sub-carriers for contention based access, Ericsson, ZTE, Qualcomm

Decision: The CR in [R1-168172](#) is endorsed in principle, conditional on RAN2 approval of 36331CR2334. Remove the comment, and showing change tracking for deletion and insertion of equation. Final CR is agreed as CR0282r1 to 36.211 (Rel-13, F) in [R1-168495](#).

Other UL

[R1-166246](#) **Capability for NB-IoT uplink gaps** Qualcomm Incorporated

Decision: Further discussion offline

[R1-167317](#) **Remaining power control issue on multiple NB-IoT carriers operation** ZTE

Decision: Further discussion offline

[R1-168284](#) **WF on signaling of nrs-Power of non-anchor carrier** ZTE, Qualcomm, Panasonic

Agreement:

- nrs-Power offset of non-anchor PRB relative to nrs-Power of anchor PRB should be included in RRC signaling.
- Send LS to RAN2 – [R1-168474](#)
 - {-12, -10, -8, -6, -4, -2, -1, 0, 3}

[R1-168474](#) **LS on nrs-Power signaling for NB-IoT non-anchor carrier** ZTE

Decision: The document is noted and final LS is **agreed in R1-168497** including the above update.

RRC Parameters

[R1-166195](#) **Corrections to RRC parameter names for NB-IoT in TS 36.211** Huawei, HiSilicon

Decision: CR0256 to 36.211 (Rel-13, F) is agreed.

[R1-166196](#) **Corrections to RRC parameter names for NB-IoT in TS 36.213** Huawei, HiSilicon

Decision: CR0691 to 36.213 (Rel-13, F) is agreed.

[R1-167911](#) **Phase difference between NRS and CRS** Qualcomm Incorporated

Late submission

Decision: Further discussion offline

[R1-168358](#) **Phase difference between NRS and CRS** Qualcomm Incorporated

Decision: The draft CR in [R1-168358](#) is **endorsed** in principle, adding a note about overlap with LTE baseband signal generation sections. Final CR is agreed as CR0735 to 36.213 (Rel-13, F) in [R1-168507](#).

Note: this CR is not intended to change legacy LTE signal generation.

Post meeting: MCC noticed that wrong CR number was provided and revised [R1-168507](#) in [R1-168219](#) (**CR0287r1 to 36.211**).

7.2 LTE Release 14

7.2.1 Enhanced Licensed-Assisted Access to Unlicensed Spectrum *WID* in [RP-160881](#).

[R1-168402](#) **Chairman's notes of AI 7.2.1 on Enhanced Licensed-Assisted Access to Unlicensed Spectrum Ad-Hoc chair (Nokia, Ericsson)**

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and incorporated as follows.

Draft CRs

[R1-166224](#) Introduction of eLAA into 36.212 HuaWei Technologies Co., Ltd

[R1-167898](#) Introduction of eLAA (PHY layer aspects) in 36.213 Motorola Mobility

[R1-167899](#) Introduction of eLAA (UL Channel Access Procedure) in 36.213 Motorola Mobility

Friday

Rapporteur will provide a list of agreements and WA until August 29th.

Editors shall provide updated draft CRs until Sept 6th, for email approval by Sept 12th.

7.2.1.1 PUSCH design

Remaining details including PUSCH structure, resource allocation and scheduling aspects

Agreement: For enabling the start times within the first DFTS-OFDM symbol, a longer cyclic prefix for the next DFTS-OFDM symbol to occupy part of the first DFTS-OFDM symbol is used

Agreement:

- RA field in DCI 0A/4A/0B/4B is 6 bits
- The 64 code points indicated by the 6 bits include the legacy RIV for contiguous interlace allocation except the code points for the allocation of 7 contiguous interlaces (70 PRBs)
 - This set of code points has 51 values
- Additional code points are defined for allocation of interlaces as follows:
 - 0,1,5,6
 - 2,3,4,7,8,9
 - 0, 5

- 1, 6
- 2, 7
- 3, 8
- 4, 9
- 1, 2, 3, 4, 6, 7, 8, 9
- Remaining code points are reserved

Agreement: One of four starting symbol positions can be signaled for the first subframe in DCI formats 0A/4A/0B/4B

Agreement: LBT type is not explicitly signaled to the UE for SRS without PUSCH.

Agreement:

- MCS 0-28 indicated to the UE in DCI formats 0A/4A/0B/4B are interpreted according to the uplink MCS table for modulation and TBS
- RV is explicitly signaled for all MCSs.

Agreement:

- TB disabling is indicated if MCS 29 is indicated for the corresponding TB in DCI formats 4A/4B.
 - The disabling applies for all scheduled subframes for DCI format 4B

Agreement:

- An aperiodic CSI report without UL-SCH is triggered when the UE receives DCI formats 0A/0B with MCS 29 and an aperiodic CSI trigger
- An aperiodic CSI report without UL-SCH is triggered when the UE receives DCI formats 4A/4B with MCS 29 for both TBs and an aperiodic CSI trigger
- UE is not expected to receive an aperiodic CSI only request if more than one subframe is scheduled with DCI formats 0B/4B

Agreement:

- 4 bits for timing offset are included in DCI format 0A/4A
 - Note: This is already agreed for DCI format 0B/4B
- DCI format 0A/4A includes 4 bits indicating HARQ process ID
 - Note: This is already agreed for DCI format 0B/4B
- DCI format 0A includes 2 bits RV indicating RV=0, 1, 2, or 3
- DCI format 4A includes 2 bits RV indicating RV=0, 1, 2 or 3 which is common to both TBs

Agreement:

- For each DCI format 0B, 4A and 4B the following BD adjustment is applied
 - (0, 33, 66, 100)% for 1st and 2nd AL and (0, 50, 100, 150)% for 3rd to 5th AL

Agreement: If not otherwise indicated by the RRC parameter supportedBlindDecoding-r13, the eNB can assume the total number of supported blind decodes to be #CCs_supported*32+#CCs_UL_TM2_supported*16 USS BDs

- SRS triggering offset in format 0B/4B (Klaus)

R1-168028

WF on SRS triggering with DCI Format 4B

Nokia, ASB

Agreement:

- For SRS triggered with DCI format 4B, the SRS subframe location is determined relative/as an offset n to the first subframe of the multi-subframe scheduling burst according to

$$n = \text{mod}(x, N)$$

where x is the value of the SRS subframe indication in the SRS parameter set configuration ($x \in \{0, 1, 2, 3\}$) and N is the number of scheduled UL subframes.

Discussion on: TPC code point for max power (Qualcomm)

Proposal:

- One of the code points for TPC in DCI Format 0A/0B/4A/4B indicates the UE to transmit at the highest allowed power on that serving cell
 - In the accumulated mode, the TPC command indicates $\{-1, 0, 1, [\text{full power or large step}]\}$
 - In the absolute mode, the TPC command indicates
 - Option 1: $\{-4, 0, 4, [\text{full power or large step}]\}$
 - Option 2: $\{-4, -1, 1, 4\}$ (no change from current proposal)

Agreement:

- Precoder indicator field in DCI format 4B applies to all the subframes in the DCI
 - Mapping to number of layers and TPMI is the same as DCI format 4
- A single DMRS and OCC field is signaled for all subframes indicated in DCI formats 0B/4B
 - The parameter $n^{\wedge}(2)_{\text{DMRS}, \text{Lambda}}$ applies to all indicated subframes

Agreement: The UE is not expected to start a new transmission subject to LBT earlier than 1 DFTS-OFDM symbol after the end of the previous transmission by the UE

Friday

Agreements:

- C-PDCCH indicates a pair of values (UL burst duration, offset)
 - UL burst duration is the number of consecutive UL subframes belonging to the same channel occupancy, with the DL subframes in the same channel occupancy signaling the UL burst duration.
 - Offset is the number of subframes to the start of indicated UL burst from the start of the subframe carrying the C-PDCCH.
 - The LBT procedure for any UL subframe from the subframe in which C-PDCCH was received upto and including all subframes until the end of the signaled UL burst duration, for which the eNB had already indicated to perform Category 4 LBT, can be switched to an LBT based on 25 us CCA.
 - The UE shall not switch to 25 us CCA if only part of a set of contiguously scheduled subframes without gap appears in the UL burst indication
 - The UE is not required to receive any DL signals/channels in a subframe indicated to be a UL subframe on the carrier
 - 5 bits to indicate combinations of offset and burst duration.
 - The code points include {offset, duration} combinations as follows
 - All combinations of $\{1, 2, 3, 4, 6\}$, $\{1, 2, 3, 4, 5, 6\}$
 - Reserved
 - No signaling of burst and offset

Agreements:

- DCI 0A/4A/0B/4B includes a single bit to indicate whether the UL grant is a triggered grant or not.
- If it is a triggered grant, the UE may transmit after receiving a 1 bit trigger in the PDCCH DCI scrambled with CC-RNTI in a subframe received after the subframe carrying the UL grant
- The timing between the 2nd trigger transmitted in subframe N and the earliest UL transmission is a UE capability, if the earliest UL transmission is before subframe N+4 (UE capability signaling between transmission in subframe N+1 and N+2 and N+3)
- The 4 bit field 'SF timing' in DCI format 0A/4A/0B/4B for the triggered grant is reused as follows:
 - When the UE may transmit after reception of the trigger is signaled to the UE 2 bits are reused to indicate X:
 - Having received a trigger in subframe N, the UE is allowed to start transmission in subframe N+X+Y
 - $X = \{0, 1, 2, 3\}$ indicated reusing two bits in the DCI
 - Y is given by the UL burst offset in the C-PDCCH DCI scrambled by CC-RNTI in the same subframe where the trigger is transmitted
 - The UE receives signaling in the first DCI 0A/4A/0B/4B grant indicating the number of subframes after which the grant becomes invalid reusing 2bits. The initial grant becomes invalid if M ms after the initial grant, no valid trigger has been received.
 - 2 bit: $M = \{8, 12, 16, 20\}$
- UE follows the LBT type indicated by the UL grant

Agreements:

- When CSI report is triggered using DCI 0A/4A/0B/4B, the reference subframe is the last valid subframe with reference to the subframe in which the CSI report is transmitted
- Note: This may not need any specification change

Agreement: DCI formats 0A and 1A which are transmitted in the same serving cell and that schedule the same serving cell shall have the same sizes. Bit padding is used to achieve this.

R1-166123	PUSCH resource allocation	Huawei, HiSilicon	
R1-166124	Enabling transmissions within the first SC-FDMA symbol in a subframe		Huawei, HiSilicon
R1-166137	Two-stage scheduling for eLAA	Huawei, HiSilicon	
R1-166249	Remaining details of PUSCH waveform	Qualcomm Incorporated	

R1-166250	TBS selection for PUSCH for multi-TTI grants	Qualcomm Incorporated
R1-166251	PUSCH and eLAA procedures	Qualcomm Incorporated
R1-166252	Control details for UL scheduling	Qualcomm Incorporated
R1-166253	Remaining details of DCI and UL search space design	Qualcomm Incorporated
R1-166504	PUSCH resource allocation method	Intel Corporation
R1-166505	Indication of the starting PUSCH DFT-S-OFDM symbols	Intel Corporation
R1-166506	Remaining issues with PUSCH structure	Intel Corporation
R1-166631	Remaining issues on PUSCH resource allocation	NEC
R1-166667	eLAA PUSCH transmission	Fujitsu
R1-166685	Remaining issues on PUSCH design for eLAA	Samsung
R1-166686	PUSCH Scheduling and Resource Allocation	Samsung
R1-166814	Remaining issues on PUSCH transmission in LAA	LG Electronics
R1-166815	Remaining issues on DCI formats for UL scheduling in LAA	LG Electronics
R1-166987	Remaining details of PUSCH design for eLAA	ZTE
R1-167024	PUSCH resource allocation details	Nokia, Alcatel-Lucent Shanghai Bell
R1-167026	Remaining Issues on LAA SCell PUSCH Transmit Power	Nokia, Alcatel-Lucent Shanghai Bell
R1-167073	On remaining scheduling aspects for eLAA	Nokia, Alcatel-Lucent Shanghai Bell
R1-167074	On Two-Stage UL scheduling for eLAA	Nokia, Alcatel-Lucent Shanghai Bell
R1-167075	On eLAA UE blind decoding capabilities	Nokia, Alcatel-Lucent Shanghai Bell
R1-167133	Special handling of MCS/TBS for normal PUSCH and the PUSCH containing UCI/SRS/blanking symbol(s)	Huawei, HiSilicon
R1-167182	Remaining issues on scheduling design for eLAA	Huawei, HiSilicon
R1-167190	Discussion on synchronous and asynchronous HARQ method for eLAA	Huawei, HiSilicon
R1-167343	Remaining details on PUSCH resource allocation and scheduling design for eLAA	NTT DOCOMO, INC.
R1-167344	Discussion on power headroom report and buffer status report enhancement for eLAA	NTT DOCOMO, INC.
R1-167420	MCS, TBS and TPMI Determination in Single and Multi-Subframe Grants	Panasonic
R1-167421	Codeword Disabling for eLAA Uplink MIMO	Panasonic
R1-167605	Remaining details on DCI design for multiple-subframe scheduling for LAA UL	SHARP Corporation, MTI
R1-167606	Remaining details on PUSCH structure for LAA UL	SHARP Corporation
R1-167719	On PUSCH Structure for Transmission within First DFTS-OFDM Symbol	Ericsson
R1-167720	On Resource Allocation Aspects for eLAA	Ericsson
R1-167721	On Remaining details of Scheduling Aspects for eLAA	Ericsson
R1-167734	Indication of starting symbol for multi-subframe scheduling	ETRI
R1-167776	Resource Allocation with Minimal Predefined Patterns for eLAA PUSCH	KT Corp.
R1-168093	WF on eLAA PUSCH retransmission with synchronous HARQ	Huawei, HiSilicon
R1-168182	WF on simultaneous transmission of periodic and aperiodic CSI in eLAA	Qualcomm

7.2.1.2 SRS design

Remaining details including whether SRS is transmitted for small gaps between SRS and following PUSCH

Agreement (Update of previous agreements: (RAN1#85 Email discussion [85-05-04]))

- If the triggering for SRS without PUSCH is received in a DL assignment in subframe n, the UE should send SRS without PUSCH in subframe n+k (not considering the LBT failure).
 - The SRS transmission is not limited to DL ending partial subframe
- k is indicated by 3 bits in DL grant. "000" represents no triggering for SRS without PUSCH; "001"~"111" represents SRS without PUSCH is transmitted in subframe n+4~n+10 respectively.

R1-166136	Remaining issues on LBT for SRS for eLAA	Huawei, HiSilicon
R1-166254	SRS procedures for eLAA	Qualcomm Incorporated
R1-166663	LBT parameters for SRS in eLAA	Sony
R1-166687	Remaining issues of SRS transmission followed by PUSCH	Samsung
R1-166816	Consideration on SRS and following PUSCH	LG Electronics
R1-166988	Remaining details of SRS design for eLAA	ZTE
R1-167625	On the Subframe Indication in SRS Triggering in eLAA	Nokia, Alcatel-Lucent Shanghai Bell
R1-167722	On the Minimum Gap between SRS and PUSCH Transmissions	Ericsson

7.2.1.3 Channel access framework

Remaining details including LBT options for SRS not immediately followed by PUSCH, contention window size adjustment for UL Category 4 LBT, continuing transmission of continuously scheduled subframes, energy detection threshold, LBT related signaling aspects and revised and 2-stage grants.

R1-168078	WF on multi-carrier UL LBT operation	Huawei, HiSilicon
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Agreement:

- A UE that has received UL grants on a set of carriers scheduled with Cat. 4 LBT with the same starting point in the subframe on all carriers can switch to a 25 us LBT immediately before transmission on a carrier in the set if Cat. 4 LBT has successfully completed on a designated carrier in the set.
 - The UE must select one carrier uniformly randomly among the carriers which were scheduled with Cat. 4 LBT as the designated carrier prior to starting the Cat. 4 LBT procedure on any of the carriers in the set.
- Note: if operating in the 5GHz band, refer to the ETSI regulations w.r.t. choosing the set of carriers.

Proposal:

- An eNB starting the DL transmission based on Type B multi-carrier LBT acquiring a given MCOT, can share its channel occupancy with its UEs on all the carriers completing Type B LBT.
 - The channel occupancy is started with a DL transmission after the carrier performing Cat.4 LBT completes Cat.4 LBT

Friday

Agreement:

- An eNB starting the DL transmission based on Type B multi-carrier LBT acquiring a given MCOT, can share its channel occupancy with its UEs on each of the carriers completing 25us LBT in the DL, if the UL transmission follows the previous subframes (DL transmission or UL transmission from other UEs on the same carrier) with a gap of not more than 25us and a successful 25us UL LBT is performed by the UE within the gap
-

Agreements:

- When the UE is scheduled two sets of UL subframes with Cat. 4 LBT, with two different UL grants and the Cat. 4 LBT does not complete for transmission of any of the subframes in the first set of UL subframes, then the Category 4 LBT for the second set of UL subframes is performed as follows
 - If the LBT priority class of the second set of UL subframes is the same as the first set of UL subframes, the UE may continue the Cat. 4 LBT for the first set of subframes for transmission of the second set of UL subframes
 - If the LBT priority class of the second set of UL subframes is different from the first set of UL subframes
 - If the LBT priority class of the second set of UL subframes(e.g. Class 1) is higher than the priority class of the first set of UL subframes (e.g., Class 3), the UE may terminate the previous Cat. 4 LBT and start a new Cat. 4 LBT
 - If the LBT priority class of the second set of UL subframes (e.g., Class 3) is lower than the priority class of the first set of UL subframes (e.g., Class 1), the UE shall terminate the previous Cat. 4 LBT and start a new Cat. 4 LBT
 - Note: If the UE continues Cat. 4 LBT, it shall use all the Cat. 4 LBT parameters that were used for the first set of subframes

R1-168165

WF on UE PSD restriction in eLAA

LG Electronics, Nokia, ASB

R1-168181

WF on supporting triggering based UL grants in eLAA

Qualcomm, Nokia, ASB, Intel, ZTE, Fujitsu,

Huawei, HiSilicon

Agreement:

- For LBT for SRS not transmitted contiguously with PUSCH, a Cat. 4 LBT with priority class 1 is used.
- SRS transmissions do not contribute to the contention window update.

Agreement (Update of previous agreement)

- ~~FFS:~~ For a set of consecutive scheduled subframes without any gaps that are subject to LBT, after the first successful LBT in that set, the UE continues transmission for all the remaining subframes in the set.
 - **FFS: Early termination of the channel occupancy**

Agreement: For category 4 LBT for PUSCH transmission on LAA SCell, the CWS is adjusted per UE and at UE based on the following procedures at UE and eNB:

- If the UE fails to transmit all of the scheduled contiguous subframes with a category 4 LBT, UE may keep the contention window size unchanged for all the LBT priority classes.
- The first subframe with UL-SCH that was transmitted at least 4 ms prior to the UL grant reception in the most recent transmitted burst of contiguous subframes that is transmitted after performing a category 4 LBT procedure is defined as the reference subframe. The HARQ ID of the reference subframe is HARQ_ID_ref.
- Based on the UL grant content

- if the NDI bit for at least one of the active HARQ processes (i.e. TB not disabled) of HARQ_ID_ref in the reference subframe is toggled, the contention window size at the UE is reset for all the priority classes.
- Otherwise (i.e. HARQ_ID_ref not scheduled or NDI of the active HARQ process(es) of HARQ_ID_ref not toggled) the contention window size of all priority classes at the UE is increased to the next higher value.
- The CWS is reset to the minimum value if the maximum CWS is used for K consecutive LBT attempts for transmission only for the priority class for which maximum CWS is used for K consecutive LBT attempts.
 - K is selected by UE implementation from the set of values from (1, ...,8).

Agreement:

- The maximum energy detection threshold requirement for a UE is aligned with the requirement for an eNB as specified in Rel-13
- The eNB can signal a RRC parameter to the UE so that the UE can derive a maximum energy detection threshold value.
 - If no RRC signalling is received, the UE uses a default maximum energy detection threshold value, X_Thresh_Max, as defined in Rel-13, using P_{c_max_H,c} for P_{TX} in the calculation of X_Thresh_Max

Agreement:

- RRC signaling has the ability to indicate to a UE either an absolute maximum energy detection threshold value or an offset to the default maximum energy detection threshold value
- Absolute maximum energy detection threshold values are indicated in the range of -85 dBm to -52 dBm in steps of 1 dB.
- Offset to the default maximum energy detection threshold value are indicated in the range of -13 dB to +20 dB in steps of 1 dB.
- Note: Ability to signal a certain maximum energy detection threshold does not indicate feasibility of operating at that threshold value.

R1-168345 Draft LS on further RRC Parameters for Enhanced LAA for LTE Huawei

Decision: The document is noted and final LS is **agreed in R1-168346**

Agreement: The UE is not required to consider LBT success or failure on the set of carriers on which transmission is attempted in order to apply power scaling rules for that set of carriers

Agreement: If the UE starts a contiguous transmission spanning a set of subframes on an LAA SCell, and the UE suspends transmission prior to the last scheduled subframe in the transmission, then the UE may resume transmission on the remaining subframes in the transmission immediately after performing an LBT of duration 25 microseconds if the channel was observed to be continuously idle since the transmission was suspended. If the channel was not observed to be continuously idle, then the UE may resume transmission after performing a successful Cat. 4 LBT with LBT parameters according to the indicated LBT priority class in the UL grant that scheduled the subframe in the transmission.

Agreement: The UE may expect an LBT priority class field in a UL grant regardless of the LBT type indicated to the UE in the UL grant. If 25 us LBT is indicated as the LBT type, then the LBT priority class is the one used by the eNB to obtain access to the channel. If Cat. 4 LBT is indicated as the LBT type, then the LBT priority is the one that is to be used by the UE to perform its Cat. 4 LBT.

Agreement: If the eNB schedules UL transport blocks with 25 us LBT in a shared channel occupancy without scheduling any DL transport blocks and if less than 10% of the scheduled UL transport blocks have been received successfully, the eNB increases its contention window size, otherwise the eNB resets its contention window.

R1-166134	Signaling for UL LBT parameters for eLAA Huawei, HiSilicon
R1-166135	Contention window size adjustment for UL category 4 LBT for eLAA Huawei, HiSilicon
R1-166255	Remaining details of UL LBT Qualcomm Incorporated
R1-166507	Remaining details of the UL channel access mechanism Intel Corporation
R1-166508	Necessary modifications to existing Logical Channel Prioritization mechanism Intel Corporation
R1-166688	Remaining issues on CWS adjustment for Cat 4 LBT Samsung
R1-166689	Remaining issues of LBT for SRS Samsung
R1-166690	Remaining issues of LBT signalling Samsung
R1-166691	Discussion on two-step UL grant scheduling Samsung
R1-166817	CWS adjustment for LAA LG Electronics
R1-166818	LBT parameter signalling in LAA LG Electronics
R1-166819	Remaining details on UL LBT for LAA LG Electronics
R1-166989	Remaining details of LBT Design for eLAA ZTE
R1-167132	Discussion on UL multi-carrier LBT for eLAA Huawei, HiSilicon
R1-167196	Channel access scheme for UE multiplexing Kyocera Corporation
R1-167345	Remaining details on channel access framework for eLAA NTT DOCOMO, INC.

R1-167509	Remaining issues of LBT mechanism for LAA uplink	Lenovo (Beijing) Ltd
R1-167607	Remaining details on channel access framework for LAA UL	SHARP Corporation
R1-167626	Remaining Issues on Channel Access for LAA UL	Nokia, Alcatel-Lucent Shanghai Bell
R1-167627	Multi-Carrier Channel Access for LAA UL	Nokia, Alcatel-Lucent Shanghai Bell
R1-167692	Common PDCCH design	Intel Corporation
R1-167723	On Contention Window Adjustment for Category 4 UL LBT	Ericsson
R1-167724	Additional Evaluations for eLAA	Ericsson
R1-167725	Energy Detection Threshold for eLAA	Ericsson
R1-167726	On Reported RSSI from Wi-Fi Devices	Ericsson
R1-167727	On Continuous Transmission for Consecutive Scheduled UL Subframes	Ericsson
R1-167728	On LBT Related Signaling for eLAA	Ericsson
R1-167729	On Remaining LBT details for Transmission of SRS without PUSCH	Ericsson
R1-167731	Discussion on overlapping of LBT procedures	HTC Corporation
R1-167735	CWS adjustment mechanism for CAT 4 UL LBT in eLAA	ETRI
R1-167736	Remaining details of SRS LBT for eLAA	ETRI
R1-167769	Considerations for the Cat 4 CW size adjustment	Sequans Communications
R1-167780	Contention Window adaptation procedure for Uplink CAT 4 LBT in eLAA	BROADCOM LIMITED
R1-167781	Details of Cat 4 LBT procedure for eLAA Uplink	BROADCOM LIMITED
R1-167786	Discussion on Modifying UL LBT Type	WILUS Inc.
R1-167787	Indication of Reference Subframe for CW adjustment	WILUS Inc.
R1-167788	UL Multi-carrier Transmission for eLAA	WILUS Inc.
R1-167793	Discussion on LBT for aperiodic SRS transmissions not multiplexed with PUSCH	BROADCOM LIMITED
R1-167800	Handling of transmission errors in case of consecutively scheduled Uplink subframes in eLAA	BROADCOM LIMITED
R1-168077	WF on UL transmission for consecutive subframes	Huawei, HiSilicon
R1-168242	WF on CWS adjustment for category 4 UL LBT in eLAA	LG Electronics
R1-168361	Way forward on the UL burst duration indication	Intel

7.2.1.4 Other

[R1-166820](#) UCI transmission for LAALG Electronics

7.2.2 Support for V2V services based on LTE sidelink - *WID in RP-161272*

[R1-168403](#) Chairman's notes of AI 72.2 on Support for V2V services based on LTE sidelink Ad-Hoc chair
(Nokia, LGE)

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and incorporated as follows.

Friday

Rapporteur will provide a list of agreements and WA until August 29th.

Editors shall provide updated draft CRs until Sept 6th, for email approval by Sept 12th.

Draft CRs

R1-166223	Introduction of V2V into TS36.212	HuaWei Technologies Co., Ltd
R1-167900	Introduction of V2V into TS36.213	Motorola Mobility

[R1-168458](#) 36.201CR0016 Introduction of V2V into 36.201 Nokia

Modify section 4.2.1 as follows:

Sidelink transmissions are defined for ProSe Direct Discovery and ProSe Direct Communication between UEs. The sidelink transmissions use the same frame structure as uplink and downlink when the UEs are in network coverage; however, the sidelink transmissions are restricted to a sub-set of the uplink resources. [V2X communication between UEs is supported via sidelink transmissions or via the eNB.](#)

Revised and [agreed in R1-168201](#).

R1-168100	Summary of Monday V2V offline discussions	LG Electronics
R1-168247	Summary of Wednesday V2V offline discussions	LG Electronics
R1-168451	Summary of Thursday V2V offline discussions	LG Electronics

Agreements:

- Only normal CP is supported in Rel-14 V2V WI.
- For PSCCH DM RS, the proposal in [R1-168439](#) with u = 8

The following LS was received during the week:

[R1-168126](#) Response LS to Priority for V2V RAN WG2

[R1-168245](#) Draft LS on RAN1 agreements in sidelink-based V2V LG Electronics [RAN WG1]

Updated in [R1-168249](#). Approved in [R1-168251](#) with the following change:

- At least when SA and data are transmitted in the same subframe, SA resource should be reselected only when the associated data resource is reselected

[R1-168246](#) Draft LS on L1 parameters for sidelink-based V2V LG Electronics, [RAN WG1]

Revised and approved in [R1-168252](#) with the following change:

- Add the probability p used in Step 3 with the value range [0, 0.2, 0.4, 0.6, 0.8].
- Capture the following in the comments of “Minimum of PSSCH MCS” and “Maximum of PSSCH MCS”:
 - Note that the current RAN1 specification does not support 64 QAM in sidelink.
- **Overall Description:**

RAN1 agreed on L1 parameters for LTE_SL_V2V-Core. RAN1 would like to inform RAN2 that the list of agreed L1 parameters is in the attached spreadsheet. Changes to the content of [R1-165968](#) are marked in yellow. RAN1 would like to observe that congestion control and synchronization will be discussed and the outcome may have RRC impact.

7.2.2.1 Remaining details of physical layer structure

Including RS sequence of PSSCH/PSBCH

[R1-168117](#) WF on PSSCH DMRS LG Electronics, Huawei, HiSilicon, Nokia

Agreement:

- Destination ID is not signaled via SA.
- 16 CRC bits from SA are used in generating PSSCH DMRS sequence and data scrambling sequence.

[R1-168440](#) WF on PSSCH sequence on V2V LG Electronics, KT, Intel

Agreement:

Parameter		PSSCH
Group hopping		enabled
	n_{ID}^{RS}	n_X
	n_s	$2n_{ss}^{PSSCH} + k, k = 0,1$
	f_{ss}	$\lfloor n_X/16 \rfloor \bmod 30$
Sequence hopping		disabled
Cyclic shift	$n_{CS,\lambda}$	$\lfloor n_X/2 \rfloor \bmod 8$
Orthogonal sequence	$[w^{(0)} w^{(1)} w^{(2)} w^{(3)}]$	$[+1 +1 +1 +1]$ if $n_X \bmod 2 = 0$ $[+1 -1 +1 -1]$ if $n_X \bmod 2 = 1$
Reference signal length	M_{sc}^{RS}	M_{sc}^{PSSCH}
Number of layers	$\mathcal{O}$	1
Number of antenna ports	P	1

where $r_{PSSCH}^{(\lambda)}(m \cdot M_{sc}^{RS} + n) = w^{(\lambda)}(m) r_{u,v}^{(\alpha_\lambda)}(n)$, $m = 0,1,2,3$

n_X is X bits in SA to be used in generating PSSCH DMRS sequence.

Formula for n_s for group hopping to be confirmed on Friday.

Friday: Formula for n_s for group hopping is confirmed.

[R1-166164](#) Details of PSSCH DMRS design Huawei, HiSilicon

[R1-166256](#) Link Level Enhancements for V2V Qualcomm Incorporated

[R1-166509](#) Remaining details of PSSCH and PSSCH physical layer structure for V2V communication Intel Corporation

[R1-166510](#) Remaining details of PSBCH physical layer structure for V2V communication Intel Corporation

[R1-166575](#) Considerations on DMRS Sequence Selection Beijing Xinwei Telecom Techn.

[R1-166713](#) Remaining details on DMRS Samsung

R1-166821	Remaining details on DMRS for PSCCH and PSSCH	LG Electronics
R1-166822	Remaining details on DMRS for PSBCH	LG Electronics
R1-166823	Remaining issues on physical layer structure for PC5-based V2V	LG Electronics
R1-166951	Outstanding Physical Layer Structure Details and Receiver Behavior for Sidelink V2V	Ericsson
R1-166959	DMRS design details for PSCCH, PSSCH and PSBCH	Ericsson
R1-166976	RS sequence of PSCCH/PSSCH	ZTE
R1-167151	Discussion of transmission parameters range of PSSCH	Huawei, HiSilicon
R1-167750	DM-RS sequence for PSCCH/PSSCH/PSBCH in V2V	Innovative Technology Lab Co.
R1-168381	WF on PSBCH demodulation for V2V communication	Intel Corporation
R1-168439	WF on PSCCH sequence on V2V	LG Electronics
R1-168472	WF on V2V Cyclic Prefix	Qualcomm, CATT

7.2.2.2 Remaining details of UE autonomous resource selection mode

R1-168475	WF on Resource definition	Ericsson
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7.2.2.2.1 Details of transmission resource (re)selection based on SA decoding and power/energy measurement

*Including down-selection of the options for sensing and transmission resource selection, considering the working assumption
“Priority information in a decoded SCI is used in resource (re)selection”*

Agreements:

- Step 2: UE excludes resources at least based on SA decoding and additional conditions.
- When SA and its associated data are transmitted in same subframe, option 2-1 (measure on DMRS of PSSCH) is supported
 - Option 2-1: A resource is excluded if it is indicated or reserved by a decoded SA and PSSCH RSRP in the associated data resource is above a threshold.
 - PSSCH Reference Signal Received Power (PSSCH-RSRP) is defined as the linear average over the power contributions (in [W]) of the resource elements that carry demodulation reference signals associated with PSSCH, within PRBs indicated by the associated PSCCH.
 - The reference point for the PSSCH-RSRP shall be the antenna connector of the UE.
 - If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding PSSCH-RSRP of any of the individual diversity branches.
- The threshold is a (pre)configurable function of the priority information.
 - SA contains the 3-bit PPPP field.
 - The threshold is in a range between [-128 dBm] and [0 dBm] with the granularity of [2] dB including minus infinity and plus infinity.
 - **Email discussion until Sept. 2nd on the numbers in the brackets – (Huawei)**
 - The threshold is dependent of both the priority information of the TB to be transmitted and the priority information of the decoded SA.
 - 64 thresholds are (pre)configured in total.
- In Step 2, a UE that decodes an SA in TTI $m + c$ within the sensing period assumes that the same frequency resource is reserved by the SA transmitter UE at TTI $m + d + P \cdot i$.
 - P is a parameter fixed to 100 in Rel-14. Possible configurability of this parameter in future releases should be considered in the CR.
 - i is selected in the range [0, 1, ..., 10] which will be restricted by carrier-specific network configuration or preconfiguration. $i=0$ means “no intention to reserve the frequency resource.”
 - RAN1 assumes the full flexibility in signaling this restriction, e.g., 10-bit bitmap is signaled in this (pre)configuration to indicate each of [1, ..., 10] is allowed or not.
 - Selection of i is up to UE implementation. RAN1 assumes that UE performs no transmission or no resource reservation if it has no data. FFS in RAN2 how to ensure this RAN1 assumption.
 - i is signalled in the SA using a 4-bit field.
- In Step 2, if an instance of a candidate semi-persistent resource X with the period of $P \cdot I$ collides with a next instance of the resource Y , which is reserved by another UE's SA and meets the condition of exclusion in the agreed threshold-test, then the UE shall exclude resource X .
 - I is the value to be signaled for i in its SA.
- If the number of remaining resource after Step 2 is smaller than [20]% of the total resources within the selection window, the UE repeats Step 2 using all the thresholds increased by [3] dB until the number of remaining resource after Step 2 is larger than [20]% of the total resources.
 - Each resource in this counting corresponds to the desired resource allocation.
 - Other mechanisms related to the congestion control will be discussed in the V2X WI if time is not allowed in the V2V WI.
 - Companies are encouraged to check what the proper number above is. The number can be revisited during the CR phase.
- In Step 3,

- The measurement periodicity of PSSCH resource is P in this step.
 - The measurement is restricted to the resources remaining after Step 2.

Consideration of the following are moved to the V2X work item:

- Case of SA and its associated data being transmitted in different subframes

Agreement: “The total resources within the selection window” above means the total resources in the interval determined in Step 1 to identify the resources the UE must take into account as possible candidates resources.

Agreement:

- In Step 3,
 - Step 3-0: When the counter reaches zero,
 - With probability p, the UE keeps the current resource and the counter is reset.
 - With probability 1-p, resource is reselected by Step 3-1 and 3-2.
 - Carrier-specific parameter p is (pre)configured in the range [0, 0.2, 0.4, 0.6, 0.8].
 - Step 3-1: UE measures and ranks the remaining PSSCH resources based on total received energy and selects a subset
 - The subset is the set of candidate resources with the lowest total received energy. The size of the subset is [20]% of the total resources within the selection window.
 - Note that the size of this subset is equal to the minimum possible size of the outcome of Step 2.
 - Step 3-2: UE randomly selects one resource from the subset
- When a TB is transmitted in one subframe, when a UE tries to select M sub-channels in one subframe in Step 3, a resource can be any M contiguous sub-channels not excluded in Step 2.
- Energy measurement of each resource is the average of the energy measured in each constituent sub-channel.

Email discussion until September 2nd on the definition of the energy measurement in each sub-channel - (LGE).
[20%] value to be checked until RAN1#86bis.

Agreement:

- When a TB is transmitted in two subframes, at least the following resource selection is supported:
 - One resource is selected using the mechanism defined for the case where a TB is transmitted in one subframe.
 - Selection of another resource is random under the condition that
 - The selected resource shall be in the remaining subset of the outcome of step 3, and
 - The selected resource shall not be in the same subframe as the first resource, and
 - The SCI shall be able to indicate the time gap between the two selected resources.
 - If no resource can meet the condition for the second resource selection, a TB is transmitted only using the first resource.

Any other resource selection methods can be considered in the V2X work item, taking into account progress in ETSI, e.g. the following:

The resource allocation follows the resource allocation when a TB is transmitted in a single subframe, but the resource is defined as a set of subchannels in two consecutive subframes.

SA resource selection

[R1-166826](#) **Resource selection details for UE autonomous resource selection mode in PC5-based V2V** **LG Electronics**

Decision: The document (Section 2.2) is noted.

[R1-167834](#) **V2V SA Resource selection** **PANASONIC R&D Center Germany**

[R1-167923](#) **WF on SA and data association** **Huawei, HiSilicon, LGE, Ericsson, Qualcomm**

Also supported by Panasonic.

Agreement: A UE cannot transmit TB without SA, i.e., SA is transmitted with each (re)transmission of a TB.

Agreement: At least when a pool is (pre)configured such that a UE always transmits SA and data in the same subframe, UE is not expected to combine PSCCH transmitted in different subframes.

Agreement:

- When a pool is (pre)configured such that a UE always transmits SA and data in adjacent RBs in the same subframe,
 - The sub-channel with the lowest index among those selected for data transmission is used for SA transmission.
- When a pool is (pre)configured such that a UE can transmit SA and data in non-adjacent RBs in the same subframe,
 - The number of SA candidate resources in a SA pool is the same as the number of sub-channels in the associated data pool.
 - Sequential one-to-one association is made between an SA candidate resource and a sub-channel in the

- associated data pool.
 - The SA resource associated with the lowest index among those selected for data transmission is used for SA transmission.
- PSCCH DM RS CS is blindly detected.
 - Transmitter UE randomly selects one CS out of 4 candidates (details FFS) for every PSCCH transmission.
 - At each SA resource candidate, a UE is not required to decode more than one PSCCH.
 - It is RAN1 understanding that a UE will select the CS with the highest reception power. The related UE requirement is up to RAN4 decision.
- At least when SA and data are transmitted in the same subframe, SA resource should be reselected only when the associated data resource is reselected.

R1-168264 WF on resource selection for SA CATT

R1-166169	Details of sensing procedure and resource (re)selection triggering mechanisms	Huawei, HiSilicon
R1-166204	Discussion on the remaining issues for priority handling	Huawei, HiSilicon
R1-166257	Details of sensing using autonomous resource selection for V2V	Qualcomm Incorporated
R1-166429	Discussion on UE autonomous resource selection mechanism in V2V	CATT
R1-166511	Sidelink measurements for V2V sensing and resource re-selection procedures	Intel Corporation
R1-166512	Transmitter behavior for sidelink resource re-selection	Intel Corporation
R1-166714	Details on sensing based resource (re)selection	Samsung
R1-166825	Sensing details for UE autonomous resource selection mode in PC5-based V2V	LG Electronics
R1-166977	SA and data resource (re)selection	ZTE
R1-167008	Resource reselection triggers	Ericsson
R1-167009	Resource reselection	Ericsson
R1-167013	Subchannelization and measurements for sensing for V2V over PC5	Ericsson
R1-167076	Discussion on triggering resource reselection based on collision detection	Sony
R1-167355	Further details of UE autonomous resource (re)selection for V2V	NTT DOCOMO, Inc.
R1-167409	Explicit/implicit resource (re)selection based on SA decoding/energy measurement	ITRI
R1-167586	Resource selection using SA decoding and energy measurements	INTERDIGITAL COMMUNICATIONS
R1-167587	Priority handling for V2V over PC5	INTERDIGITAL COMMUNICATIONS
R1-167693	Design options to support priority for V2V communication	Intel Corporation
R1-167694	Discussion on resource selection aspects to support V2V communication with different transmission periodicity	Intel Corporation
R1-167835	Discussion on resource selection and indication in V2V based on sensing	PANASONIC R&D Center Germany
R1-168380	WF on V2V priority specific thresholds	Intel Corporation
R1-168383	WF on step #3 of V2V resource reselection procedure	Intel Corporation
R1-168384	WF on UE-specific transmission windows for V2V communication	Intel Corporation
R1-168454	WF on resource selection for multiple transmissions	CATT, Qualcomm Incorporated, LG Electronics

7.2.2.2.2 Details of timing of PSCCH/PSSCH transmission and the indication of the intention to reuse the frequency resource for another TB

Including the discussion points identified in [85-09]

Agreement

- UE makes resource selection/reselection decision at TTI m ($\geq n$).
 - TTI m when the UE makes resource selection/reselection decision is the arrival time of the corresponding TB.
- For resource reselection, the UE must take into account as possible candidates resources in the interval $[m+T1, m+T2]$ in Step 1.
 - $T1 \leq [4]$ where $T1$ is up to UE implementation.
 - $20 \leq T2 \leq 100$ where $T2$ is up to UE implementation.
 - Selection of $T2$ shall fulfill the latency requirement.
- Sensing window is changed to $[m-a, m-b)$, where $a=b+1000$ and $b=1$.
- Note: If there is any inconsistency between the above proposal and the existing agreement, the above proposal overrides.
- If a problem is found, e.g., in designing the time resource indication in SCI, this agreement may be revisited.

R1-166258	Details of semi-persistent transmission for V2V	Qualcomm Incorporated
R1-166435	Discussion on details of resource reselection and reservation	CATT
R1-166513	On timing relationship between sensing window, packet arrival, resource reselection trigger, PSCCH and PSSCH transmissions	Intel Corporation

R1-166643	Contents of Schedule Assignment for SPS	NEC
R1-166715	Timeline of PSCCH/PSSCH transmission and resource reservation	Samsung
R1-166827	Remaining details of the indication of resource reservation	LG Electronics
R1-166978	Considerations for UE SPS resource selection and indication	ZTE
R1-167077	Discussion on the remaining issues of transmission UE behaviour	Sony
R1-167356	Further details of sensing based semi-persistent resource selection for V2V	NTT DOCOMO, Inc.
R1-167588	Forward reservation of resources on PSCCH/INTERDIGITAL COMMUNICATIONS	
R1-167751	Details on PSCCH/PSSCH transmission timing in UE autonomous resource selection mode	Innovative Technology Lab Co.
R1-167926	Details of sensing timeline design	Huawei, HiSilicon
R1-168139	WF on the timeline of sensing and PHY channel transmissions	LGE
R1-168145	WF on reservation indication	LGE
R1-168382	WF on timing relationship for V2V sensing and resource selection	Intel Corporation

7.2.2.2.3 Details of the measurement metric to reflect the congestion level

[R1-168348](#) WF on CBR measurement Ericsson

Decision: For email discussion until September 2nd (Ericsson)

[R1-168080](#) WF on V2V congestion control Ericsson

Decision: For email discussion until September 2nd (Ericsson)

R1-166166	Congestion control for V2V	Huawei, HiSilicon
R1-166259	Measurement metric for congestion control	Qualcomm Incorporated
R1-166431	Measurement metric for the congestion level in V2X	CATT
R1-166514	Metric and sidelink measurements for V2V congestion control	Intel Corporation
R1-166616	UE measurement based congestion control	Guangdong OPPO Mobile Telecom.
R1-166716	Discussion on congestion control	Samsung
R1-166828	Details of congestion level measurement	LG Electronics
R1-166953	Radio measurements for congestion control for V2X	Ericsson
R1-166955	Congestion Control Framework for V2V	Ericsson
R1-166969	Discussion on channel busy ratio measurement in V2V	Panasonic
R1-166979	Discussion on congestion control of PC5 carrier	ZTE
R1-167410	Considering measurement metric and report for zone based resource management in V2V service	ITRI
R1-167422	Adaptation of MCS, RB allocation, and number of retransmissions	Ericsson
R1-167621	Discussion on details of UE measurement for resource reselection	Potevio
R1-167745	Congestion management for V2V in 5.9GHz ITS	VODAFONE Group Plc
R1-167802	On congestion control for V2V communication	Nokia, Alcatel-Lucent Shanghai Bell
R1-168079	WF on CBR Measurement	Ericsson
R1-168349	Harmonized WF on Pools Configuration	Ericsson, Huawei, HiSilicon
R1-168506	Harmonized WF on Pools Configuration	Ericsson

7.2.2.2.4 Other

[R1-166644](#) On the needs of collision detection and resolution in V2X NEC

7.2.2.3 Remaining details of resource pool design

Including how to configure SA and data resources and how a data pool is associated with an SA pool

[R1-168101](#) WF on resource pool configuration LG Electronics

Agreement:

- Case 1: When a pool is (pre)configured such that a UE always transmits SA and data in adjacent RBs in the same subframe,
 - The resource pool consists of one or multiple sub-channels in frequency domain.
 - A sub-channel consists of a group of contiguous RBs in a same subframe.
 - The sub-channel size in a resource pool can be configured by eNB or preconfigured.
 - Candidate size of a sub-channel is {5, 6, 10, 15, 20, 25, 50, 75, 100}
 - Each sub-channel includes one SA resource candidate at the low end of the sub-channel from system perspective.
 - The SA resource candidate can be used for data transmissions.
 - Resource pool configuration includes the number of sub-channels in the pool.
 - Different sub-channels have disjoint group of adjacent RBs.

- Case 2: When a pool is (pre)configured such that a UE transmits SA and data potentially in non-adjacent RBs in the same subframe,
 - The PSSCH resource pool consists of one or multiple sub-channels in frequency domain.
 - A sub-channel consists of a group of contiguous RBs in a same subframe.
 - The sub-channel size in a resource pool can be configured by eNB or preconfigured.
 - **Candidate size is for email discussion until September 2nd (LGE).**
 - Note that only the RB sizes supported for UE transmission in Rel-13 will be supported in Rel-14 V2V.
 - The maximum number of sub-channels possible in a subframe is 20.
 - The minimum candidate size is not less than 4.
 - PSSCH resource pool configuration includes the number of sub-channels in the pool.
 - Different sub-channels have disjoint group of adjacent RBs.
 - A resource pool consists of N contiguous PRBs in frequency domain.
 - $N = \text{The sub-channel size} * \text{the number of sub-channels}$.
 - The PSCCH resource pool consists of a set of contiguous PRBs.
 - The size of a PSCCH resource pool is configurable.
 - Candidates of PSCCH resource are disjoint.
- Energy sensing granularity of PSSCH in Step 3 is the size of sub-channel.
- The UE always (re)selects an integer number of adjacent subchannels for transmission.
- A UE is not expected to try to decode more than [100] RBs in a subframe.
- A UE is not expected to try to decode more than [10] PSCCHs in a subframe.
- SA pool and the associated data pool can overlap. An SA pool and a non-associated data pool can overlap.
 - This overrides the existing agreement including “An RB of an SA pool in a TTI cannot be included an un-associated data pool (if exists)” made in RAN1#84bis.

Agreement:

- When a pool is (pre)configured such that a UE always transmits SA and data in adjacent RBs in the same subframe,
 - A resource pool consists of N contiguous PRBs in frequency domain.
 - $N = \text{The sub-channel size} * \text{the number of sub-channels}$.
 - A UE transmits PSSCH on the largest subset of PRBs in the selected sub-channel(s) subject to the DFT size restriction and the adjacency to the associated SA resource.
- When a pool is (pre)configured such that a UE can transmit SA and data in non-adjacent RBs in the same subframe,
 - The UE always transmits on an integer number of adjacent subchannels.

R1-168082 WF on pools for V2X Ericsson

Agreement:

- V2V pool is defined by a repeating bitmap mapped to all subframes except for at least SLSS subframes which are skipped
 - The bitmap length is 16, 20, or 100.
 - FFS if/how to handle the case where the bitmap does not repeat an integer number of times within the DFN period
- The bitmap defines which subframes are allowed for V2V SA/data transmission and/or reception for a pool.

Association of SA and data

R1-166162 Multiplexing of SA and its associated data Huawei, HiSilicon
R1-167925 WF on time resources indication Huawei, HiSilicon, LGE, Ericsson

Agreement:

- Once resource reselection is triggered, UE reselects resources for all the transmissions corresponding to a TB.
- SA only schedules transmission(s) corresponding to one TB.
- UE is not required to perform PSSCH-RSRP measurement in a TTI that occurs before the reception of a successfully decoded associated SA.
 - UE applies the PSSCH-RSRP measured in a TTI that occurs at or after the reception of a successfully decoded associated SA to a TTI that is indicated by the SA but occurs before the reception of the SA.
- Number of transmissions of a TB is 1 or 2.
- Each SA indicates the time/frequency resources of all the data transmissions corresponding to the same TB.

R1-166161 Resource pool design Huawei, HiSilicon
R1-166163 Indication of time and frequency resources Huawei, HiSilicon

R1-166260	Details of Resource Pool Design	Qualcomm Incorporated
R1-166436	Resource pool enhancement in PC5-based V2V	CATT
R1-166515	Details of resource pool design for sidelink V2V communication	Intel Corporation
R1-166576	Consideration on V2V sub-channelisation	Beijing Xinwei Telecom Techn.
R1-166645	Resource pool design for V2X	NEC
R1-166717	Details on resource pool design	Samsung
R1-166829	Remaining issues for resource pool configuration	LG Electronics
R1-166963	On the orthogonality of SA and data pools	Ericsson
R1-166974	Pool design for V2V	Ericsson
R1-166975	On Pools Overlap for Mode 1 and Mode 2	Ericsson
R1-166980	Discussion on resource pools for V2V	ZTE
R1-167357	Discussion on resource pool for PC5 based V2V Communications	NTT DOCOMO, Inc.
R1-167619	V2V resource pool allocation	Potevio
R1-167695	On PSCCH and PSSCH retransmission and combining options	Intel Corporation
R1-167922	WF on floating period	Huawei, HiSilicon, CATT
R1-167924	WF on SA resource allocation	Huawei, HiSilicon
R1-168060	WF on resource pool signalling	LG Electronics, Huawei, ITRI

7.2.2.4 Remaining details of scheduling for sidelink resource in eNB scheduling mode

R1-166956	Cross carrier and multi-operator scheduling for V2V over PC5	Ericsson
R1-168471	WF on DCI for PC5-based V2V with mode-1	CMCC

7.2.2.4.1 Details of DCI format for SPS and dynamic scheduling

Including how to trigger/release different SPS configurations

R1-166126	Enhancements to support cross-carrier scheduling for V2V	Huawei, HiSilicon
R1-166167	SPS enhancement for V2V	Huawei, HiSilicon
R1-166203	DCI design for V2V	Huawei, HiSilicon
R1-166261	Details of DCI and SPS configuration	Qualcomm Incorporated
R1-166430	Discussion on eNB signaling in V2V mode 1	CATT
R1-166718	Sidelink SPS operation for eNB scheduling mode	Samsung
R1-166830	Remaining details of (E)PDCCH design of scheduling for sidelink resource	LG Electronics
R1-166957	Contents of Downlink Control Information for V2V over PC5	Ericsson
R1-166970	Discussion on DCI design in V2V	Panasonic
R1-166981	Scheduling of V2V SPS resources	ZTE
R1-167091	Details of DCI in eNB scheduling mode	CMCC
R1-167358	(E)PDCCH for sidelink SPS configuration switching	NTT DOCOMO, Inc.
R1-167589	DCI contents for SPS and resource allocation in Mode 1	INTERDIGITAL COMMUNICATIONS
R1-167839	Details on PC5 SPS enhancement	PANASONIC R&D Center Germany

[R1-168301](#) WF on DCI used for multiple SPS configurations NTT DOCOMO, Huawei, HiSilicon, Panasonic, CMCC, ITRI

Agreement:

- DCI for dynamic scheduling:
 - At least the following fields are included in the DCI
 - CIF (3 bits)
 - Interpretation of CIF is (pre)configured. This (pre)configuration can be different from CIF for UL/DL.
 - Lowest index of the sub-channel allocated to the initial transmission
 - SA content
 - Time gap between initial transmission and retransmission: [4] bits
 - Frequency resource location of the initial transmission and retransmission: 8 bits
 - FFS
 - TPC
 - The DCI length is the same as DCI format 0 configured for UL of the UE.
 - An RNTI different from C-RNTI/SPS-RNTI is used.
 - Time location of the initial transmission is the first subframe included in the resource pool on the V2V carrier that occurs after 4 ms from the DCI transmission subframe.
- Email discussion until September 2nd to finalise the above square-bracketed figure and FFS (Qualcomm)

SPS scheduling is postponed to V2X work item, e.g.:

- For SPS, the following are included in the DCI in addition to the content of the DCI for dynamic scheduling:
 - SPS configuration indicator
 - FFS whether this can indicate more than 1 SPS configuration
 - SPS activation / release indicator

7.2.2.5 Remaining details of SCI contents

R1-166202	Scheduling assignment design for V2V	Huawei, HiSilicon
R1-166262	Details of SCI	Qualcomm Incorporated
R1-166434	Discussion on contents of scheduling assignment	CATT
R1-166516	Scheduling assignment for sidelink V2V communication	Intel Corporation
R1-166719	SCI size and SCI contents	Samsung
R1-166831	Remaining issues on SCI contents	LG Electronics
R1-166971	Repetition and relationship between SA and associated data	Panasonic
R1-166982	Discussion on SA content	ZTE
R1-167011	Contents of PSCCH for V2V over PC5	Ericsson
R1-167359	Discussion on enhancement of scheduling assignment in V2V communications	NTT DOCOMO, Inc.
R1-167510	SA contents for V2V	Lenovo (Beijing) Ltd
R1-167590	SCI contents for R14 V2V INTERDIGITAL COMMUNICATIONS	

[R1-168379](#) WF on V2V priority signaling Intel Corporation

Agreement:

- SCI contents (48 bits in total):
 - Priority: 3 bits
 - Resource reservation: 4 bits
 - MCS: 5 bits
 - CRC: 16 bits
 - Retransmission index: 1 bit
 - Time gap between initial transmission and retransmission: [4] bits
 - This field indicates a value in [0, [15]]. Value 0 means no retransmission of the associated TB.
 - Frequency resource location of the initial transmission and retransmission: **Working assumption**: 8 bits
 - Frequency location of the other transmission and the number subchannels are jointly encoded.
 - Reserved bits: [7] bits
 - A UE transmitting SCI defined in Rel-14 V2V WI shall set all these bits to 0.
 - A UE shall not use this field as virtual CRC.
- RV 0 and 2 are used for the initial transmission and retransmissions, respectively.

Email discussion until September 2nd to confirm the above working assumption and square-bracketed figures, and the details of joint encoding of frequency location of the other transmission and number of subchannels - (Huawei)

7.2.2.6 Remaining details of coexistence of PC5-based V2V operation and legacy Uu operation

Including prioritizing sidelink transmissions over UL transmissions

R1-166125	Coexistence of cellular and V2V services on the same carrier	Huawei, HiSilicon
R1-166263	Coexistence of PC5 and Uu for V2V	Qualcomm Incorporated
R1-166720	Coexistence of Uu and PC5 based V2V	Samsung
R1-166832	Remaining issues on coexistence of PC5-based V2V and legacy Uu	LG Electronics
R1-166961	On the Need for V2V Gaps	Ericsson
R1-166983	Co-existence of PC5-based V2V operation and legacy Uu operation	ZTE
R1-167175	Coexistence of cellular and V2V services in partial network coverage	Huawei, HiSilicon
R1-167360	Details of prioritizing sidelink transmissions over UL transmissions	NTT DOCOMO, Inc.
R1-167591	Coexistence of PC5-based V2V and legacy Uu operation	INTERDIGITAL COMMUNICATIONS
R1-167803	On Prioritization of V2V Sidelink TX over WAN UL TX	Nokia, Alcatel-Lucent Shanghai Bell
R1-168302	WF on prioritizing of LS V2V communication	NTT DOCOMO

Power control

R1-166206	Power control for SA and data	Huawei, HiSilicon
R1-168146	WF on power control	LG Electronics, Huawei, HiSilicon, Qualcomm

Agreement:

- When PSCCH and the associated PSSCH are transmitted in the same subframe,
 - Power control parameters are (pre)configured only for PSSCH.

- PSD offset to that of PSSCH is used to determine the transmission power of PSCCH.
 - The PSD offset is fixed to X(FFS in [0, 3]) dB in specifications.
 - **Friday: Email approval on FFS until September 1st – (LGE)**
- For all cases, the PSD difference between PSCCH and PSSCH shall be the same as the PSD offset value.

7.2.2.7 Remaining details of sidelink synchronization procedure

Including priority order of synchronization sources for remaining cases. Low priority is given to enhancements to Rel-12/13 SLSS-based synchronization.

R1-168283

WF on GNSS Priority for Synchronization

Huawei, HiSilicon

Agreement:

- GNSS is at the highest priority of synchronization source for time and frequency when the following conditions are met:
 - The UE is out of coverage on the V2X carrier (as defined by RAN2)
 - The UE does not receive any eNB synchronization configuration
 - The UE directly receives GNSS with sufficient reliability (as defined by RAN4)
 - The UE does not receive any SLSS_net signal with in-coverage indicator 1
- The existing agreements apply when at least one of the above conditions is not met.
 - FFS UE behaviour when the UE is out-of-coverage and receives SLSS_net.
- RAN1 observed the potential benefit of (pre)configuring an offset to shift the DFN #0 w.r.t the reference timing derived from GNSS. RAN1 assumes that RAN2 will decide whether this feature will be included in the outcome of V2V WI.
 - The offset is in range [0, 1 ms] with the granularity of 1 us.
- LS to RAN2 to inform this (Stefano – Ericsson) in [R1-168244](#). **Approved in [R1-168250](#)** with adding RAN4 to CC.

Agreement: SLSS period is 160 ms. Note that this changes the existing working assumption.

R1-166168	Timing alignment of different synchronization sources for V2V	Huawei, HiSilicon
R1-166200	OOB sync priority and SLSS ID set definition	Huawei, HiSilicon
R1-166201	PSBCH contents and SLSS transmission procedure	Huawei, HiSilicon
R1-166207	Sidelink synchronization enhancement in V2V communication	Huawei, HiSilicon
R1-166264	Synchronization Procedure for V2V	Qualcomm Incorporated
R1-166432	Synchronization enhancements in PC5-based V2V	CATT
R1-166433	Timing alignment for V2V	CATT
R1-166517	Sidelink synchronization procedure for V2V communication	Intel Corporation
R1-166617	Discussion on the GNSS based synchronization	Guangdong OPPO Mobile Telecom.
R1-166618	Discussion on the V2V synchronization source priority	Guangdong OPPO Mobile Telecom.
R1-166721	Remaining issues on sidelink synchronization	Samsung
R1-166833	Remaining details of sidelink synchronization	LG Electronics
R1-166960	Distributed Synchronization Procedure for V2X over PC5	Ericsson
R1-166964	Receiver Timing Assumptions for V2V SL Operation	Ericsson
R1-166984	The remaining details of sidelink synchronization procedure	ZTE
R1-167007	PSBCH Contents for V2V	Ericsson
R1-167012	V2V Signals Transmission Dropping for SLSS Reception	Ericsson
R1-167014	SLSS/PSBCH and Transmitter Behavior under Congestion Control Restrictions	Ericsson
R1-167361	SLSS enhancements for GNSS based synchronization	NTT DOCOMO, Inc.
R1-167411	Discussion priority order and multiple synchronization references on sidelink synchronization procedure for V2V communication	ITRI
R1-167412	Coordination among multiple synchronization sources on sidelink synchronization procedure for V2V communications	ITRI
R1-167592	Priority order of synchronization sources	INTERDIGITAL COMMUNICATIONS
R1-167608	Further Discussions on V2V Synchronization Design	SHARP Corporation, MTI
R1-167804	Final details of V2V synchronization procedure	Nokia, Alcatel-Lucent Shanghai Bell
R1-167837	V2V synchronization remaining issues	PANASONIC R&D Center Germany
R1-168081	WF on SLSS periodicity	Ericsson, Qualcomm, ZTE
R1-168455	WF on SLSS ID	CATT, LG Electronics

7.2.2.8 Other

R1-166834	Open issues for V2V work item completion	LG Electronics
R1-166835	on supporting 64 QAM for PC5-based V2V	LG Electronics
R1-167152	Discussion on inband emission suppression for V2V communications	Huawei, HiSilicon

Rapporteur will capture in the status report all remaining essential issues of V2V that are to be transferred to the V2X WI.
LS to RAN2:

[R1-168203](#) LS on L1 parameters for sidelink-based V2V RAN1, LGE

Decision: LS is agreed.

7.2.3 LTE-based V2X Services - WID in [RP-161298](#)

[R1-168404](#) Chairman's notes of AI 7.2.3 on LTE-based V2X Services Ad-Hoc chair (Nokia)

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and incorporated as follows.

[R1-166836](#) Work plan for LTE-based V2X Services LG Electronics

7.2.3.1 Enhancement to UL SPS

Including support for multiple SPS configurations

[R1-166170](#) SPS enhancement on Uu for V2X Huawei, HiSilicon

[R1-166265](#) Uplink SPS enhancements for V2X Qualcomm Incorporated

[R1-166437](#) Discussion on enhancement of UL SPS in V2X CATT

[R1-167015](#) UL-SPS for LTE-based V2X services Ericsson

Agreements:

- A SPS RNTI for V2X over Uu is necessary.
 - FFS whether this SPS RNTI is specific to V2X or can be the same as the legacy SPS C-RNTI
- A DCI format 0 for V2X scrambled by the SPS RNTI for V2X is used to activate or update the SPS.
- Both explicit release and an implicit release mechanism for SPS over Uu are supported (details FFS).
- Explicit signaling from the UE to the eNB (ask RAN2 if they can design the appropriate signalling, e.g. using a MAC CE) can be used to indicate to the eNB when activation/update/release is desired.
 - For activation, a “desirable time offset” (e.g. relative to SFN0) is included
- When the period is to be changed, the UE notifies the eNB with the new period
- Multiple SPS configurations can be active at the same time.
 - An indicator(s) in DCI format 0 (e.g. SPS index or an indicator mapped to SPS index) is used to differentiate SPS configurations.
 - FFS whether existing field(s) (e.g. TPC for PUSCH) is reused or a new field is added
 - FFS whether each SPS configuration is always activated/released by a separate DCI or whether multiple SPS configurations can be activated or released by a single DCI.
- In the event of a resource conflict between SPS configurations, only one transmission can occur
 - RAN1 leaves it up to RAN2 to determine any possible mechanism for resolving resource conflicts between SPS configurations

[R1-166837](#) Discussion on details of (E)PDCCH design for uplink SPS LG Electronics

7.2.3.2 Resource selection for pedestrian UEs

Including random resource selection for P-UEs potentially on the PC5 resource pool shared with V-UE transmissions, with additional study on sensing operation during a limited time for P-UEs

[R1-166838](#) Discussion on P-UE sidelink transmissions LG Electronics

[R1-166266](#) PC5 for V2P Qualcomm Incorporated

[R1-167805](#) On resource selection for V2P communication Nokia, Alcatel-Lucent Shanghai Bell

[R1-166723](#) Resource selection for pedestrian UE Samsung

[R1-166205](#) Discussion on the P-UE resource selection Huawei, HiSilicon

[R1-166986](#) Considerations for resource selection for P-UEs ZTE

[R1-166965](#) Discussion on P2x Ericsson

[R1-167362](#) Evaluation and discussion on resource selection for pedestrian UEs NTT DOCOMO, Inc.

Revised in [R1-167886](#)

[R1-167869](#) Discussion on sensing operation for P-UE Sequans Communications

[R1-166438](#) Discussion on resource selection for P-UE CATT

[R1-166993](#) Discussion on resource sensing and selection for pedestrian UEs Spreadtrum Communications

[R1-167512](#) Discussion on resource selection for pedestrian UEs Lenovo (Beijing) Ltd

[R1-167609](#) Power Efficient Sensing for V2X Pedestrian UEs SHARP Corporation

[R1-168083](#) WF on new P2x transmission mode Ericsson

R1-168385 WF on pedestrian UE resource selection NTT Docomo, Huawei, HiSilicon

Proposal:

- If shared Tx resource pool is used by pedestrian UEs and vehicle UEs
 - Pedestrian UE can sense in a subset of subframes and skip sensing in other subframes for energy saving
 - FFS details on how/when UE skip sensing
 - Vehicle UE resource selection is reused as the baseline for pedestrian UE resource selection
 - FFS details
 - FFS whether pedestrian UE can skip sensing in all the subframes and use random resource selection

Agreement:

- The specification supports the possibility for a P-UE to use random selection, including at least all P-UEs which do not have sidelink Rx capability
 - If a P-UE uses random selection, it shall only pools in which random selection by P-UEs is permitted
 - It is up to network configuration whether a pool in which random selection by P-UEs is permitted overlaps with other pools
 - The specification supports the possibility to configure pools in which random selection by P-UEs is not permitted
- The specification supports the possibility for a P-UE to use partial sensing in a subset of subframes
 - Details of P-UE partial sensing are FFS
 - V2V sensing-based resource selection is the baseline; strive to define P-UE partial sensing-based resource selection to be as similar as possible to V2V sensing-based resource selection
 - FFS whether support of partial sensing is mandatory for P-UEs with sidelink Rx capability
 - FFS under what conditions a P-UE that supports partial sensing uses partial sensing
 - If a P-UE uses partial sensing,
 - details of resource pool FFS

Pedestrian Authorization

R1-167817	Discussion on Pedestrian Authorization	Ericsson
R1-167828	[DRAFT] LS on Pedestrian Authorization	Ericsson
R1-168084	WF on authorization for pedestrian UEs	Ericsson

7.2.3.3 Other

Including support of inter-PLMN for Uu and PC5

R1-166208	Discussion on inter-PLMN supporting	Huawei, HiSilicon
R1-166209	Design for multi-carrier operation	Huawei, HiSilicon
R1-166267	Inter-PLMN support for PC5 and Uu	Qualcomm Incorporated
R1-166268	Co-channel coexistence for DSRC and LTE-V2V	Qualcomm Incorporated
R1-166839	Considerations on the co-channel coexistence of LTE PC5 V2V and IEEE 802.11p	LG Electronics
R1-166962	Discussion on inter-PLMN V2x PC5 and Uu operation	Ericsson
R1-166985	Uu transport enhancement for V2X ZTE	

R1-168025 Draft LS on RAN1 agreements for LTE-based V2X LGE

Decision: The LS to RAN2, RAN3 and SA2 is approved in [R1-168026](#).

7.2.4 Enhancements on Full-Dimension (FD) MIMO for LTE - *WID* in [RP-160623](#)

R1-168405 Chairman's notes of AI 7.2.4 on Enhancements on Full-Dimension (FD) MIMO for LTE Ad-Hoc chair (Samsung, Nokia)

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and incorporated as follows.

R1-166724 Rapporteur Workplan on eFD-MIMO Samsung, Nokia, CATT

R1-168542 Friday's notes of FD-MIMO offline Nokia

7.2.4.1 Reference signals

7.2.4.1.1 Non-coded CSI-RS

At least decide on:

- *M_k value(s)*

- *High level mechanism for CSI-RS overhead reduction*

CSI-RS aggregation details

[R1-166725](#) Discussions on CSI-RS enhancements for Class A CSI reporting Samsung
[R1-167955](#) Further discussion on non-precoded CSI-RS design for eFD-MIMO ZTE Corporation, ZTE

Microelectronics

Revision of [R1-166329](#)

[R1-166269](#) Non-precoded CSI-RS design for up to 32 ports Qualcomm Incorporated
Section 2

[R1-167137](#) CSI-RS pattern design for up to 32 ports Huawei, HiSilicon

[R1-166339](#) Nonprecoded CSI-RS for Class A CSI Reporting Nokia, Alcatel-Lucent Shanghai Bell
Section 2

[R1-166519](#) Performance comparison of CDM-4 and CDM-8 for CSI-RS Intel Corporation

[R1-167980](#) WF on aggregation for NP CSI-RS ZTE Corporation, ZTE Microelectronics, Qualcomm, Xinwei, Potevio

[R1-168056](#) WF on CDM-2 and CDM-4 for non-precoded CSI-RS LG Electronics, ITRI, Samsung, Ericsson, ZTE

[R1-168049](#) WF on Class A CSI-RS Enhancement CATT, Alcatel-Lucent Shanghai Bell, Intel, InterDigital, Nokia, Huawei, HiSilicon

Also supported by Qualcomm

Agreements:

- For {24, 32} ports, $\sum_k M_k \in \{24, 32\}$, $M_k = 8$, where M_k is the same for all k
- For {20, 28} ports, $\sum_k M_k \in \{20, 28\}$, $M_k = 4$, where, at least for CDM-2, M_k is the same for all k
 - FFS whether $M_k = 8$ is also supported, and if so, whether M_k is the same or different for different k for CDM-4
- FFS port indexing
- In Rel-14, CDM-2 and CDM-4 is supported.
 - For CDM-2, port numbering in Rel-13 is reused in order to share CSI-RS with legacy UEs.
 - FFS CDM-4 port numbering

Working Assumption:

- CDM-8 is supported for at least {24,32} port CSI-RS
 - FFS CSI-RS aggregation and CDM mapping details
 - FFS additional REs other than legacy CSI-RS RE

[R1-167996](#) WF on CDM aggregation for NP CSI-RS Samsung, Xinwei, Ericsson

CSI-RS overhead reduction

[R1-166726](#) Discussions on NP CSI-RS overhead reduction Samsung

[R1-167633](#) CSI-RS Design for Class A eFD-MIMO Ericsson

[R1-166440](#) Discussion on CSI-RS overhead reduction for class A CATT

[R1-166339](#) Nonprecoded CSI-RS for Class A CSI Reporting Nokia, Alcatel-Lucent Shanghai Bell
Section 3

[R1-167635](#) Support of CSI-RS port sharing with Rel-13 and Rel-12 UEs Ericsson

[R1-167652](#) On CSI-RS Overhead Reduction Schemes InterDigital Communications

[R1-167981](#) WF on overhead reduction for Class A NZP CSI-RS ZTE Corporation, ZTE Microelectronics, Ericsson, Samsung, NTT DOCOMO

Agreement: At least for Class A NZP CSI-RS with more than 16 CSI-RS ports:

- All ports in a CSI-RS resource are transmitted within the same subframe
 - i.e. CSI-RS overhead reduction is done in the frequency domain
- CSI-RS density $d \in \{1, 1/2, \text{ and at least one other value } \leq 1/3\}$ RE/RB/port
 - Other values of d are not precluded (e.g. $2/3, 3/4$)
 - FFS whether different ports in a CSI-RS resource may have different densities
- FFS PDSCH rate matching in the REs in PRBs with no CSI-RS ports within a group
 - Opt-1: comb like transmission
 - Opt-2: frequency domain measurement restriction
- FFS the detailed signalling design

R1-166325	Aperiodic CSI-RS for non-precoded CSI-RS	ZTE Corporation, ZTE Microelectronics
R1-166439	CSI-RS design for {20,24,28,32} ports	CATT
R1-166518	Discussion on CSI-RS for Class A FD-MIMO	Intel Corporation
R1-166577	Further discussion on non-precoded CSI-RS designs for eFD-MIMO	Beijing Xinwei Telecom Techn.
R1-166632	Discussion on CSI-RS with CDM8 NEC	
R1-166633	Proposals for CSI-RS overhead reduction	NEC
R1-166727	Discussions on CDM-8 for NP CSI-RS	Samsung
R1-166840	Discussions on NP CSI-RS designs for eFD-MIMO	LG Electronics
R1-167092	Discussion on non-precoded CSI-RS enhancement	CMCC
R1-167346	Discussion on non-precoded CSI-RS design	NTT DOCOMO, INC.
R1-167618	CSI-RS design for eFD-MIMO	Potevio
R1-167634	Performance of CDM-8 for Non-Precoded CSI-RS	Ericsson

7.2.4.1.2 Beamformed CSI-RS

At least decide on:

- *Scheme 1 and/or 2 – if down selection is needed*
- *Additional FFS details on scheme 1 and/or 2*

R1-166442	Support for aperiodic CSI-RS	CATT
R1-166520	Evaluation of CSI-RS overhead reduction for Class B using frequency decimation	Intel Corporation
R1-166728	Additional details on aperiodic CSI-RS	Samsung
R1-167653	On Rate-matching of A-CSI-RS	InterDigital Communications
R1-167675	Aperiodic CSI-RS transmission for beamformed CSI-RS	Huawei, HiSilicon

R1-168046	WF on Aperiodic CSI-RS for Rel.14	Samsung, Nokia, Alcatel-Lucent Shanghai Bell, KT Corporation, Ericsson, LG Electronics, Interdigital, Qualcomm, AT&T, CHTTL, Xinwei, Straightpath, ITL
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Agreement:

Aperiodic CSI-RS

- Two-step NZP CSI-RS resource configuration:
 - Step 1. RRC configuration with a newly defined Aperiodic CSI-RS-Resource-Config IE
 - Without Subframe_config
 - Configure a UE with $K = \{1, 2, \dots, 8\}$ CSI-RS resources
 - Step 2. Activation/release mechanism
 - Activate N out of K CSI-RS resources per CSI process
 - Note: Activation refers to down selection of N out of K CSI-RS resources
 - Once activated, a CSI resource remains activated until released
 - FFS: Whether N is always equal to K or the case where $K=N$ is not precluded
 - If N is always equal to K , step 2 is bypassed
 - Choose at least one of the following alternatives for activation/release mechanism (TBD in RAN1#86bis)
 - Alt1. Using UL grant(s)
 - FFS: Support for cross-carrier activation/release
 - Alt2. Using MAC CE
 - Other alternatives are not precluded
 - FFS the values of X and Y , max value of N (or the value of N), how to signal N
- One out of N CSI-RS resources is selected via the UL-related DCI
 - A UL grant carries a CSI request and indicates transmission of one CSI-RS resource if $N>1$ aperiodic CSI-RS resources are activated for a CSI process for which the CSI is requested
 - A CSI request is for one CSI-RS resource per CSI process
 - Choose one out of the following alternatives for indicating transmission of 1 out of N CSI-RS resources (TBD in RAN1#86bis)
 - Alt1. use code points from an existing DCI field to select 1 out of N CSI-RS resources
 - Alt2. Introduce additional bit(s) in DCI
 - Note: The number DCI fields and number of code points for the combinations of CSI process, CC, and CSI-RS resource indication are FFS
- Only PUSCH based A-CSI reporting is supported
- Aperiodic CSI-RS transmission is in the same DL subframe as the associated UL-related DCI
 - FFS: Whether to CSI reference resource definition needs to change when aperiodic CSI-RS is used or not

- Whether and, if needed, how to support CSI processing relaxation for aperiodic CSI-RS are TBD
- FFS: Possibility to support aperiodic CSI-RS with $K=1$ and trigger (using UL-related DCI carrying A-CSI request) a subset of antenna ports.

“Multi-shot” CSI-RS

- Two-step NZP CSI-RS resource configuration:
 - Step 1. RRC configuration with a *Rel-13 periodic* CSI-RS-Resource-Config IE
 - Configure a UE with $K = \{1, 2, \dots, 8\}$ CSI-RS resources
 - Step 2. Activation/release mechanism
 - Activate N out of K CSI-RS resources per CSI process
 - Note: Activation refers to transmission of N CSI-RS resources
 - Once activated, a CSI resource remains activated until released
 - Choose at least one of the following alternatives for activation/release mechanism (TBD in RAN1#86bis)
 - Alt1. Using UL grant(s)
 - FFS: Support for cross-carrier activation/release
 - Alt2. Using MAC CE
 - Other alternatives are not precluded
 - FFS the values of X and Y , max value of N (or the value of N), how to signal N
- CSI reporting
 - $N=1$: CQI/PMI/RI is reported
 - $N>1$: CRI ($=0, 1, \dots, N-1$) is reported along with CQI/PMI/RI associated with the reported CRI value

Overhead reduction for Class B – both for periodic and aperiodic CSI-RS

- Support CSI-RS frequency-domain density reduction for Class B
 - All antenna ports of a single CSI-RS resource configuration can be transmitted every N PRBs
 - $N = 1$ (existing CSI-RS design), 2, and >2
 - FFS: Exact mechanism

R1-168147 WF on Rate Matching Issue for Beamformed CSI RS LG Electronics, InterDigital, Samsung, Huawei, HiSilicon, Qualcomm, CATT

Agreement:

- A solution is to be selected from the following three alternatives for aperiodic ZP CSIRS resource indication (TBD RAN1#86bis)
 - Alternative-1: Aperiodic ZP CSIRS, dynamically indicated by a new common DCI.
 - The common DCI is monitored in common search space.
 - Alternative-2: Aperiodic ZP CSIRS, aperiodic ZP CSI-RS resource signaling field is introduced in DL DCIs for all TMs.
 - Alternative-3: Use the existing PQI states or increase the number of PQI states for TM10; no PDSCH RM solution for other TMs
 - In this case, aperiodic ZP CSIRS resource is not defined
- Definition of Aperiodic ZP CSIRS:
 - For PDSCH rate matching on BF CSIRS due to aperiodic CSI-RS and/or multi-shot CSI-RS, an aperiodic ZP CSIRS resource is indicated.
 - Aperiodic ZP CSIRS resource configuration is defined without Subframe_config
 - UE conducts PDSCH rate matching on aperiodic ZP CSIRS at the subframe when the DCI is signaled.
- Study the impact of collision between EPDCCH RE and aperiodic CSI-RS

R1-168148 WF on QCL issue for Beamformed CSI RS LG Electronics, Samsung, Intel

Agreement:

- Decide the need for QCL indication on DMRS to aperiodic and/or multi-shot CSI-RS NZP CSIRS (TBD RAN1#86bis)
- If needed, at least one solution is to be selected from the following alternatives (TBD RAN1#86bis)
 - Alt 1: UE is not expected that aperiodic and/or multi-shot NZP CSIRS is indicated in PQI for QCL purpose with DMRS.
 - Alt 2: aperiodic and/or multi-shot NZP CSIRS can be indicated in PQI for QCL purpose, and follow legacy QCL assumption
 - Periodic NZP CSI-RS can also be indicated for QCL purpose

R1-166270	Enhancements on Beamformed CSI-RS	Qualcomm Incorporated
R1-166324	Enhancements on Beamformed CSI-RS	ZTE Corporation, ZTE Microelectronics
R1-166340	Aperiodic CSI-RS and Overhead Reduction	Nokia, Alcatel-Lucent Shanghai Bell
R1-166441	Discussion on CSI-RS overhead reduction for class B CATT	
R1-166578	Further discussion on beamformed CSI-RS designs for eFD-MIMO	Beijing Xinwei Telecom Techn.
R1-166841	Remaining details on beamformed CSI-RS enhancements	LG Electronics
R1-167138	Rate matching enhancements for aperiodic CSI-RS in different transmission mode	Huawei, HiSilicon
R1-167347	Discussion on Aperiodic CSI-RS	NTT DOCOMO, INC.
R1-167636	Beamformed CSI-RS Design with Activation Mechanism	Ericsson
R1-167637	UE specific Beamforming with Aperiodic CSI-RS Transmission	Ericsson
R1-167651	Remaining Issues on A-CSI-RS	InterDigital Communications
R1-167977	Overhead Reduction for Class B CSI-RS	Ericsson

7.2.4.1.3 Uplink DM-RS

At least decide on:

- *Choosing one from IFDMA and DMRS sequence enhancements*
- *Additional details on the chosen scheme*

R1-166521	Remaining details of UL DMRS enhancement	Intel Corporation
R1-166271	Discussion on uplink DMRS enhancements for FD-MIMO	Qualcomm Incorporated
R1-166141	Uplink DMRS enhancement to support more orthogonal partial overlapped ports	Huawei, HiSilicon
R1-166341	Control Signalling for UL DMRS with IFDMA	Nokia, Alcatel-Lucent Shanghai Bell
R1-166326	Discussion on UL DMRS enhancement for eFD-MIMO	ZTE Corporation, ZTE Microelectronics
R1-166742	Proposals on uplink DMRS design enhancements	Samsung
R1-167087	UL DMRS Base Sequences with IFDMA	Nokia, Alcatel-Lucent Shanghai Bell
R1-167139	Uplink DMRS sequence enhancement for IFDMA	Huawei, HiSilicon
R1-166634	Discussion on IFDMA based scheme	NEC
R1-166842	Discussion on uplink DMRS enhancements for eFD-MIMO	LG Electronics
R1-166443	On UL DMRS enhancement	CATT
R1-168050	WF on UL DMRS enhancement	Intel
R1-167972	WF on UL DMRS	Nokia, Alcatel-Lucent Shanghai Bell, Huawei, HiSilicon

Agreement:

- Support orthogonal DMRS (more than 2) for MU-MIMO with partial overlapping BW allocation by
 - IFDMA with at least RPF 2
 - FFS: RPF 4
- FFS during this week which new IFDMA sequence lengths (if any) shall be supported and designed
 - If any new lengths larger than 36 are supported, the corresponding DMRS sequences are generated by the legacy mechanism by extension of a Zadoff-Chu sequence
- FFS: whether and how CS of DMRS generation shall be modified to improve backward compatibility for the pairing with legacy UE.
- Additional power boosting shall be supported and applied to IFDMA DMRS depending on the value of RPF
 - FFS: x dB for RPF 2 and y dB for RPF 4

R1-168369	WF on UL DMRS Lengths	Nokia, Alcatel-Lucent Shanghai Bell, Huawei, HiSilicon, Qualcomm, CATT, Samsung
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Agreement:

- IFDMA Sequence Design for RPF=2,
 - New lengths larger than 36 are supported. The corresponding DMRS sequences are generated by the legacy mechanism by extension of a Zadoff-Chu sequence.
 - FFS: whether new lengths of 6, 18, 30 are supported

7.2.4.2 CSI reporting

7.2.4.2.1 Non-precoded CSI-RS codebooks

At least decide on:

- Down selection of $(N1, N2)$ and/or $(O1, O2)$ configurations

[R1-166272](#) Non-precoded CSI-RS Codebooks for eFD-MIMO Qualcomm Incorporated
[R1-167954](#) Class A codebook design for eFD-MIMO ZTE Corporation, ZTE Microelectronics
Revision of [R1-166323](#)

[R1-166342](#) Codebook Design for Class A CSI Reporting up to 32 Ports Nokia, Alcatel-Lucent Shanghai Bell
[R1-166444](#) Reducing the number of combinations of codebook parameters CATT
[R1-166445](#) Codebook design for {20,24,28,32} ports CATT

[R1-166729](#) View on class A codebook extension Samsung
[R1-167639](#) On 1D antenna port layouts in Rel-14 Ericsson

[R1-168065](#) Way Forward on 1D Antenna Port Layouts Ericsson, Verizon, Kathrein-Werke, Deutsche Telekom, AT&T
Proposal:

- The following 1D antenna layouts are supported:
 - $(N1, N2) = (16, 1), (14, 1), (12, 1), (10, 1)$

[R1-166522](#) Performance evaluation of Class A codebooks with 32 ports Intel Corporation
[R1-166523](#) Discussion on Class A codebook extension Intel Corporation
[R1-166579](#) Discussion on codebook design to support up to 32 ports CSI-RS Beijing Xinwei Telecom Techn.
[R1-167140](#) Codebook for up to 32 ports CSI-RS Huawei, HiSilicon
[R1-167348](#) Codebook Enhancement for eFD-MIMO NTT DOCOMO, INC.
[R1-167638](#) Antenna port layout support for up to 32 Ports in Rel-14 Ericsson
[R1-167930](#) Discussions on non-precoded CSI-RS codebook design for eFD-MIMO LG Electronics

[R1-168353](#) Way Forward on Antenna Port Layouts Ericsson, Qualcomm, Intel, CATT, AT&T, NTT DOCOMO
Offline discussion until Friday (Ericsson)

Friday

[R1-168511](#) Way Forward on Antenna Port Layouts Ericsson, QUALCOMM, Intel, CATT, ATT, DOCOMO, Verizon

- Simplify 1D configuration
 - Drop the $(1, N2)$ rows (with red text)
 - Single design can be used for $(N1, 1)$ and $(1, N2)$.
- Reduce UE computational complexity
 - Remove $(8, 8)$ combinations for 20, 24, 28, 32 ports (with green text)
 - Reduces number of beams by 2
 - Limited performance gain from $(8, 8)$ vs. $(8, 4)$

Number of CSI-RS antenna ports, P	(N1,N2)	(O1, O2)
20 ports	(2,5)	(8,4), (8,8)
	(5,2)	(8,4), (4,4)
	(10,1)	(4,-),(8,-)
	(1,10)	(-4),(-8)
24 ports	(3,4)	(8,4), (8,8)
	(4,3)	(8,4), (4,4)
	(2,6)	(8,4), (8,8)
	(6,2)	(8,4), (4,4)
	(12,1)	(4,-),(8,-)
	(1,12)	(-4),(-8)
28 ports	(2,7)	(8,4), (8,8)
	(7,2)	(8,4), (4,4)
	(14,1)	(4,-),(8,-)
	(1,14)	(-4),(-8)
32 ports	(8,2)	(8,4), (8,8)
	(2,8)	(8,4), (4,4)
	(4,4)	(8,4), (4,4)
	(16,1)	(4,-),(8,-)
	(1,16)	(-4),(-8)

- The main concern of some companies is that the necessity or the complexity of all or a large group of codebook combinations is not justified by evaluation yet. Rel 13 does not support all possible layouts.
- However some UE vendors state that the complexity of codebook combination at the UE side is not a major issue. It is still an open question which codebook combination(s) are concerns.
- It is encouraged to indentify the problem or concern or redundancy for specific codebook combination(s).

Email discussion until next meeting – (Ericsson)

7.2.4.2.2 CSI reporting for hybrid CSI-RS

At least decide on:

- Confirm working assumption of mechanism 1
- Additional mechanisms, if needed
- Reported CSI parameters, e.g. RI in the first and/or second report

R1-168282 WF on hybrid CSI reporting LG Electronics, Samsung, LG Uplus, KT Corporation, ITRI, NTT Docomo, IITL, Ericsson, Xinwei, NEC, InterDigital

Agreement

- Confirm the working assumption of hybrid CSI
- Further details on Mechanism 1
 - Reporting content
 - For the 1st eMIMO-Type (CLASS A), $i1^{(1)}$ and x -bit $RI^{(1)}$ are reported, while $CQI^{(1)}$ and $i2^{(1)}$ are not reported
 - If UE supports up to 2 layers, $x=0$
 - If UE supports up to 8 layer, $x=1$ where $RI^{(1)}=\{1, 3\}$
 - For the 2nd eMIMO-Type (CLASS B $K=1$), $CQI^{(2)}$, $PMI^{(2)}$, $RI^{(2)}$ are reported
 - Note: Superscript (y) represents the y-th eMIMO-Type, where $y=1,2$.
 - FFS: Option for one eMIMO-Type to inherit RI reporting from another eMIMO-Type
 - Working assumption: No inter-dependence between CSI calculations across two eMIMO-Types
 - Reuse legacy CSI reporting mechanisms with the following refinement
 - For PUCCH-based P-CSI
 - Report $i1^{(1)}$ and $RI^{(1)}$ in one subframe
 - FFS: Using either PUCCH format 2 or 3
 - Periodicity of the CSI of 1st eMIMO-Type is an integer multiple of $RI^{(2)}$ periodicity of the 2nd eMIMO-Type.
 - Subframe offset of the 1st eMIMO-Type is defined relative to $RI^{(2)}$ subframe offset of the 2nd eMIMO-Type.
 - FFS: Whether subframe offset of the 1st eMIMO-Type can be fixed to 0
 - Priority rule for collision handling is FFS.
 - For PUSCH-based A-CSI
 - FFS: what CSI(s) will be reported from UE when aperiodic CSI reporting is triggered

- Option 1: UE reports both CSI of 1st eMIMO-type and CSI of 2nd eMIMO-type.
- Option 2: UE reports either one of the 2 eMIMO-types.
- CSI encoding/mapping mechanisms is FFS.

Support of at least one more mechanism

[R1-168286](#) WF on Hybrid CSI Reporting NTT DOCOMO, KT corporation, ITL, KDDI, LG Electronics, Mitsubishi Electric, NEC, Samsung, Sharp, Softbank, Sony, Straightpath

[R1-168339](#) Way Forward on Inclusive Hybrid CSI-RS Framework Ericsson, ZTE Corporation, ZTE Microelectronics, Nubia, Xinwei, ITRI, ASTRI

Conclusion:

- **Proposal I:** For hybrid CSI with one CSI process, support CLASS B with $K > 1$ CSI-RS resources for the 1st eMIMO-Type and CLASS B with $K = 1$ CSI-RS resource for the 2nd eMIMO-Type
 - For the 1st eMIMO-Type, two options
 - Option 1: CRI (without CQI/PMI/RI) is reported
 - Option 2 (only support $K = 2$): PMI assuming $RI = 1$ for each of the two CSI-RS resources are reported
 - For the 2nd eMIMO-Type
 - CQI/PMI/RI are reported
 - Working assumption: No interdependence in CQI calculation between 1st and 2nd eMIMO-Types
 - FFS: for option 1, dynamic CSI-RS resource configuration for the 2nd eMIMO-Type based on CRI reporting 1st eMIMO-Type.
- **Proposal II:**
 - Hybrid CSI reporting with eMIMO-Type pairs is supported
 - No restriction on the configuration for 1st and 2nd eMIMO-Types
 - UE supports eMIMO-Type pairs
 - For TM9, different CSI-RS resources and/or CSI reporting configurations can be used for PUCCH and PUSCH
 - UE calculates one CSI report for only one eMIMO-Type of a pair at a time and one eMIMO-Type at a time
 - FFS: Define the period of CSI-RS associated with the 1st eMIMO-Type as N times of the period of CSI-RS associated with the 2nd eMIMO-Type, where $N > 1$
 - Configurable or fixed value of N needs to be specified
 - Whether new dropping rules need to be specified
 - Rel-13 CSI process configurations are supported
 - A report for either eMIMO-type contains all Rel-13 CSI parameters (CQI/PMI/RI/CRI)
- Study whether it is possible to simplify a combination, or to down select, between/within proposals I and II

R1-166142	Hybrid CSI reporting in one CSI process	Huawei, HiSilicon
R1-166273	Discussion on CSI reporting for hybrid CSI-RS	Qualcomm Incorporated
R1-166327	Discussion on CSI reporting for hybrid CSI-RS	ZTE Corporation, ZTE Microelectronics
R1-166343	Hybrid CSI Reporting Schemes based on Single CSI Process	Nokia, Alcatel-Lucent Shanghai Bell
R1-166580	Further discussion on hybrid CSI report for eFD-MIMO	Beijing Xinwei Telecom Techn.
R1-166730	Hybrid PMI codebook based CSI reporting and simulation results	Samsung
R1-166731	Supported schemes for hybrid CSI	Samsung
R1-166844	Discussion on CSI reporting enhancements for hybrid CSI-RS	LG Electronics
R1-167349	CSI reporting for hybrid CSI-RS	NTT DOCOMO, INC.
R1-167406	Discussion on CSI reporting for hybrid CSI-RS	ITRI
R1-167640	Hybrid CSI Reporting with One and Two CSI Processes	Ericsson
R1-167641	Performance of Hybrid CSI-RS with Large CSI-RS Overhead	Ericsson
R1-168047	Further considerations on CSI reporting for hybrid CSI-RS	CATT

7.2.4.2.3 Advanced CSI reporting and interference measurement

At least decide on:

- *Select one advanced CSI scheme (combination-based codebook enhancement vs. channel quantization)*
- *The need for interference measurement enhancement*

Framework

[R1-167971](#) **WF on Advanced CSI feedback framework in Rel-14** **Huawei, HiSilicon, Ericsson, Nokia, Alcatel-Lucent Shanghai Bell, Samsung, CATT, ZTE, NTT DOCOMO, Qualcomm, Intel, InterDigital, ITRI**

Agreement:

- Specify CSI feedback enhancement with the following advanced CSI feedback framework:
 - Reduced space (eigenvectors)/W1 is constructed based on one of the following alternatives (TBD RAN1#86bis):
 - Alt1. Orthogonal basis (e.g. orthogonal DFT matrix)
 - Alt2. Non-orthogonal basis (e.g. Rel.13 Class A W1 for rank-1 and/or 2)
 - Reduced space representation/W2 is to further combine selected beams
 - Granularity of weighting(phase and/or amplitude) can be either wideband only or wideband/subband, and is constructed based on one of the following alternatives (TBD RAN1#86bis):
 - Alt1. Phase and amplitude
 - Alt2. Phase-only weighting
 - How the enhanced framework can be applicable for Class A and/or Class B eMIMO-Types is FFS
 - FFS: How to handle the relationship between advanced CSI feedback and legacy CSI feedback framework
- Companies are encouraged to provide results comparing the above alternatives, considering a mix of smaller and larger numbers of ports within the following antenna port configurations
 - {4,8,12,16,20,24,28,32} ports
 - Focus on rank≤2 scenario MU-MIMO for evaluation
 - Feedback overhead needs to be taken into account
 - For {4,8,12,16, 20,24,28,32}-port scenario, companies are encouraged to compare their proposals to dual-stage codebook enhancement with increased number of beams in W1

[R1-166845](#) **Performance evaluation on advanced implicit CSI LG Electronics**
[R1-167645](#) **W1 design for implicit advanced CSI reporting Ericsson**
[R1-166734](#) **Linear combination (LC) codebook based CSI reporting and simulation results Samsung**

[R1-166139](#) Advanced CSI feedback framework for LTE Huawei, HiSilicon
[R1-166140](#) Uplink control channel enhancements for advanced CSI feedback Huawei, HiSilicon
[R1-166274](#) Discussion on advanced CSI reporting and initial evaluation results Qualcomm Incorporated
[R1-166322](#) Discussion on the design of linear combination codebook ZTE Corporation, ZTE Microelectronics
[R1-166330](#) Discussion on interference measurement for MU-CSI ZTE Corporation, ZTE Microelectronics
[R1-166447](#) On analog CSI feed back CATT
[R1-166448](#) Discussion on advanced CSI reporting and interference measurement enhancement CATT
[R1-166524](#) Further study of advanced CSI feedback Intel Corporation
[R1-166525](#) Beam combining codebook enhancements for FD-MIMO Intel Corporation
[R1-166526](#) Discussion on the performance of CQI reporting based on the NZP CSI-RS Intel Corporation
[R1-166581](#) Advanced CSI feedback and simulation results Beijing Xinwei Telecom Techn.
[R1-166656](#) Considerations on MU-CQI transmission Sony
[R1-166732](#) Discussions on periodic CSI reporting for class A in eFD-MIMO Samsung
[R1-166733](#) Discussions on interference measurement enhancement in eFD-MIMO Samsung
[R1-166735](#) LC based explicit CSI feedback and simulation results Samsung
[R1-166736](#) Comparison between implicit and explicit feedback Samsung
[R1-167093](#) Enhancing interference measurement for MU transmissions CMCC
[R1-167134](#) Uplink control channel enhancements for reduced space CSI feedback Huawei, HiSilicon
[R1-167135](#) Superposition codebook for Class A CSI feedback Huawei, HiSilicon
[R1-167136](#) Superposition codebook for Class B CSI feedback Huawei, HiSilicon
[R1-167350](#) Enhancements on MU Interference Measurement and MU-CQI Reporting NTT DOCOMO, INC.
[R1-167642](#) Discussion on Interference Measurement Enhancements Ericsson
[R1-167643](#) Explicit versus implicit feedback for advanced CSI reporting Ericsson
[R1-167644](#) On the need for W1 enhancements for advanced CSI Ericsson
[R1-167674](#) Enhanced interference measurement Huawei, HiSilicon
[R1-167967](#) WF on advanced CSI in Rel-14 Huawei
[R1-167968](#) WF on interference measurement in Rel-14 Huawei
[R1-168323](#) WF on Advanced CQI measurement and report NTT DOCOMO

Friday

[R1-168504](#) **WF on interference measurement in Rel-14** **Huawei, HiSilicon, CATT, Samsung, Xinwei**
• Specify interference measurement enhancements in Rel-14.

Conclusions:

- Whether the need of interference measurement enhancement in Rel-14 shall be decided in next meeting.
- If needed, one or more schemes shall be supported in Rel 14. Possible schemes are:
 - Definition and configuration of a new type interference measurement
 - Interference measurement is based on cancellation of intended signals
 - Both inter-cell and intra-cell interference should be captured
 - FFS NZP CSI-RS or DMRS as CSI-IM or PDSCH
 - Definition and configuration of a new type interference measurement
 - Only intra-cell interference to be measured using NZP
 - Aperiodic CSI-IM, based on
 - The existing CSI-IM
 - The new CSI-IM type (see above, if specified).
 - New UE measurement behavior for CQI reporting based on DMRS ports when corresponding PDSCH is transmitting.
 - If needed, L1/RRC signaling to assist UE interference measurement
 - Other schemes are not excluded.

Conclusion: Companies are encouraged to investigate the usage of new or existing PUCCH format for the purpose of analog feedback to carry advanced CSI.

7.2.4.3 DMRS-based open-loop and semi-open-loop transmission

At least decide on:

- CSI parameters to be reported
- Down selection of Tx enhancement scheme, if needed

[R1-168446](#) **WF on semi-open-loop transmission** Samsung, Nokia, ASB, ZTE, ZTE Microelectronics, CATT, KT

Agreement:

- Support both CLASS A and CLASS B with $K \geq 1$ CSI-RS resources for the eMIMO-Type of semi-open-loop
 - For dual-stage codebook,
 - RI, i_1 and CQI reporting is supported for {CLASS A} and {CLASS B with $K=1$ and 8Tx/alternate 4Tx codebooks}
 - FFS: reporting i_{11} and/or i_{12} for Class A codebooks
 - CRI, RI, i_1 and CQI reporting is supported for CLASS B with $K > 1$
 - FFS: reporting i_1 and subsampled i_2
 - FFS: Hybrid CSI with semi-open-loop
 - FFS: Reporting multiple CRIs for CLASS B $K > 1$
 - For single-stage codebook with 2 and 4 ports (CLASS B with $K > 1$), CRI, RI and CQI are reported
 - For single-stage codebook with 2 and 4 ports (CLASS B with $K=1$), RI and CQI are reported
- Support RE level transmitter operation on PDSCH for both CSI reporting and PDSCH transmission
 - Down selection from the following transmission schemes in RAN1#86bis, including possible combination
 - Precoder cycling
 - Tx diversity
 - LD-CDD
 - Layer Permutation

[R1-168048](#) **WF on DMRS-Based Open-Loop/Semi-Open-Loop** CATT, Nokia, Alcatel-Lucent Shanghai Bell, CATR, Huawei, HiSilicon, InterDigital, Intel, Qualcomm

Conclusion: RAN1#86bis: companies need to justify the need for introducing new DMRS pattern(s) to support open-loop/semi-open-loop transmission scheme. Otherwise the proposal in [R1-168048](#) is agreed.

[R1-166275](#) Discussion on DMRS based OL and Semi-OL Transmission Qualcomm Incorporated
[R1-166328](#) DMRS-based Semi-Open-Loop Transmission ZTE Corporation, ZTE Microelectronics
[R1-166344](#) DMRS-based Semi-open Transmission Schemes Nokia, Alcatel-Lucent Shanghai Bell
[R1-166449](#) Transmission scheme for OL-MIMO CATT
[R1-166450](#) CSI feedback for OL-MIMO CATT
[R1-166527](#) Remaining details of open loop techniques Intel Corporation
[R1-166737](#) Discussions on open and semi-open loop transmission in eFD-MIMO Samsung
[R1-166738](#) Simulation results for precoder cycling based on semi-open-loop transmission Samsung

R1-166846	Initial performance evaluation on semi-OL MIMO	LG Electronics
R1-167351	Enhancements for DMRS-based semi-open-loop MIMO schemes	NTT DOCOMO, INC.
R1-167646	DMRS-based Open-loop MIMO Design	Ericsson
R1-167676	DMRS based open loop transmission	Huawei, HiSilicon
R1-167807	Evaluations on DMRS based Semi-open loop MIMO schemes	CEWiT

7.2.5 Downlink Multiuser Superposition Transmission for LTE - WID in [RP-161019](#)

[R1-168406](#) **Chairman's notes of AI 7.2.5 on Downlink Multiuser Superposition Transmission for LTE** Ad-Hoc chair (Qualcomm)

The document was presented by Wanshi Chen from Qualcomm.

Decision: The document is endorsed and incorporated as follows.

7.2.5.1 Superposition transmissions

Power ratios, modulation, etc

Power ratio

R1-166185	Further discussion on power ratios for MUST	Huawei, HiSilicon
R1-166277	Power ratio set considerations for MUST	Qualcomm Incorporated
R1-166847	Discussion on power ratio and modulation order	LG Electronics
R1-167508	Selection of power ratios for MUST Case1 & 2	MediaTek Inc.
R1-167689	MUST Case 1 and 2 transmission schemes	Nokia, Alcatel-Lucent Shanghai Bell
R1-168141	Way forward on Power Ratios	ZTE, ZTE Microelectronics, MediaTek, ITRI
R1-168152	WF on power ratios for MUST Case 1/2	Nokia, ASB, Qualcomm
R1-168316	Way Forward MUST power ratios	Huawei, HiSilicon, MediaTek

Agreement

- For Case 1/2, numbers of power ratios should be decided based on system level simulation and analysis:
 - For QPSK + QPSK, number of power ratios is to be selected from 2/3/4
 - For QPSK + 16 QAM, number of power ratios is to be selected from 2/3/4
 - For QPSK + 64 QAM, number of power ratios is to be selected from 1/2/3/4

Conclusion:

Companies are encouraged to provide principle of generating power ratio, examples are:

- Super-constellation/grid coordinates
 - Supported: Huawei, HiSilicon, Qualcomm, MediaTek, Nokia, ASB, KT
- Evenly spaced
 - Supported: ZTE, Mediatek, LG

Note that final selection of power ratios can be a combination of the above examples.

[R1-168280](#) **Way Forward on the Gray conversion** LG Electronics, ZTE, ZTE Microelectronics, Huawei, HiSilicon

Agreements:

- For Gray-mapped composite constellation:
 - Alt 1: Bit-level Gray conversion is specified
 - Alt 2: Symbol-level Gray conversion is specified
 - Alt 3: up to implementation (where the bits are mapped to the composite-constellation)
- Down-select one alternative till next meeting

[R1-168142](#) **Way forward on MUST Transmission** ZTE, ZTE Microelectronics, MediaTek, Sharp
Continue discussion next meeting

[R1-168279](#) **Way Forward on MUST UE multiplexing** Huawei, HiSilicon
Proposals:

- In all PDSCH REs, the composite constellation symbols transmitted in a given sub-frame and a given spatial layer to a same MUST-near UE carry the same number of MUST-near UE codeword bits

Continue discussion next meeting

R1-166276	Superposition transmissions	Qualcomm Incorporated
R1-166424	Simulation for power ratio down selection	ZTE

R1-166425	Specification for joint modulation Gray mapping	ZTE
R1-166848	Discussion on Gray mapping for superposed constellation	LG Electronics
R1-167121	Discussion on superposition transmission	Intel Corporation
R1-167131	MUST UE multiplexing and resource allocation	Huawei, HiSilicon
R1-167363	Discussion on power ratios optimization for MUST scheme	NTT DOCOMO, INC.
R1-167407	Discussion on EVM constraint for MUST Case1&2	ITRI
R1-167408	Discussion on Power Ratios for MUST Case 1&2	ITRI
R1-167511	On power allocation for MUST	MediaTek Inc.
R1-167775	On Considerations of Power Ratios for MUST	KT Corp.
R1-168071	Performance of MUST with HARQ	National Taiwan University
R1-168072	Design issues of MUST with HARQ	National Taiwan University

7.2.5.2 Mechanisms for efficient operation

Related RRC signaling, DCI, UE blind detection etc.

[R1-168328](#) **Way Forward on MUST DCI Design for Case 1&2** **Qualcomm, Nokia, ABS, NEC**

Agreement:

- Consider the following options for providing MUST-near UE co-schedule information
 - Alt 1. Single DCI by adding bits in the self DCI
 - FFS details (particularly regarding RA alignment)
 - Alt 2. Use common companion DCI to carry all MUST-far UE information
 - FFS details (particularly regarding RA alignment)
 - Alt3. Use user-specific companion DCI to carry all MUST-far UE information within near-UE allocation
 - FFS details (particularly regarding RA alignment)
 - Other alternatives are not precluded
 - FFS the number of blind decodes
- Down-select one option until next meeting

[R1-168241](#) **Way Forward on MUST Assistance Information in Cases 1 and 2** **MediaTek, Huawei, HiSilicon, NTT DOCOMO, CMCC**

Agreements:

- The following assistance information is provided to MUST-near UE
 - For CRS based transmission schemes in MUST Case 1, the information of “existence of MUST interference” and “power ratio” is provided for each spatial layer
 - For MUST Case 2, “existence of MUST interference” and “power ratio” are signaled
 - FFS: how to signal “existence of MUST interference” (particularly the granularity) and “power ratio”

[R1-168317](#) **Way Forward on signaling design for MUST new DCI** **Huawei, HiSilicon, Media Tek, China Telecom, NTT DOCOMO, LG Electronics**

[R1-168149](#) **WF on the Design Principle for a new DCI** **LG Electronics, MediaTek, Huawei, HiSilicon**

Agreements:

- A new DCI should follow the design principles
 - In addition to assistance information, all legacy DCI contents should be able to be signaled to MUST UE.

[R1-168376](#) **WF on the number of MUST layers for Case 3** **LG Electronics, MediaTek**
Continue discussion next meeting

[R1-168336](#) **Way forward for Case 3 of MUST** **ZTE, ZTE Microelectronics, Qualcomm, Sharp**

Agreements:

- For DMRS based Case 3, support multiuser superposition transmission with orthogonal ports
 - FFS non-orthogonal ports

[R1-168150](#) **WF on PDSCH starting symbol** **LG Electronics, MediaTek**

Agreements:

- The starting symbol of interfering PDSCH to be canceled or suppressed should be provided to MUST UE by one of the following the two options:
 - Option 1: it should be blindly detected or signaled (assuming potentially different starting symbols)
 - Option 2: MUST UE assumes the same starting symbol of interfering PDSCH as its own PDSCH
- Down-selection till next meeting

R1-166186	Discussion on signaling design for MUST	Huawei, HiSilicon
R1-166278	Mechanisms for efficient operation	Qualcomm Incorporated
R1-166279	MUST UE pairing with existing CQI feedback	Qualcomm Incorporated
R1-166426	Mechanism for MUST operation	ZTE
R1-166451	Support of downlink superposition transmission	CATT
R1-166646	Power control and configuration for MUST	NEC
R1-166647	New DCI design for MUST	NEC
R1-166849	Discussion on Signaling Assistance Information and remaining issues	LG Electronics
R1-167094	On signaling design for MUST case 3	CMCC
R1-167122	On downlink control signalling for MUST	Intel Corporation
R1-167167	Demodulation performance for MUST far UE	Huawei, HiSilicon
R1-167364	Discussion on remaining issues and signaling design for DL MUST	NTT DOCOMO, INC.
R1-167443	Power ratio and assistance information for MUST case 1 and case 2	China Telecommunications
R1-167513	On scheduling constraints for MUST operation	MediaTek Inc.
R1-167514	Supported TMs for MUST	MediaTek Inc.
R1-167610	Signaling for MUST	SHARP Corporation, MTI
R1-167688	On network assistance and operation of MUST	Nokia, Alcatel-Lucent Shanghai Bell
R1-168143	WF on DCI for case 1 and case 2	ZTE

7.2.5.3 Evaluation for MUST using up to 8Tx

Conclude evaluation etc.

Evaluations

R1-166427	Discussion and evaluation for MUST Case 3	ZTE
R1-167095	Non-full buffer Evaluation for MUST case 3 DMRS-based TM	CMCC
R1-167690	System-level Evaluation of Case 3 MUST	Nokia, Alcatel-Lucent Shanghai Bell
R1-167515	System-level evaluation for MUST Case 3	MediaTek Inc.

Revised in [R1-167890](#)

R1-168291	WF on MUST supported TMs	CMCC, Nokia, ASB, MTK, ZTE
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Agreements:

- DMRS-based Case 3 is supported in
 - TM 8/9/10

Conclusion:

- Case 1&2 using up to 4Tx is not supported in DMRS-based TM

Possible working assumption:

- CRS-based Case 3 using 2Tx and 4Tx is supported in TM 4
 - Supported by: Nokia, ASB, ZTE, MTK, CMCC
 - Objected by: Huawei, HiSilicon, LG
 - Companies are encouraged to bring more results to confirm/abandon the WA.

Continue discussion next meeting

R1-168144	Way forward on Mechanism for Case 3	ZTE, ZTE Microelectronics, Qualcomm, Sharp
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R1-167365	Evaluation for CRS-based MUST with 4 Tx antennas	NTT DOCOMO, INC.
R1-167890	System-level evaluation for MUST Case 3	MediaTek Inc.
R1-168292	WF on supporting MUST case 3	CMCC

7.2.5.4 Other

R1-166187	Implementation for MUST transmitter	Huawei, HiSilicon
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7.2.6 eMBMS enhancements for LTE - WID in [RP-161297](#)

[R1-168407](#) Chairman's notes of AI 7.2.6 on eMBMS enhancements for LTE Ad-Hoc chair (Nokia)

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and incorporated as follows.

7.2.6.1 Longer cyclic prefix for MBSFN subframe

[R1-167090](#) Background Information on Inter-site Distances BBC

[R1-167749](#) Link level simulation assumptions Huawei, HiSilicon

Note that delays in Table 1 should be a factor of 10 larger.

[R1-168070](#) Summary of email discussion Ericsson

[R1-166177](#) Evaluations of longer CP for eMBMS Huawei, HiSilicon

[R1-166280](#) System level Evaluation results for longer cyclic prefix Qualcomm Incorporated

[R1-167841](#) System simulation results for longer CP in MBSFN subframes Ericsson

[R1-166281](#) Design options for longer cyclic prefix and link level simulation results Qualcomm Incorporated

[R1-166528](#) Considerations on longer cyclic prefix for MBSFN subframes Intel Corporation

[R1-167842](#) MBSFN reference signal design Ericsson

[R1-168366](#) WF on eMBMS Enhancements Qualcomm, Ericsson, BBC, EBU, Nokia, ASB, Dish, AT&T, Telstra, Fraunhofer IIS, Verizon, Telefónica, Intel

Also supported by Nomor

Agreement:

- A single new numerology with a CP of at least 100us and core symbol duration of at least 400us is introduced for PMCH
 - Working assumption that the CP length is 200us and core symbol duration of 800us.
 - Link level results may be provided at RAN1#86bis.
 - Working assumption then to be confirmed at RAN1#86bis.

Agreements in respect of at least objectives a, b and c:

- If a carrier is operated with 100% MBSFN subframe allocation, the new CP length and legacy extended CP for 15kHz subcarrier spacing are supported
 - It is understood that 100% MBSFN subframe allocation does not preclude some resources being set aside for e.g. cell search
 - FFS: Any SI that may be needed on this carrier will also be broadcasted in these subframes
 - In these subframes, FDM between PMCH and other channels (potentially with a different numerology) is not precluded.
 - With the 100% MBSFN subframe configuration, this carrier does not support unicast transmissions in the downlink
 - This carrier can be configured without a unicast control region in a subset of the MBSFN subframes (including all of them)
 - The UE is not expected to receive PMCH with legacy extended CP for 15kHz subcarrier spacing in the MBSFN subframes without unicast control region
 - The UE is not expected to receive PMCH with the new CP in MBSFN subframes with unicast control region
- If a carrier is operated with less than 100% MBSFN subframe allocation, the new CP length and legacy extended CP for 15kHz subcarrier spacing are supported
 - This carrier has at least subframes 0 and 5 of each radio frame as non-MBSFN subframes
 - FFS: Further CRS reductions
 - This carrier can be configured without unicast control region in a subset of the MBSFN subframes (including all of them)
 - The UE is not expected to receive PDSCH/(E)PDCCH in the MBSFN subframes without unicast control region
 - The UE is not expected to receive PMCH with numerologies other than the new CP length in the MBSFN subframes without unicast control region
 - The UE is not expected to receive PMCH with the new CP length in MBSFN subframes with unicast control region
- eMBMS enhancements do not require changes to any channels and signals needed for MBMS operation except PMCH and MBSFN-RS

- FFS whether use of more REs, TTI extension and/or change in payload are needed for PBCH coverage enhancements.

R1-168449 WF on the support of longer CP in MBSFN subframes Huawei, HiSilicon, Orange, ZTE

Proposal:

- Whether to introduce a new CP beyond the existing LTE CPs for eMBMS transmissions in Rel-14 should be concluded after the mapping of the SINR achievable with a 95% coverage probability to the corresponding MCS is agreed.

R1-168029 Draft LS regarding agreements for FeMBMS Qualcomm

Decision: The document is noted and final LS is approved in **R1-168200**.

7.2.6.2 Increased number of MBSFN subframes per radio frame

R1-166193 Radio frame design for increased number of MBSFN subframes Huawei, HiSilicon

R1-166282 Increased number of MBSFN subframes per radio frame Qualcomm Incorporated

R1-167789 eMBMS cell support of PSS/SSS/PBCH Nokia, Alcatel-Lucent Shanghai Bell

R1-167843 Radio frame design for extended MBSFN subframe allocation Ericsson

R1-166529 Design guidelines to increase the number of MBSFN subframes per radio frame Intel Corporation

7.2.6.3 MBSFN subframes without a unicast control region and cell-specific reference signals

R1-167784 MBSFN subframe unicast control region considerations Nokia, Alcatel-Lucent Shanghai Bell

R1-167748 On MBSFN subframes without a unicast control region and cell-specific reference signals Huawei, HiSilicon

R1-166283 MBSFN subframes without a unicast control region and cell-specific reference signals Qualcomm Incorporated

R1-166530 On MBSFN subframes without a unicast control region and cell-specific reference signals Intel Corporation

7.2.6.4 Other

R1-166284 Standalone eMBMS carrier Qualcomm Incorporated

R1-166285 Simultaneous reception of broadcast and unicast Qualcomm Incorporated

7.2.7 SRS Carrier Based Switching for LTE - WID in RP-160935

R1-168408 Chairman's notes of AI 7.2.7 on SRS Carrier Based Switching for LTE Ad-Hoc chair (Huawei)

The document was presented by Weimin Xiao from Huawei.

Decision: The document is endorsed and incorporated as follows.

R1-168276 Way Forward on SRS Carrier-Based Switching Huawei, HiSilicon, SoftBank Corp.

7.2.7.1 SRS Transmission on TDD CCs without PUSCH

Including details for power control, timing advance, and possible new symbol positions

R1-166127 SRS symbol positions for SRS switching Huawei, HiSilicon

R1-166286 SRS Transmission on TDD CCs without PUSCH Qualcomm Incorporated

R1-166452 Further considerations on SRS carrier based switching CATT

R1-166531 On SRS transmission without PUSCH Intel Corporation

Agreement:

- No consensus to support in Rel-14 new SRS symbol position in addition to already agreed ones.

R1-167715 Power control for SRS switching Nokia, Alcatel-Lucent Shanghai Bell

R1-167485 Support of power control mechanism for SRS transmission in cells without configured PUSCH transmission Ericsson Inc.

R1-166128 Details on power control for SRS on TDD CCs without PUSCH Huawei, HiSilicon

R1-166739 SRS Transmission Aspects for Carrier Switching Samsung

Agreements:

- PC parameters
 - Configure open loop parameters P_0 and α for SRS-only CC
 - No need to have $P_{\text{SRS_offset}}$

- Down selection from TPC command options:
 - Option 1: by UL grant DCI 0/4 (with cross-carrier indication)
 - Option 2: by DL DCI (with cross-carrier indication)
 - Option 3: by group DCI
 - Adopt Option 3 and only apply to SRS-only CC without PUSCH
 - Joint group DCI for triggering and TPC
 - FFS: Number of bits for each UE and the meaning for the states of the field
 - Introduce RNTI for the group
- Support 2 types of PHR as in Rel-13
 - Details FFS
- Dropping/power scaling rules as in Rel-13

[R1-167484](#) **Support of non-contention based PRACH transmission** **Ericsson Inc.**
[R1-166129](#) Details on timing advance for SRS on TDD CCs without PUSCH Huawei, HiSilicon

Agreements:

- SRS-only CC without PUSCH needs to be configured in a TAG
- PRACH
 - PRACH trigger and SRS trigger for a SRS-only carrier are independent
 - Support all PRACH preamble formats

7.2.7.2 Details of periodic and/or aperiodic SRS

[R1-166287](#) **Details of Periodic and/or aperiodic SRS** **Qualcomm Incorporated**
[R1-166740](#) P-SRS and A-SRS Transmission with Carrier Switching Samsung

Agreements:

- For A-SRS, trigger is carried in:
 - DL scheduling DCI and group DCI
 - Group DCI is only used for SRS-only CC without PUSCH
- In addition to all existing parameter configurations
 - In case the UE supports multiple switching-from CCs, selected by
 - Option 1: rule(s) defined
 - Option 2: RRC configuration

[R1-166130](#) Support of periodic SRS Huawei, HiSilicon
[R1-167446](#) Further considerations on aperiodic SRS Ericsson Inc.
[R1-166532](#) Remaining details of SRS triggering with CC switching Intel Corporation
[R1-166131](#) Support of aperiodic SRS Huawei, HiSilicon

7.2.7.3 Details of collision handling

[R1-166132](#) **Details on collision handling for SRS switching** **Huawei, HiSilicon**
[R1-166288](#) **Collision Handling** **Qualcomm Incorporated**
[R1-166533](#) Collision handling for SRS CC-based switching Intel Corporation
[R1-166741](#) SRS Collisions in Carrier Switching Samsung
[R1-167483](#) Impact of slot dropping in SRS switching Ericsson Inc.
[R1-167757](#) Proposals on collision handling for SRS switching SoftBank Corp.

7.2.7.4 Other

[R1-167716](#) **SRS switching UE capability** **Nokia, Alcatel-Lucent Shanghai Bell**

Agreements:

- UE reports the switching time/interruption time for SRS switching
 - FFS: Per band-pair or Per CC-pair
 - FFS: set of potential values

Agreements:

- R14 SRS switching supports RF retuning time no longer than X us
 - Option 1: X = 200
 - Option 2: X = 300
 - Option 3: X = 500
 - Option 4: X = 900

Agreement: Send LS to RAN4 and RAN2 with the agreements achieved during this meeting

[R1-166289](#) **Support of multiple antennas for SRS switching** **Qualcomm Incorporated**
[R1-166133](#) **SRS switching for UEs with multiple antennas** **Huawei, HiSilicon**

Agreements:

- Support SRS from each of the multiple antennas with carrier switching for periodic and aperiodic SRS
 - For 2 antenna cases, supported if UE is capable of UL 2x2 MIMO or 2 antenna switching
 - For 4 antenna cases, supported if UE is capable of UL 4x4 MIMO or 4 antenna switching (if introduced)
 - Details FFS

Friday

[R1-168470](#) **Draft LS for SRS Carrier-Based Switching** **Huawei**

Decision: The document is noted and final LS is **agreed in R1-168556**

7.2.8 Further Indoor Positioning enhancements for UTRA and LTE -WID in [RP-160538](#)

[R1-168409](#) **Chairman's notes of AI 7.2.8 on Further Indoor Positioning enhancements for UTRA and LTE** **Ad-Hoc chair (Qualcomm)**

The document was presented by Wanshi Chen from Qualcomm.

Decision: The document is endorsed and incorporated as follows.

7.2.8.1 Remaining issues for OTDOA enhancements

[R1-168266](#) **WF on PRS sequence generation per TP** **Huawei, HiSilicon, Nokia, Alcatel-Lucent Shanghai Bell**

Decision: The way forward is agreed. LS is to prepared in [R1-168447](#).

Friday

[R1-168447](#) **[Draft] LS on PRS sequence generation per TP** **Huawei**

Decision: The document is noted and final LS is **agreed in R1-168557**.

[R1-168337](#) **Draft CR on PRS sequence generation per TP** **Huawei, HiSilicon**
[R1-168086](#) **Way forward on CRS usage together with PRS** **Intel Corporation, Acorn Technologies, Huawei, HiSilicon**

Proposal:

- Support the use of CRS together with PRS for OTDOA enhancement
 - If CRS usage together with PRS is configured,
 - Signal CP information for CRS if PRS is present.
 - Note: this CP information signaling is additional one to the existing CP signaling for PRS.
 - Quasi-collocation between PRS and CRS is assumed.
- Send the LS for the above to RAN2 to be captured for their works

Study till next meeting

[R1-168289](#) **WF on Rich RSTD reporting for OTDOA** **Ericsson, Nokia, Qualcomm**

Conclusion:

- RAN1 can further study the following for the OTDOA enhancement
 - Richer RSTD reporting by UE to E-SMLC

[R1-166290](#) PRS sequence generation and value range for PRS-ID **Qualcomm Incorporated**
[R1-166291](#) Introduction of UE inter-frequency RSTD calibration accuracy reporting **Qualcomm Incorporated**
[R1-166952](#) RSTD Reporting Enhancement in OTDOA **Nokia, Alcatel-Lucent Shanghai Bell**
[R1-166958](#) OTDOA Enhancement for Same PCI Issue **Nokia, Alcatel-Lucent Shanghai Bell**
[R1-167148](#) Discussion on the PRS sequence generation per TP **Huawei, HiSilicon**
[R1-167661](#) PRS sequence generation for same-PCI issue for enhanced indoor positioning **Ericsson**
[R1-167662](#) Enhanced reference cell selection for enhanced indoor positioning **Ericsson**
[R1-167663](#) Multipath RSTD reporting per cell for enhanced indoor positioning **Ericsson**
[R1-167696](#) On range of virtual cell ID **Intel Corporation**
[R1-167697](#) CRS Usage together with PRS **Intel Corporation**
[R1-168087](#) Way forward on PRS sequence generation **Intel Corporation**

7.2.8.2 PRS-based beacons

[R1-166292](#) PRS subframe configuration for PRS-based TBS **Qualcomm Incorporated**
[R1-166293](#) PRS-only TBS Transmission Points **Qualcomm Incorporated**
[R1-166954](#) Discussion of PRS-Based Beacon for Indoor Positioning **Nokia, Alcatel-Lucent Shanghai Bell**
[R1-167664](#) PRS patterns for PRS-based TBS for enhanced indoor positioning **Ericsson**

[R1-168297](#) WF on PRS-based TBS Qualcomm

Decision: The way forward is agreed. LS is to RAN2 and RAN3 (cc-ing RAN4) prepared in [R1-168466](#).

Friday

[R1-168466](#) [DRAFT] LS on PRS-based Terrestrial Beacon System (TBS) Qualcomm

Decision: The document is noted and final LS is agreed in [R1-168558](#).

7.2.8.3 E-CID enhancements

[R1-167170](#) WF on the same PCI for E-CID Huawei, HiSilicon, China Unicom

[R1-167665](#) On CSI-RSRP reporting to E-SMLC for enhanced indoor positioning Ericsson

[R1-167149](#) Further discussion on the same PCI case for E-CID enhancements Huawei, HiSilicon

Conclusion

- Companies are encouraged to study E-CID enhancements according to the WID, especially considering existing techniques (e.g., cell portion)

[R1-167150](#) Further discussion on the UE Rx-Tx measurement over multiple serving cells Huawei, HiSilicon

7.2.8.4 Other

[R1-167666](#) Defining indoor/outdoor classification for enhanced indoor positioning Ericsson

7.2.9 Uplink Capacity Enhancements for LTE - WID in [RP-160664](#)

Specification of PUSCH in special subframe, with focus on the design of HARQ timing, TBS determination, UL DM-RS, TTI bundling, related signalling and procedure

[R1-168410](#) Chairman's notes of AI 7.2.9 on Uplink Capacity Enhancements for LTE Ad-Hoc chair (Ericsson)

The document was presented by Sorour Falahati from Ericsson.

Decision: The document is endorsed and incorporated as follows.

[R1-167100](#) Work plan for UL capacity enhancement CMCC

[R1-166144](#) Scheduling and HARQ timing for PUSCH on UpPTS Huawei, HiSilicon

[R1-166534](#) PUSCH transmission in special subframe Intel Corporation

[R1-166294](#) PUSCH in UpPTS Qualcomm Incorporated

[R1-166601](#) Considerations on PUSCH design in special subframe ZTE Corporation

[R1-166635](#) TTI bundling for uplink coverage enhancement NEC

[R1-167717](#) HARQ timing for PUSCH transmission in special subframe Nokia, Alcatel-Lucent Shanghai Bell

[R1-166145](#) Signaling for PUSCH on UpPTS Huawei, HiSilicon

[R1-166146](#) Transmission of PUSCH on UpPTS Huawei, HiSilicon

[R1-166453](#) Support of PUSCH transmission in UpPTS CATT

[R1-167096](#) General Discussion on support of PUSCH in UpPTS CMCC

[R1-167097](#) Timing for newly added PUSCH in UpPTS CMCC

[R1-167098](#) Discussion on the TBS scaling design CMCC

[R1-167099](#) Discussion on TTI bundling design for PUSCH in UpPTS CMCC

[R1-167141](#) UCI in PUSCH on UpPTS Huawei, HiSilicon

[R1-168096](#) WF on new special subframe configuration CMCC, ZTE, CATT

[R1-168097](#) WF on timing design for PUSCH in UpPTS CMCC

[R1-168098](#) WF on TTI bundling for PUSCH in UpPTS CMCC, NEC

[R1-168099](#) WF on TBS scaling design for PUSCH in UpPTS CMCC

Agreement: Support a new special subframe configuration 10 as in the following table, with 6 DL symbols of NCP in DwPTS, together with 6 symbols of NCP in UpPTS or with 5 symbols of ECP in UpPTS

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
10	$13168 \cdot T_s$	$13152 T_s$	$12800 T_s$	-	-	-

- Send LS to RAN2 about the supported new special subframe configuration

Friday

[R1-168396](#)

[Draft] LS on introducing a new special subframe configuration CMCC

Decision: The document is noted and final LS is agreed in [R1-168559](#).

Agreement: In UpPTS, independent transport block(s) is transmitted as a separate transmission resource

Agreement:

- Support synchronized HARQ timing
- For TDD UL/DL configuration 1~5, specify the timing from UL grant to PUSCH according to the following table, when supporting PUSCH transmission in UpPTS, i.e.,
 - The UE shall upon detection of a PDCCH with DCI format 0/4 in subframe n intended for the UE, adjust the corresponding PUSCH transmission in subframe $n+k$, where the k is in the following table

TDD UL/DL Configuration	DL subframe index n									
	0	1	2	3	4	5	6	7	8	9
1	6	6			4	6	6			4
2		5		4			5		4	
3	4							4	4	4
4								4	4	4
5								4	4	

Agreement: For TDD UL/DL configuration 0, reuse the UL index field in UL grant to schedule PUSCH in UpPTS.

Agreement:

- For TDD UL/DL configuration 1~5, down-select between the following options for HARQ transmission:
 - Option1: Only support adaptive HARQ transmission, i.e., the retransmission of a PUSCH in UpPTS is scheduled by a UL grant with NDI not toggled
 - Option2: Support both adaptive and non-adaptive HARQ transmission. For non-adaptive HARQ transmission, the PHICH is used, and the PHICH timing is designed based on the following principle:
 - Principle: To keep the backward compatibility, the PHICH corresponding to PUSCH in UpPTS can only be added in DL subframes including legacy PHICH region
- FFS if non-adaptive HARQ transmission is supported for TDD UL/DL configurations 0 and 6

Agreement:

- Support TTI bundling for TDD configuration 2 and 3 when supporting of PUSCH in UpPTS
- Specify the scheduling and HARQ timing for TTI bundling as follows
 - The UE shall upon detection of a PDCCH with DCI format 0 in subframe n intended for the UE, adjust the corresponding PUSCH transmission in subframe $n+k$, with k in the following table

TDD UL/DL Configuration	DL subframe number n									
	0	1	2	3	4	5	6	7	8	9
2		5		4			5		4	
3	4							4	4	4

7.2.10 Further Enhanced MTC for LTE - SID in [RP-161321](#)

[R1-168411](#)

Chairman's notes of AI 7.2.10 on Further Enhanced MTC for LTE Ad-Hoc chair (Ericsson)

The document was presented by Johan Bergman from Ericsson.

Decision: The document is endorsed and incorporated as follows.

[R1-167667](#) **WI work plan for Further Enhanced MTC for LTE** Ericsson

[R1-168295](#) Draft LS regarding agreements for FeMTC Qualcomm, Huawei

Decision: The document is noted and final LS is [agreed in R1-168300](#)

7.2.10.1 Higher data rates

[R1-166297](#) **Support of larger data channel bandwidth** Qualcomm Incorporated

[R1-167892](#) **Initial analysis on bandwidth and TBS increase for FeMTC** Intel Corporation

Revision of [R1-166536](#)

Agreement:

- The wider bandwidth operation is enabled by eNB.
- Wider bandwidth PDSCH/PUSCH is cross subframe scheduled by MPDCCH.
- MPDCCH follows Rel-13 design, which implies that it can be decoded by a UE operating in narrowband operation (6RB).
- If a new grant is introduced for wideband PDSCH/PUSCH, the number of blind decodings of MPDCCH does not increase with respect to Rel-13 eMTC.

[R1-166535](#) **Views on support of higher data rates for FeMTC** Intel Corporation

[R1-167158](#) **On supporting larger maximum TBS** Huawei, HiSilicon

[R1-168057](#) **WF on support of larger maximum TBS and channel bandwidth for FeMTC** Intel, Spreadtrum, Huawei, HiSilicon, Ericsson

Agreement:

- For Rel-14 FeMTC UEs, the maximum UL TBS for CEMode A UEs with maximum 1.4 MHz bandwidth in TDD/HD-FDD is increased to 2984 bits.
 - Idle mode operations reuse the Rel-13 eMTC design.
- Study till next meeting whether there are any issues with a maximum useable PDSCH/PUSCH channel bandwidth which is a multiple of 6 PRBs.
- For Rel-14 FeMTC UEs supporting larger UE channel BW for PDSCH and PUSCH:
 - The larger max. DL TBS is at least 2984 bits.
 - The larger max. UL TBS is at least 2984 bits.
- For Rel-14 FeMTC UEs with larger TBS and channel BW:
 - Idle mode operations reuse the Rel-13 eMTC design.

Agreement:

- For Rel-14 BL UEs in CE mode A (FFS for CE mode B), the single larger maximum UE channel BW for PDSCH and PUSCH in RRC connected mode is 5 MHz.
- For Rel-14 non-BL UEs in CE mode A (FFS for CE mode B), the single larger maximum UE channel BW for PDSCH and PUSCH in RRC connected mode is (FFS: 5 or 20) MHz.

[R1-166296](#) Support of HARQ-ACK bundling in HD-FDD Qualcomm Incorporated

[R1-166298](#) Support of higher data rates Qualcomm Incorporated

[R1-166596](#) Higher performance targets for Further Enhanced MTC Apple Europe Limited

[R1-166602](#) Consideration on larger channel bandwidth for FeMTC Nokia, Alcatel-Lucent Shanghai Bell

[R1-166603](#) Increasing the number of HARQ processes in FeMTC Nokia, Alcatel-Lucent Shanghai Bell

[R1-166625](#) Higher data rates for feMTC Sequans Communications

[R1-166628](#) Techniques for supporting high data rate transmission for FeMTC NEC

[R1-166660](#) Higher data rate for feMTC Sony

[R1-166680](#) Ack Bundling Design Consideration Sierra Wireless, S.A.

[R1-166850](#) Higher data rate support for FeMTC LG Electronics

[R1-167159](#) On improving peak rate for HD-FDD in FeMTC Huawei, HiSilicon

[R1-167161](#) Discussion on larger Max PDSCH/PUSCH channel bandwidth in FeMTC Huawei, HiSilicon

[R1-167162](#) Analysis on increasing DL HARQ processes in CE mode A for FD-FDD Huawei, HiSilicon

[R1-167195](#) Design for the higher data rates Kyocera Corporation

[R1-167318](#) Support of HARQ-ACK bundling for MTC ZTE

[R1-167319](#) Support of larger TBS and larger PDSCH/PUSCH bandwidth for MTC ZTE

[R1-167352](#) Views on techniques to improve the data rate for Rel-14 MTC NTT DOCOMO, INC.

R1-167418	Introduction of larger max TBS for MTC in TS36.213	Huawei
R1-167516	Discussion on Higher Data Rate for Further eMTC	Lenovo
R1-167668	Higher data rates for MTC	Ericsson
R1-167974	WF on supporting larger TBS in FeMTC	Huawei, HiSilicon
R1-168061	WF on harq bundling in hd-fdd for mtc	ZTE

7.2.10.2 Multicast

R1-168166	WF on Multicast for FeMTC	Nokia, Alcatel-Lucent Shanghai-Bell, Ericsson, Qualcomm
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Proposal:

- All BL/CE UEs supporting SC-PTM, are able to decode the SC-MCCH even if it is configured for worst case CE Mode B operation and the UE is only a CE Mode A capable UE
- A cell supporting FeMTC SC-PTM, has the option to configure multiple parallel SC-MTCH services.
- FFS: A BL/UE UE can receive SC-PTM services in:
 - Idle mode only
 - Connected mode only
 - Either Idle or connected modes
- A MPDCCH search space is used to schedule the SC-MCCH.
 - Both dynamic and SPS-like scheduling are supported
 - FFS: If the SS reuses existing definition or is a new SS.
- A MPDCCH search space is used to schedule the SC-MTCH.
 - Both dynamic and SPS-like scheduling are supported
 - FFS: If the SS reuses existing definition or is a new SS.

R1-166299	Support of multicast	Qualcomm Incorporated
R1-166537	On multicast support for Cat M1 UEs	Intel Corporation
R1-166605	SC-PTM for FeMTC General Considerations	Nokia, Alcatel-Lucent Shanghai Bell
R1-166606	SC-PTM for FeMTC Search Space Considerations	Nokia, Alcatel-Lucent Shanghai Bell
R1-167160	Consideration on SC-PTM transmission for FeMTC	Huawei, HiSilicon
R1-167320	Considerations on multicast support for MTC	ZTE
R1-167669	Overview of SC-PTM and common eMTC and NB-IoT aspects	Ericsson
R1-167670	Multicast support for MTC	Ericsson

7.2.10.3 Other

R1-166300	Paging channel enhancements	Qualcomm Incorporated
R1-167612	Power consumption reduction techniques for eMTC	Qualcomm Incorporated
R1-166607	VoLTE support for Cat-M1 UE	Nokia, Alcatel-Lucent Shanghai Bell
R1-166851	VoLTE support for FeMTC	LG Electronics

7.2.11 Enhancements of NB-IoT - WID in [RP-161324](#).

The objectives apply to the in-band, guard-band, and standalone operation modes and the same coverage enhancement targets as defined in the Rel-13 NB-IoT work item.

[R1-168412](#) Chairman's notes of AI 7.2.11 on Enhancements of NB-IoT Ad-Hoc chair (Qualcomm)

The document was presented by Wanshi Chen from Qualcomm.

Decision: The document is endorsed and incorporated as follows.

R1-166189	NB-IoT Release 14 enhancements work plan	Huawei, HiSilicon
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Noted

7.2.11.1 Positioning

R1-168114	WF on observations on NB-IoT positioning performance	Ericsson, ZTE
R1-168310	WF on simulation assumption for NB-IoT positioning	ZTE, Ericsson, Nokia, Alcatel-Lucent Shanghai Bell

Agreement:

- [R1-168310](#) is agreed with the following updates:
 - Slide 3, add UL transmission timing error modelling according to RAN4 requirements

The above agreement is captured in

R1-168363	WF on simulation assumption for NB-IoT positioning	ZTE, Ericsson, Nokia, Alcatel-Lucent Shanghai Bell, Huawei, HiSilicon
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7.2.11.1.1 Requirements

R1-167743	Requirements for NB IoT Positioning Enhancements Evaluations	VODAFONE Group Plc
R1-167101	Discussion on positioning requirements for enhanced NB-IoT	CMCC
R1-167790	Requirements for NB-IoT/eMTC positioning	Deutsche Telekom AG
R1-167983	WF on requirements for NB-IoT positioning	Huawei, HiSilicon

Agreed way forward for reporting to RAN#73

- Report the horizontal accuracy and TOA estimation accuracy at 67%.
- Report the operator requirement to strive towards horizontal accuracy of 50 m for 67% of NB-IoT UEs
- Report observations on positioning accuracy for stationary (i.e., 0 km/h) and pedestrian (i.e., 3 km/h) and 30km/h UEs. 120km/h may be evaluated during the design.
- Report observations for outdoor channel models, and outdoor-indoor channel models where they are available.
- Report observations on time to determine position according to MCL
 - This is the time from trigger for positioning to availability of a positioning estimate
- Report observations on impact of having a lower power class UE
- Report observations on network complexity/cost, for example including LMUs (as described in 36.111)
- Other requirements as for Rel-13 NB-IoT, including
 - Report changes UE complexity compared to Rel-13 NB-IoT
 - Report total impact to UE battery life
 - Report scalability to support massive numbers of UEs per cell
- Report dependency of accuracy performance on synchronous (E-SMLC is assumed to know the absolute timing of each involved eNB) or asynchronous networks
- Requirements are the same for all three operation modes (i.e. stand-alone/in-band/guard band) per the WID
- Companies can provide other inputs to RAN#73 on aspects outside the scope of RAN1 such as security, RAN sharing, etc.

R1-166171	NB-IoT positioning scenarios and requirements	Huawei, HiSilicon
R1-166301	Requirements for narrowband positioning	Qualcomm Incorporated
R1-167423	On requirements and assumptions for NB-IoT positioning	Ericsson
R1-166587	NB-IoT positioning requirements	Nokia, Alcatel-Lucent Shanghai Bell
R1-167321	Discussion of NB-IoT positioning requirement and evaluation methodology	ZTE
R1-167424	A new system simulator for NB-IoT positioning	Ericsson

7.2.11.1.2 Uplink-based narrowband positioning

R1-166173	Design of NB-IoT uplink positioning	Huawei, HiSilicon
R1-166174	Evaluation of NB-IoT uplink positioning	Huawei, HiSilicon
R1-166302	Uplink-based narrowband positioning	Qualcomm Incorporated
R1-167322	UTDOA support for NB-IoT	ZTE
R1-167425	On uplink-based positioning for NB-IoT	Ericsson
R1-166588	UTDOA positioning in NB-IoT	Nokia, Alcatel-Lucent Shanghai Bell
R1-166627	UTDOA based positioning for NB-IoT	Fraunhofer IIS
R1-167426	On timing advance based multi-leg positioning for NB-IoT	Ericsson

7.2.11.1.3 Downlink-based narrowband positioning

R1-167427	On Downlink-based narrowband positioning for NB-IoT	Ericsson
R1-166303	Downlink-based narrowband positioning	Qualcomm Incorporated
R1-166589	OTDOA positioning in NB-IoT	Nokia, Alcatel-Lucent Shanghai Bell
R1-167323	OTDOA support for NB-IoT	ZTE
R1-166172	Evaluation of NB-IoT downlink positioning	Huawei, HiSilicon
R1-166852	Positioning support for eNB-IoT	LG Electronics

Section 3

R1-167163	Design of NB-IoT downlink positioning	Huawei, HiSilicon
R1-167740	Discussion on OTDOA for eNB-IoT	III
R1-167752	Support of OTDOA in NB-IoT	Innovative Technology Lab Co.

7.2.11.1.4 Comparison of uplink- and downlink-based methods

[R1-168332](#) WF on observations on performance aspects of NB-IoT positioning Huawei, HiSilicon
Revision of [R1-167984](#)

Agreement: The WF is agreed with the following updates:

- Slide 5,
 - add “reusing of NPSS”
 - in ZTE’s result, adding [...] for the sampling rate of 1920
 - Update the sentence from
 - For in-band operation, the positioning accuracy of OTDOA schemes evaluated by RAN1#86 reported by most companies is on the order of tens of meters. One evaluation found accuracy on the order of a few hundred meters
 - To
 - For in-band operation, the positioning accuracy of OTDOA schemes evaluated by RAN1#86 reported by most companies is on the order of tens of meters.
 - One evaluation found accuracy on the order of a few hundred meters, which is under assumptions of Rel-13 UE complexity
- Slide 3, update the sentence from
 - (this sentence is not staying here) Companies have used differing simulation assumptions, which leads to the performance differences between companies. Comparisons can be made within each company’s results.
 - To
 - Companies have used different assumptions, which leads to the significant performance differences between companies. Results from different companies may not be comparable

[R1-168333](#) WF on observations on UE impact aspects of NB-IoT positioning Huawei, HiSilicon
Revision of [R1-167985](#)

[R1-168334](#) WF on observations on network impact aspects of NB-IoT positioning Huawei, HiSilicon
Revision of [R1-167986](#)

LS to RAN plenary (cc-ing RAN2/3/4) capturing the above 3 agreements to be drafted in [R1-168552](#) (Huawei)

Friday:

[R1-168552](#) [DRAFT]LS on NB-IoT positioning Huawei

Decision: The document is noted and final LS is **agreed in [R1-168553](#)**

R1-166175	Comparison of downlink and uplink positioning	Huawei, HiSilicon
R1-166176	UE complexity and power consumption analysis for NB-IoT positioning	Huawei, HiSilicon, Neul
R1-166304	Comparison of uplink and downlink based positioning	Qualcomm Incorporated
R1-166590	Comparison of UTDOA and OTDOA in NB-IoT	Nokia, Alcatel-Lucent Shanghai Bell
R1-166654	Considerations on NB-IoT positioning	Sony
R1-167164	Capacity limit evaluation	Huawei, HiSilicon
R1-167324	Comparison of NB-IoT positioning solution	ZTE
R1-167428	On uplink- and downlink-based positioning for NB-IoT	Ericsson
R1-167897	NB-IoT localization performance analysis and enhancement	Nokia, Alcatel-Lucent Shanghai Bell
R1-168094	Performance summary for NB-IoT Positioning	Nokia, Alcatel-Lucent Shanghai Bell

7.2.11.2 Multicast support

Extend Rel-13 SC-PTM to support multicast downlink transmission

[R1-166178](#) Physical layer design for multicast in NB-IoT Huawei, HiSilicon
[R1-166199](#) Search space and collision handling for multicast in NB-IoT Huawei, HiSilicon
[R1-166538](#) SC-PtM support for NB-IoT Intel Corporation
[R1-166591](#) On Multicast support for NB-IoT Nokia, Alcatel-Lucent Shanghai Bell

[R1-167987](#) WF on collision handling for NB-IoT SC-PTM Huawei, HiSilicon, ITL

Agreement:

- SC-PTM in NB-IoT is supported at least in RRC_IDLE mode. FFS RRC CONNECTED mode.
- In RRC_IDLE mode, priority between SC-PTM and the following needs to be decided at least for:
 - SC-PTM and paging, if there is a collision issue
 - SC-PTM and a random access procedure (e.g. for unicast BSR), if there is a collision issue
- If RRC_CONNECTED mode is supported, priority between SC-PTM and the following needs to be decided at least for:
 - SC-PTM and unicast, if there is a collision issue

[R1-167988](#) **WF on design principle of search space for NB-IoT SC-PTM** Huawei, HiSilicon, ITL
Continue discussion next meeting

[R1-166305](#) Support of multicast Qualcomm Incorporated
[R1-167325](#) Consideration for multicast support for NB-IoT ZTE
[R1-167354](#) Discussion on multicast support for Rel-14 NB-IoT NTT DOCOMO, INC.
[R1-167429](#) Multicast support for NB-IoT Ericsson
[R1-167556](#) Discussion on SC-PTM in enhanced coverage MediaTek Inc.
[R1-167753](#) Support of SC-PTM in NB-IoT Innovative Technology Lab Co., KT Corp.
[R1-167877](#) Multicast support for eNB-IoT LG Electronics
[R1-167883](#) Physical-layer processing for multi-segment transmission in NB-IoT Huawei, HiSilicon

7.2.11.3 Non-anchor PRB enhancements

Transmission of paging on non-anchor PRBs

[R1-166306](#) **Non-anchor PRB enhancements** Qualcomm Incorporated
[R1-168052](#) **WF on Paging on non-anchor PRBs** Qualcomm Incorporated
Also supported by Intel
[R1-168062](#) **WF on Paging enhancement for Rel-14 NB-IoT** ZTE, Nubia
Also supported by ITL.

Agreements:

- For paging:
 - For a Rel-14 NB-IoT UE, both anchor and non-anchor PRB can be selected as the paging PRB
 - A Rel-14 UE chooses the PRB based on UE_ID
 - Paging message on NPDSCH is scheduled by NPDCCH on the same PRB.
- Send LS to RAN2 with these RAN1 agreements – (Qualcomm, ZTE)

Friday

[R1-168362](#) **[DRAFT] LS regarding agreement on paging for NB-IoT** Qualcomm
Decision: The document is noted and final LS is **agreed in [R1-168554](#)**

[R1-166854](#) **Non-anchor PRB enhancements for eNB-IoT** LG Electronics
Section 2
[R1-167326](#) **Considerations to support paging on multiple PRBs** ZTE
[R1-168344](#) **Paging PRB configuration for eNB-IoT** LG Electronics, ITL
Continue discussion next meeting.

[R1-166179](#) On paging transmission on non-anchor NB-IoT PRB Huawei, HiSilicon
[R1-166539](#) MCO enhancements for paging Intel Corporation
[R1-166592](#) On non-anchor PRB enhancements for NB-IoT Nokia, Alcatel-Lucent Shanghai Bell
[R1-167353](#) Initial views on the paging on non-anchor PRB for Rel-14 NB-IoT NTT DOCOMO, INC.
[R1-167430](#) NB-IoT non-anchor carrier Paging Ericsson
[R1-167431](#) Random Access on Non-Anchor Carriers in NB-IoT Ericsson

7.2.11.4 Other

[R1-166593](#) Scheduling request multiplexing with ACK/NACK Nokia, Alcatel-Lucent Shanghai Bell
[R1-166855](#) Low power UE support for eNB-IoT LG Electronics
[R1-167557](#) Support of higher data rate for NB-IoT MediaTek Inc

7.2.12 Shortened TTI and processing time for LTE - *WID in [RP-161299](#)*

[R1-168413](#) **Chairman's notes of AI 7.2.12 on Shortened TTI and processing time for LTE** Ad-Hoc chair
(Nokia)

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and incorporated as follows.

[R1-167502](#) **Work plan for shortened TTI and processing time** Ericsson
[R1-167069](#) **On LTE PHY processing time reduction** Nokia, Alcatel-Lucent Shanghai Bell

7.2.12.1 Shortened processing time for 1ms TTI

General

- [R1-167366](#) Views on shortened processing time for 1ms TTI NTT DOCOMO, INC.
[R1-167497](#) Reduced processing for 1ms TTI Ericsson
Revised in [R1-168307](#)
[R1-167501](#) Supported HARQ timings for 1ms TTI Ericsson
[R1-167891](#) Processing time reduction and related procedures for 1ms TTI Huawei, HiSilicon
Revision of [R1-166159](#)
[R1-166540](#) On reducing processing time for 1ms TTI Intel Corporation
[R1-166692](#) Overview of latency reduction operation with subframe TTI for FS1 Samsung

Downlink

- [R1-166307](#) Shortened processing time for 1ms TTI for DL Qualcomm Incorporated
[R1-167070](#) On processing time reduction between PDSCH transmission and DL HARQ feedback Nokia,
Alcatel-Lucent Shanghai Bell
[R1-166696](#) FDD DL HARQ-ACK feedback procedure for latency reduction with subframe TTI Samsung
[R1-166454](#) HARQ and scheduling timing design for LTE processing timing reduction with 1ms TTI CATT

Uplink

- [R1-166308](#) Shortened processing time for 1ms TTI for UL Qualcomm Incorporated
[R1-167500](#) Asynchronous HARQ for PUSCH Ericsson

- [R1-168230](#) WF on Tx timing for 1ms TTI LG Electronics, NTT DOCOMO, Ericsson, Qualcomm, ZTE Corp,
ZTE Microelectronics, Panasonic, Sharp, Nokia, Alcatel-Lucent Shanghai Bell
[R1-168192](#) WF on support of reduced processing time for 1ms TTI Intel, Ericsson, Huawei, HiSilicon, LG
Electronics, Panasonic, Samsung, Nokia, Alcatel-Lucent Shanghai Bell, Sharp, NTT DOCOMO

Agreement:

- For FS1,2&3, a minimum timing $n+3$ is supported for UL grant to UL data and for DL data to DL HARQ for UEs capable of operating with reduced processing time with only the following conditions:
 - A maximum TA is reduced to x ms, where $x \leq 0.33$ ms (exact value FFS);
 - At least when scheduled by PDCCH
- For FS2, new DL HARQ and UL scheduling timing relations will be defined
 - Details FFS
- FFS:
 - Possible minimum timing of $n+2$ TTI
 - FFS max TA in this case
 - FFS what other restrictions (if any) on when reduced processing times of $n+2$ could be applied
 - Possibility of scheduling by EPDCCH.

- [R1-168243](#) WF on $n+2$ transmission timing for 1ms TTI Nokia, ASB

- [R1-168231](#) WF on fallback transmission for shortened processing time in 1ms TTI LG Electronics, Sharp,
Huawei, HiSilicon, Qualcomm, Ericsson, Intel, NTT DOCOMO

Also supported by Nokia

Proposal:

- For UE capable of shortened processing time for 1ms TTI, the following fallback operations should be supported:
 - If PDCCH for DL assignment is transmitted in the common search space, use legacy processing timing with a minimum timing of 4ms for DL data to DL HARQ feedback
 - If PDCCH for UL grant is transmitted in the common search space, use legacy processing timing with a minimum timing of 4ms for UL grant to UL data
 - The above fallback operations are applied to both FS1 and FS2

Agreement:

- Reduced processing time(s) are RRC configured for the UE
- Working assumption:** A mechanism for dynamic fallback to legacy processing timings ($n+4$) is supported
 - Details FFS
 - Working assumption can be revisited if it is not found to be feasible

R1-168187 WF on asynchronous UL HARQ Ericsson, Nokia, ASB

Agreement:

- PHICH-less asynchronous HARQ for UL is used for 1 ms TTI with shortened processing time
 - For FS1 and FS2, bit fields are defined in the applicable DCI messages to indicate HARQ processes ID and RV
 - No change in FS3 asynchronous UL HARQ operation

Asynchronous HARQ: Qualcomm, Huawei, HiSilicon, Ericsson, LGE, ZTE, NTT Docomo, Nokia, ASB, Spreadtrum, Sharp

Synchronous HARQ: Samsung, CATT, ITRI,

Configurable by the network: Samsung, CATT, ITRI

R1-168261 WF on support of Synchronous UL HARQ Samsung

Proposal:

- PHICH-based synchronous HARQ for UL is supported for 1 ms TTI with shortened processing time for FS1 and FS2.
- For FS3, asynchronous UL HARQ is supported for 1 ms TTI with shortened processing time.

R1-166693	Overview of latency reduction operation with subframe TTI for FS2	Samsung
R1-166694	Overview of latency reduction operation with subframe TTI for FS3	Samsung
R1-166695	Processing time reduction for latency reduction with subframe TTI	Samsung
R1-166697	TDD DL HARQ-ACK feedback procedure for latency reduction with subframe TTI	Samsung
R1-166698	UL HARQ-ACK feedback procedure for latency reduction with subframe TTI	Samsung
R1-166856	Consideration for shortened processing time for 1ms TTI	LG Electronics
R1-166857	Discussion on CSI feedback for 1ms TTI with reduced processing time	LG Electronics
R1-166995	Shortened Processing Time Analysis	Spreadtrum Communications
R1-167016	Latency reduction for FS2 with 1ms TTI	Nokia, Alcatel-Lucent Shanghai Bell
R1-167017	On HARQ-timing with 1-ms TTI and reduced processing times	Nokia, Alcatel-Lucent Shanghai Bell
R1-167071	On processing time reduction between UL grant and UL data transmission	Nokia, Alcatel-Lucent Shanghai Bell
R1-167083	System level study on processing time reduction with 1ms TTINokia, Alcatel-Lucent Shanghai Bell	
R1-167084	Mechanism for indicating the processing time to the UE for 1ms TTI	Nokia, Alcatel-Lucent Shanghai Bell
R1-167147	Performance evaluation of short TTI vs. 1ms TTI with processing time reduction	Huawei, HiSilicon
R1-167367	HARQ/Scheduling timing for FS2 with Shortened processing time for 1ms TTI	NTT DOCOMO, INC.
R1-167499	Fast CSI for 1ms TTI	Ericsson
R1-167577	HARQ with shortened processing time for 1ms TTI	ZTE Corp, ZTE Microelectronics
R1-167582	Some issues in 1ms TTI latency reduction operation	ZTE Corp, ZTE Microelectronics
R1-167597	Considerations on processing time reduction for legacy TTIs	Mediatek Inc.
R1-167611	Shortened processing time for 1ms TTI	SHARP Corporation
R1-168232	WF on PUCCH resource allocation for shortened processing time for 1ms TTI	LGE, Intel
R1-168275	WF on reduced processing time for 1ms TTI	Samsung, Huawei, HiSilicon
R1-168307	Reduced processing for 1ms TTI	Ericsson

7.2.12.2 Shortened TTI length together with shortened processing time

7.2.12.2.1 Design of sTTI for DL and UL

R1-168350 WF on sPDCCH Huawei, HiSilicon, Qualcomm, Ericsson, Nokia, ASB, InterDigital, Xiaomi Communication, NTT DOCOMO, CATT, Samsung, Intel, LG, ZTE, ZTE Microelectronics, Spreadtrum, Sharp, CATR, Panasonic, Potevio, Mediatek, Motorola Mobility, Lenovo, NEC, SONY

R1-168533 WF on UL DMRS for sTTI Huawei, HiSilicon, Nokia, ASB, Ericsson, Potevio, Qualcomm, CATT, Intel, Spreadtrum, LG, Mediatek, Samsung, ZTE, ZTE Microelectronics, NTT DOCOMO, Panasonic, Sony

R1-168500 WF on short TTI lengths LG Electronics, Ericsson, Intel, NTT DOCOMO, CATT, Sharp, Samsung, Huawei, HiSilicon, Qualcomm, ZTE Corp, ZTE Microelectronics, Nokia, Alcatel-Lucent Shanghai Bell, MediaTek, Panasonic, KT Corp

R1-168482 Way forward on search space for sTTI Ericsson, Huawei, HiSilicon, Intel, CATT, Panasonic, NTT DOCOMO, LG Electronics

Agreements:

- The DL sTTI length of a UE is indicated by eNB
 - FFS details of configuration (based on RRC or PDCCH)

R1-166143	Discussion on the HARQ issues for TTI length reconfiguration	Huawei, HiSilicon
R1-166147	Discussion on sTTI length	Huawei, HiSilicon
R1-166148	sPDCCH design for short TTI	Huawei, HiSilicon
R1-166149	Details of two-level DCI schemes for short TTI	Huawei, HiSilicon
R1-166150	Discussion on DCI design for short TTI	Huawei, HiSilicon
R1-166151	PDSCH design for short TTI	Huawei, HiSilicon
R1-166152	PUCCH design for short TTI	Huawei, HiSilicon
R1-166153	PUSCH design for short TTI	Huawei, HiSilicon
R1-166154	UCI on sPUSCH	Huawei, HiSilicon
R1-166155	Discussion on DL RS for short TTI	Huawei, HiSilicon
R1-166156	Discussion on UL RS for short TTI	Huawei, HiSilicon
R1-166309	DL design for shortened TTI	Qualcomm Incorporated
R1-166310	UL design for shortened TTI	Qualcomm Incorporated
R1-166455	sPDCCH design for LTE short TTI	CATT
R1-166457	sPUSCH design for LTE short TTI	CATT
R1-166458	Discussion on UL sTTI operation	CATT
R1-166459	sPUCCH design for LTE short TTI	CATT
R1-166460	Discussion on the simultaneous transmissions of normal TTI and sTTI	CATT
R1-166541	DCI formats for shorten TTI	Intel Corporation
R1-166542	On sPDCCH design for shoten TTI	Intel Corporation
R1-166543	UL channes design for shorten TTI	Intel Corporation
R1-166629	sPDSCH/sPDCCH with 2-symbol sTTI and 1-slot sTTI	NEC
R1-166661	Discussion on sPDCCH for shortened TTI	Sony
R1-166699	Overview of sTTI operations	Samsung
R1-166700	sDCI design for sTTI operations	Samsung
R1-166701	sPDCCH for 2-symbol sTTI	Samsung
R1-166702	sPDCCH for 1-slot sTTI	Samsung
R1-166703	sPDSCH for 2-symbol and 1-slot sTTI	Samsung
R1-166704	sPUCCH for 2-symbol, 4-symbol and 1-slot sTTI	Samsung
R1-166705	sPUSCH for 2-symbol, 4-symbol and 1-slot sTTI	Samsung
R1-166706	TDD-specific issues on sTTI operations	Samsung
R1-166707	Coexistence between subframe TTI and sTTI operations for DL and UL	Samsung
R1-166858	Discussions on sPDCCH for latency reduction	LG Electronics
R1-166859	Discussions on sPDSCH for latency reduction	LG Electronics
R1-166860	sPUCCH design for HARQ-ACK feedback with shortened TTI length	LG Electronics
R1-166861	sPUCCH design for CSI feedback with shortened TTI length	LG Electronics
R1-166862	Discussion on UL design for shortened TTI	LG Electronics
R1-166966	Discussion on single level DCI and two-level DCI	Panasonic
R1-166968	UL simultaneous transmission between sTTI and TTI	Panasonic
R1-166972	Discussion on reference signal design for shortened TTI	Panasonic
R1-166973	Discussion on multiplexing between sTTI and TTI in the same subframe	Panasonic
R1-166996	Discussion on sPDCCH design for sTTI	Spreadtrum Communications
R1-166997	Discussion on sPUSCH design for sTTI	Spreadtrum Communications
R1-167018	On requirements of DM-RS design for UL shorter TTI	Nokia, Alcatel-Lucent Shanghai Bell
R1-167019	Simultaneous Transmissions of UL Signals for Shortened TTI Operation	Nokia, Alcatel-Lucent Shanghai Bell
R1-167021	sPUCCH design for shortened TTI	Nokia, Alcatel-Lucent Shanghai Bell
R1-167022	Considerations of slot-level sTTI for FS2	Nokia, Alcatel-Lucent Shanghai Bell
R1-167072	On simultaneous unicast PDSCH and sPDSCH operation	Nokia, Alcatel-Lucent Shanghai Bell
R1-167081	On DL control channel design for shorter TTI operation	Nokia, Alcatel-Lucent Shanghai Bell
R1-167082	On two-level DL control channel design for shorter TTI operation	Nokia, Alcatel-Lucent Shanghai Bell
R1-167085	On details of DMRS design for DL shorter TTI	Nokia, Alcatel-Lucent Shanghai Bell
R1-167102	Discussion on HARQ timing for shortened TTI in TDD	CMCC
R1-167189	Discussion on CA issues for shortened TTI operation	Huawei, HiSilicon
R1-167334	Discussions on DCI design consideration for shortened TTI SPS operation	Beijing Xiaomi Mobile Software
R1-167368	sPDCCH for shortened TTI	NTT DOCOMO, INC.
R1-167369	sPDSCH for shortened TTI	NTT DOCOMO, INC.
R1-167370	sPUCCH for shortened TTI	NTT DOCOMO, INC.
R1-167371	sPUSCH for shortened TTI	NTT DOCOMO, INC.
R1-167486	DL DMRS design for TTI shortening	Ericsson
R1-167487	sPDCCH search space design	Ericsson
R1-167488	Design aspects of sPDCCH	Ericsson

R1-167489	DL control for short TTI	Ericsson
R1-167490	Design aspects of sPDSCH	Ericsson
R1-167491	Design aspects of sPUSCH	Ericsson
R1-167492	UCI on sPUSCH with short TTI	Ericsson
R1-167493	Design aspects of sPUCCH	Ericsson
R1-167495	TDD aspects of short TTI	Ericsson
R1-167496	On the operation with different TTI lengths	Ericsson
R1-167498	Asynchronous HARQ for UL retransmissions with short TTI	Ericsson
R1-167503	Handling overlapping allocations with short and 1 ms TTI	Ericsson
R1-167504	Puncturing sTTI in legacy TTI	Ericsson
R1-167596	Considerations on short TTI design	Mediatek Inc.
R1-167598	UL RS design for short TTI	Mediatek Inc.
R1-167599	DL channel design for short TTI	Mediatek Inc.
R1-167620	sPUCCH design for shortened TTI	Potevio
R1-167628	Shortened TTI design	Motorola Mobility
R1-167629	Multiplexing of Regular TTI and shortened TTI	Motorola Mobility
R1-167654	On sPDCCH Design	InterDigital Communications
R1-167655	On sPDSCH Design	InterDigital Communications
R1-167656	On sPUCCH Design	InterDigital Communications
R1-167658	On sPUSCH Design	InterDigital Communications
R1-167774	Views on short PUSCH design	KT Corp.
R1-167865	Discussion on sPDCCH for sTTI	ZTE Corp., ZTE Microelectronics
R1-167866	Study on PDSCH transmission in sTTI	ZTE Corp., ZTE Microelectronics
R1-167867	Study on PUSCH transmission in sTTI	ZTE Corp., ZTE Microelectronics
R1-167868	PUCCH to carry HARQ-ACK for sTTI	ZTE Corp., ZTE Microelectronics
R1-167873	sPDSCH design for LTE short TTI	CATT
R1-168188	Way Forward on DCI monitoring for sTTI	Ericsson
R1-168195	WF on sPDSCH and sPUSCH transmission	Huawei, HiSilicon, Ericsson
R1-168196	Way forward on sPUCCH	Huawei, HiSilicon, Ericsson
R1-168197	Way forward on sTTI patterns	Huawei, HiSilicon, CATR, Intel
R1-168233	WF on short TTI lengths for FS1	LGE

7.2.12.2.2 Processing time

Including maximum TA, CSI processing and minimum data processing time

R1-166157	Discussion on CSI feedback for short TTI	Huawei, HiSilicon
R1-166158	Processing time reduction and related procedures for short TTI	Huawei, HiSilicon
R1-166311	Processing time reduction and related procedures for DL	Qualcomm Incorporated
R1-166312	Processing time reduction and related procedures for UL	Qualcomm Incorporated
R1-166313	TDD-specific design for shortened TTI	Qualcomm Incorporated
R1-166461	HARQ and scheduling timing design for LTE short TTI	CATT
R1-166708	Processing time reduction for sTTI operations	Samsung
R1-166863	Consideration for shortened processing time for shortened TTI length	LG Electronics
R1-166864	Discussion on HARQ timing with shortened TTI length	LG Electronics
R1-166967	Evaluation results on processing time reduction in physical layer	Panasonic
R1-167120	On the processing time reduction for latency reduction	Intel Corporation
R1-167372	Views on processing time reduction and related procedures	NTT DOCOMO, INC.
R1-167613	Processing time reduction for TDD with 1-slot sTTI	SHARP Corporation
R1-167614	Reduced processing time for different UL and DL sTTI lengths	SHARP Corporation, MTI
R1-167650	Processing time reduction and related procedures	ZTE Corp, ZTE Microelectronics
R1-167657	On Processing Time Reduction for sTTI	InterDigital Communications
R1-168306	On reduced processing time for short TTI	Ericsson

7.2.12.3 Other

R1-166314	Link evaluation of DL data transmission under symbol--dependent impact	Qualcomm Incorporated
R1-167342	Reduced timing for retransmission request	HTC Corporation

7.2.13 Performance enhancements for high speed scenario - *WID in RP-160172*

R1-168414	Chairman's notes of AI 7.2.13 on Performance enhancements for high speed scenario	Ad-Hoc chair (Qualcomm)
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The document was presented by Wanshi Chen from Qualcomm.

Decision: The document is endorsed and incorporated as follows.

- [R1-168354](#) PRACH enhancement in high speed scenario Huawei
Revision of [R1-167171](#)
[R1-167773](#) PRACH for very high speed UEs Nokia, Alcatel-Lucent Shanghai Bell
- [R1-166315](#) PRACH enhancements Qualcomm Incorporated
[R1-167416](#) Introduction of PRACH enhancement for high speed scenario Huawei
[R1-168248](#) Modified Option 3-2 Results Qualcomm

Agreements:

- Study until next meeting to down-select one of the following options:
 - Alt 1: Set 3 in [R1-168354](#) as the new restricted set of cyclic shifts for PRACH
 - Alt 2: The PRACH method described in 6.5.3.1 of RAN4 TR 36.878 for very high speed scenario is specified in 36.211
- Study further how to enable Rel 8 – 13 UEs to access the cell that supports new very high speed scenario

7.2.14 Study on Further enhancements to Coordinated Multi-Point Operation - SID in [RP-160954](#)

- [R1-168415](#) Chairman's notes of AI 7.2.14 on Study on Further enhancements to Coordinated Multi-Point Operation
Ad-Hoc chair (Intel)

The document was presented by Alexei Davydov from Intel.

Decision: The document is endorsed and incorporated as follows.

- [R1-166335](#) TP on TR 36.741 Study on FeCoMP ZTE Corporation, Intel Corporation

Agreement:

- Endorse TP for TR36.741 in [R1-166335](#)

- [R1-167622](#) TP for TR36.741 on Section 5 ZTE Corporation, Intel Corporation
[R1-167648](#) feCoMP Motivations and Techniques Ericsson

7.2.14.1 Remaining details of the deployment scenarios and system-level evaluation assumptions

- [R1-166331](#) Remaining details of evaluation assumptions for FeCoMP ZTE Corporation, ZTE Microelectronics
[R1-167647](#) feCoMP evaluation assumption omissions and errata Ericsson
[R1-166544](#) Remaining details of evaluation assumptions Intel Corporation
[R1-166709](#) Remaining details for simulation assumptions for feCoMP Samsung
[R1-167088](#) Simulation assumptions related to new measurements and LTE architecture IAESI, Thales, Fairspectrum

- [R1-168253](#) WF on further details of simulation assumptions for FeCoMP ZTE Corporation, ZTE Microelectronics, Intel, ASTRI, Qualcomm, Ericsson, Nokia, Alcatel-Lucent Shanghai Bell, Samsung

Agreements:

- Add the following details into the simulation assumptions:
 - Performance Metric / Parameter
 - Mean, 5%, 50%, 95% user throughput
 - Served cell throughput
 - Resource utilization (RU)
 - Packet arrival rate λ
 - Overhead
 - 3 symbols for DL CCHs, 2 CRS ports and DM-RS overhead according to number of scheduled layers
 - Antenna Polarization Model
 - Model -2 from 36.873
 - Feedback
 - PUSCH 3-2 for non-reciprocity operation (PUSCH 3-0 for reciprocity based operation)
 - CQI, PMI and RI reporting triggered per 5ms
 - Feedback delay is 5 ms
 - Other parameters can be also used
- Baseline schemes are at least below:
 - Rel-13 FD-MIMO without coordination for CS/CB
 - DPS/DPB for NCJT
 - Other option can be also used
- Support M=1 in antenna configuration only for small cell layer in evaluation of Scenario D
- Fix the reference errors proposed in [R1-167647](#)

7.2.14.2 Potential enhancements for non-coherent joint transmission

Include initial evaluation results

R1-166865	Discussion on enhancements for non-coherent JT	LG Electronics
R1-167142	Discussion on non-coherent JT schemes for FeCoMP	Huawei, HiSilicon
R1-166317	Enhancements for non-coherent JT	Qualcomm Incorporated
R1-166332	Initial evaluation results of non-coherent JT	ZTE Corporation, ZTE Microelectronics
R1-166333	Potential enhancements for non-coherent JT	ZTE Corporation, ZTE Microelectronics
R1-166334	QCL Issues of Joint Transmission	ZTE Corporation, ASTRI
R1-166462	Enhancement for non-coherent joint transmission	CATT
R1-166545	CSI feedback enhancements for non coherent JT	Intel Corporation
R1-166546	Control signalling enhancements for non coherent JT	Intel Corporation
R1-166547	Evaluation results for non coherent JT	Intel Corporation
R1-166710	Discussion on potential enhancements for non-coherent JT	Samsung
R1-167143	Potential enhancements for non-coherent JT	Huawei, HiSilicon
R1-167144	Initial simulation results of non-coherent JT	Huawei, HiSilicon
R1-168267	WF on non-coherent JT schemes for FeCoMP	Huawei, HiSilicon, Intel, SoftBank Corp, ZTE, CATT, Qualcomm

Agreements:

- Capture the following non-coherent JT definition and classification in the TR
 - Definition: Non-coherent JT scheme corresponds to the transmission scheme where transmission of the MIMO layer(s) is performed from two or more transmission points (TPs) without adaptive precoding across the TPs.
 - Non coherent JT schemes can be classified based on the CWs transmitted from TPs:
 - **Case 1:** Different CWs are transmitted from different TPs. Each TP perform adaptive precoding independently
 - **Case 2a:** The same CW is transmitted from different TPs with spatial diversity (e.g. SFBC) coding/spatial multiplexing.
 - **Case 2b:** The same CW is transmitted from different TPs with SFN.
 - Non coherent JT schemes can be classified based on overlapping of resource allocations from different TPs:
 - **Scheme1:** Fully overlapping scheme
 - In this scheme the resource allocations from different TPs for a UE are fully overlapped
 - **Scheme 2:** Partly overlapping scheme
 - In this scheme the resource allocations from different TPs for a UE are partly overlapped
 - **Scheme 3:** Non overlapping scheme,
 - In this scheme the resource allocations from different TPs for a UE are not overlapped

7.2.14.3 Potential enhancements for coordinated scheduling/beamforming with FD-MIMO

Include initial evaluation results

R1-166318	Enhancements for coordinated scheduling/beamforming with FD-MIMO	Qualcomm Incorporated
R1-166336	Potential enhancements for CS/CB with FD-MIMO	ZTE Corporation, ZTE Microelectronics
R1-166463	Coordinated beamforming with FD-MIMO	CATT
R1-166548	Enhancements and evaluation of CS/CB CoMP	Intel Corporation
R1-166712	Discussion on potential enhancements for CS/CB with FD-MIMO	Samsung
R1-166866	Discussion on enhancements for CS/CB with FD-MIMO	LG Electronics
R1-167145	Potential enhancements for CS/CB with FD-MIMO	Huawei, HiSilicon
R1-167146	Initial simulation results of CS/CB with FD-MIMO	Huawei, HiSilicon
R1-167649	Preliminary FeCoMP Results for Indoor Hotspot Scenario	Ericsson
R1-168269	Summary of Evaluation Results of CS/CB	Huawei, HiSilicon

7.2.15 Study on Enhancement of VoLTE - SID in [RP-160902](#)

[R1-168416](#) Chairman's notes of AI 7.2.15 on Study on Enhancement of VoLTEAd-Hoc chair (CMCC)

The document was presented by Hui Tong from CMCC.

Decision: The document is endorsed and incorporated as follows.

7.2.15.1 VoLTE/video quality improvements

R1-167442	Performance evaluation of coverage enhancements for VoLTE/video quality	China Telecommunications
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Agreement:

Capture the following text in the reply LS to RAN2 (see [R1-168256](#) under AI 5):

- VoLTE coverage can be effectively enhanced by relaxing the air interface delay budget. As an example, if the delay budget is extended to 100ms, about 1~3dB coverage gain can be achieved compared with 50ms delay budget for full duplex UEs. Extending maximum packet transmission time beyond 100ms can further improve the coverage. Techniques that can be used to extend the coverage if the air interface delay budget is relaxed are asynchronous UL HARQ transmission and different repetition levels in combination with RTP packet bundling.
 - Note that the performance can be significantly impacted by the assumption of header compression.
- The multi-subframe frequency hopping technique that was specified in CE mode A, which enables cross-subframe channel estimation, can be used to enhance the VoLTE coverage effectively.
- The coverage for half-duplex FDD UEs is less than the coverage for full-duplex UEs. In order to maximize the VoLTE coverage that can be achieved in half-duplex FDD, opportunities to optimize the UL/DL resource utilization have been identified e.g. through techniques to reduce DL repetitions, new repetition factors, and adjusted scheduling delay.

ACTION: RAN1 respectfully asks RAN2 to take the above into account.

R1-168168	Text proposal for the RAN1 coverage enhancement for eVoLTE	Sierra Wireless, Sony, AT&T
R1-168064	Text proposal for the RAN1 coverage enhancement for eVoLTE	Huawei, HiSilicon

R1-166319	Coverage enhancement techniques	Qualcomm Incorporated	
R1-166320	On eNB and UE awareness of EVS codec for coverage and mobility enhancement		Qualcomm
R1-167103	Evaluation results of coverage enhancement schemes for eVoLTE	CMCC	
R1-167798	VoLTE Enhancements	Nokia, Alcatel-Lucent Shanghai Bell	
R1-167893	Evaluation of VoLTE support for Cat M1 UEs	Intel Corporation	
R1-167907	VoLTE quality improvements	Ericsson	
R1-167982	Sub-PRB Method to Improve UL Coverage, UL Capacity, and Battery Life		Sierra Wireless, Sony
R1-168063	Overview of the eVoLTE coverage enhancement technologies	Huawei, HiSilicon	

8 NR

8.1 Study on New Radio Access Technology - SID in [RP-161214](#)

R1-167373	Workplan for Study on NR Access Technology	NTT DOCOMO, INC.
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Decision: The document is noted.

R1-167374	Draft TR 38.802 Study on New Radio (NR) Access Technology - Physical Layer Aspects	NTT DOCOMO, INC.
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The document (draft v0.0.4) was presented by Kazuaki Takeda from NTT DOCOMO.

Decision: The document is noted. Companies are encouraged to contact rapporteur until Wednesday.

Friday: Draft TR is revised in:

R1-168523	Draft TR 38.802 Study on New Radio (NR) Access Technology - Physical Layer Aspects	NTT DOCOMO, INC.
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Decision: The document is endorsed as v.0.1.0 in [R1-168526](#).

8.1.1 Forward compatibility for new radio interface

General principles to achieve forward compatibility with Phase II specification and beyond

R1-166345	NR service multiplexing requirements	Qualcomm Incorporated
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The document was presented by Tingfang Ji from Qualcomm and provides Qualcomm's view on forward compatibility requirements, design and timeline for difference service multiplexing scenarios:

- eMBB networks + future URLLC services
- eMBB network + future mMTC services
- WAN network + future side link services
- eMBB non-standalone (NSA) + standalone (SA)
- eMBB licensed + unlicensed
- eMBB + positioning
- Other scenarios

Discussion: Chair suggested companies using the tables as shown in this contribution and get their feedback on the different scenarios.

Samsung → objection on NSA and SA

Decision: The document is noted. Revised in [R1-168088](#).

R1-166868 NR operation in unlicensed spectrum LG Electronics

The document was presented by ... from LGE.

- Proposal 1: With on-going work on LTE LAA for 5 GHz frequency, NR study can first focus on 60 GHz for unlicensed spectrum. For 5 GHz, it seems desirable to consider tight interworking between NR and LAA.
- Proposal 2: 120 kHz (FFS: 240 kHz) sub-carrier spacing can be considered for candidate numerologies for 60 GHz, the same as for 70 GHz.
- Proposal 3: The frame structure containing UL channel/signal in unlicensed spectrum should be designed considering channel access procedure.
- Proposal 4: For UL control design in unlicensed spectrum, consider regional regulation such as PSD, symbol duration, and multiplexing with UL sounding signal.
- Proposal 5: Consider how to transmit cell/beam identification related signals based on channel access procedure.

Decision: The document is noted.

R1-166682 Forward Compatibility of Broadcasted Signals and Channels for mMTC Sierra Wireless, S.A.

The document was presented by Serkan Dost from Sierra Wireless.

- Observation: In LTE, adding support for narrowband UEs required the duplication of many broadcasted signals/channels/info, resulting in >45% broadcasted resource usage in some cases.
- Conclusion: In LTE, it would have been advantageous if the legacy broadcasted signals/channels/info could have been decodable by narrowband UEs.
- Proposal: To avoid duplication, the NR broadcasted signals/channels/info should be decodable by both wideband and narrowband UEs
- Proposal: To optimize wideband UE performance, it shall be possible for NR broadcasted signals/channels/info to use wideband resources not decodable by narrowband UEs.

Decision: The document is noted.

R1-167119 Forward compatibility considerations on NR Integrated Access and Backhaul Qualcomm

Incorporated

- Proposal 1: NR design should allow for multiple-hop self-backhauling without dictating hard limits on the hop count.
- Proposal 2: NR design should allow for topological redundant self-backhauling without confining the degree of inter-node connectivity.
- Proposal 3: NR design should allow for dynamic load balancing between backhaul links as well as between backhaul-and access links.
- Proposal 4: NR design should allow for accommodation of local changes in network topology while the remaining self-backhaul network carries traffic.

Decision: The document is noted.

R1-167235 Forward compatibility on duplexing Huawei, HiSilicon

The document was presented by Zukang Shen from Huawei.

- Proposal 1: NR should support unified duplex, fulfilling the following design targets:
 - It should allow traditional FDD operation on a paired spectrum
 - It should allow both DL and UL in either part of a paired spectrum
 - It should allow TDD operation on an unpaired spectrum where the DL/UL configuration is not dynamically changing;
 - It should allow TDD operation on an unpaired spectrum where the transmission direction of most subframes can be dynamically changing;
 - It should allow support of full duplex in the future in a forward compatible way
- Proposal 2: NR should support band-agnostic and duplex-agnostic frame structure.

Decision: The document is noted.

R1-166745 Dynamic Bandwidth Considerations for NR Samsung

The document was presented by ... from Samsung.

- Observation 1: Provision of a low complexity and low cost system is necessary in order to overcome the limitations on the NR deployment that may be imposed by the requirement of a large number of RF chains to support very wide bandwidths.
- Observation 2: CA and CB can be considered to achieve freedom of spectrum usage by supporting dynamic BW configuration with CA/CB.
- Proposal: RAN1 should study a potential benefit of channel bonding scheme for unlicensed and shared spectrum in NR deployments.

Decision: The document is noted.

R1-168059 WF on unified duplex Huawei, HiSilicon, CMCC, NTT DOCOMO, CATR, Deutsche Telekom, Softbank

The document was presented by Zukang Shen from Huawei.

- NR should support unified duplex, fulfilling the following design targets:
 - It should allow traditional FDD operation on a paired spectrum
 - It should allow different transmission directions in either part of a paired spectrum
 - It should allow TDD operation on an unpaired spectrum where the transmission direction of time resources is not dynamically changing;
 - It should allow TDD operation on an unpaired spectrum where the transmission direction of most time resources can be dynamically changing;
 - It should allow support of full duplex in a forward compatible way
 - Note: transmission directions include all of downlink, uplink, sidelink, and backhaul link

Discussion: Samsung concern with second sub-bullet and the timing for that one → make clear that it relates to forward compatibility target and not a design target without additional feasibility study (suggested LS asking RAN4 about it)

Decision: The document is noted, modified as follows:

Agreements:

- NR should support at least following design targets:
 - It should allow FDD operation on a paired spectrum
 - It should allow different transmission directions in either part of a paired spectrum
 - It should allow TDD operation on an unpaired spectrum where the transmission direction of time resources is not dynamically changing
 - It should allow TDD operation on an unpaired spectrum where the transmission direction of most time resources can be dynamically changing
 - FFS: It should allow support of full duplex in a forward compatible way
 - Note: transmission directions include all of downlink, uplink, sidelink, and backhaul link
 - Note that additional discussion is needed about the timing to support above targets, particularly the second sub-bullet
 - Note that some design targets may or may not be transparent to UE

Wednesday

[R1-168106](#)
Mediatek

WF on Forward Compatibility for Broadcast Signals/Channels

Sierra Wireless, Sony, Ericsson,

The document was presented by GustavVos from Sierra Wireless.

- Whether wideband and narrowband UEs can decode the same NR broadcasted signals and channels, should be considered.
 - This doesn't mean the broadcasted signals/channels need to be narrowband

Discussion: Also supported by Panasonic.

Decision: The document is noted and agreed as follows:

Agreements:

- Whether wideband and narrowband UEs can decode either all or partially the same NR broadcasted signals and channels, should be considered
 - This doesn't mean the broadcasted signals/channels need to be narrowband

Friday

[R1-168132](#)

Way forward on the forward compatibility for NR unlicensed

Intel, Interdigital, Ericsson, Nokia,

ASB, Qualcomm, Huawei, HiSilicon, ZTE

- At least 5 GHz and 60 GHz unlicensed bands are considered for NR unlicensed operation.
- RAN1 to start studying regulatory aspects of potential unlicensed spectrum from forward compatibility perspective.
- Note: Other unlicensed bands are not precluded for NR unlicensed operation.

Decision: The document is noted.

Not treated.

[R1-166210](#)

On forward compatibility for new radio interface ZTE Corporation, ZTE Microelectronics

[R1-166346](#)

Forward compatibility consideration for numerology and frame structure Qualcomm Incorporated

[R1-166347](#)

Forward compatibility consideration on service multiplexing Qualcomm Incorporated

[R1-166464](#)

NR on-demand access for forward compatibility CATT

[R1-166465](#)

NR time interval and system design for forward compatibility CATT

[R1-166550](#)

Forward compatibility for new radio interface Intel Corporation

[R1-166608](#)

Discussion on forward compatibility of subframe structure for NR Guangdong OPPO Mobile Telecom.

[R1-166636](#)

Proposals for forward compatibility NEC

[R1-166648](#)

On the aspects of waveform multiplexing requirements NEC

[R1-166743](#)

Discussion on forward compatibility for NR Samsung

R1-166744	Discussion on sync. signal considering forward compatibility aspects	Samsung
R1-166867	Further considerations for forward compatibility support	LG Electronics
R1-166998	Reference signal design to support bandwidth flexibility	Spreadtrum Communications
R1-167123	Forward compatibility considerations for NR unlicensed operation	Intel Corporation
R1-167124	Multiplexing of different numerologies for forward compatibility	Intel Corporation
R1-167220	Forward compatibility consideration on symmetric design across multiple links for unified duplex	Huawei, HiSilicon
R1-167327	Forward compatible control channel framework for NR	INTERDIGITAL COMMUNICATIONS
R1-167541	Discussion on Supported Carrier Bandwidth for Forward Compatible NR design	MediaTek Inc.
R1-167797	Baseline design for forward-compatible lean carrier in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-168088	NR service multiplexing requirements	Qualcomm Incorporated

8.1.2 Waveform and multiple access schemes for new radio interface

[R1-168417](#) **Chairman's notes of AI 8.1.2 on waveform and multiple access schemes for NR** **Ad-Hoc chair (Qualcomm)**

The document was presented by Wanshi Chen from Qualcomm.

Decision: The document is endorsed and incorporated as follows.

8.1.2.1 Waveform

Including remaining evaluation assumptions for waveform evaluation

R1-166092	Waveform evaluation results for above 6GHz bands	Huawei, HiSilicon
R1-166355	WOLA and filtered-OFDM comparison beyond link level performance	Qualcomm Incorporated
R1-166487	Link Level Evaluation of Waveforms for NR	AT&T GNS Belgium SPRL
R1-166494	Low PAPR Single Carrier Circularly Pulse Shaped Waveform	Idaho National Laboratory
R1-166748	Evaluation results of OFDM-based waveform in DL and UL mixed numerology case (case 2 and 4)	
	Samsung	
R1-167104	Preliminary evaluations of f-OFDM and w-OFDM CMCC	
R1-167376	Comparison of candidate waveforms	NTT DOCOMO, INC.
R1-167529	An RX based interference mitigation method for waveform with multiple numerologies	MediaTek Inc.
R1-167550	Filter delay impact of filtered OFDM on fast feedback	Ericsson
R1-167595	OTFS Performance Evaluation for High Speed Use Case	Cohere Technologies
R1-167794	Waveform proposal for carrier frequencies beyond 40 GHz	Nokia, Alcatel-Lucent Shanghai Bell
R1-167963	Way forward on waveform	Huawei, HiSilicon, NTT DOCOMO, Nokia, ASB, Ericsson, Qualcomm, China Unicom, CATT, Samsung, CATR, Vodafone, InterDigital, LG Electronics, Softbank, Deutsche Telekom

Also supported by CT, Verizon

Agreement:

- At least up to 40 GHz for eMBB and URLLC services, NR supports CP-OFDM based waveform with Y greater than that of LTE (assuming Y=90% for LTE) for DL and UL, possibly with additional low PAPR/CM technique(s) (e.g., DFT-S-OFDM, etc.)
 - $Y (\%) = \text{transmission bandwidth configuration} / \text{channel bandwidth} * 100\%$
 - RAN1 specification will support transmission bandwidth configuration corresponding to Y up to approximately 100%
 - Some evaluations in RAN1 show that Y for a NR carrier can be up to 98% of the evaluated channel bandwidths for both DL and UL without complexity and latency constraints [[R1-166093](#)]
 - Note: additional pre-processing techniques on top of CP-OFDM are not precluded, e.g., OTFS
- Additional waveforms may be supported by NR for e.g. other services (e.g. mMTC)
- It is recommended that RAN4 should target to support eNB/UE with Y significantly higher than 90% when defining the RAN4 requirements where the specification of Y should consider complexity and latency constraints
- In-band frequency multiplexing of different numerologies is supported in NR for both DL and UL, at least from the network perspective
 - It is expected that spectrum confinement on sub-band basis is specified as requirements on
 - Transmitter side in-band emission and EVM requirements
 - Reception performance in presence of other-subband interferer
 - The definition of sub-band is FFS
- From RAN1 perspective, spectral confinement technique(s) (e.g. filtering, windowing, etc.) for a waveform at the transmitter is transparent to the receiver
- Inform RAN4 the above agreements
 - RAN1 plans to perform more evaluations on waveform and will inform RAN4 with future updates, if any

[R1-168422](#) WF on low-PAPR/CM technique Ericsson, Huawei, Panasonic, Vodafone, Qualcomm, ZTE, ZTE Microelectronics

Agreements:

- At least up to 40 GHz for eMBB and URLLC services,
 - CP-OFDM without specified low-PAPR/CM technique(s) is recommended to be supported for uplink
 - For data transmission, additional low-PAPR/CM technique(s) is only considered for uplink from RAN1 specification perspective
 - Additional low-PAPR/CM technique(s) for special downlink signals such as sync signals is FFS
 - Additional low-PAPR/CM technique(s) for other uplink signals/channels is FFS
 - Additional low PAPR/CM technique(s), if specified, and CP-OFDM without specified low-PAPR/CM technique(s) for uplink are considered *as complementary to each other*

[R1-168240](#) LS on NR waveform Huawei

Conclusion:

- The LS is **agreed** in [R1-168258](#), with the following update (figure 1 is deleted):
For clarification, Figure 1 gives an exemplary illustration of spectrum confinement on a sub-band basis.

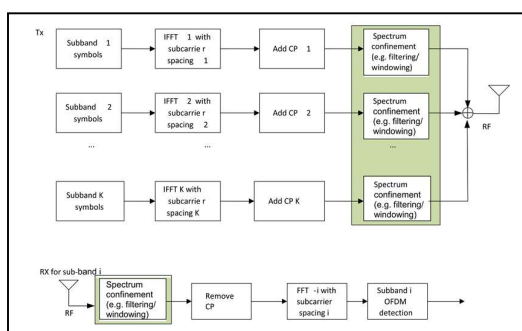


Figure 1 Illustration of spectrum confinement on a sub-band basis for downlink

[R1-168051](#) WF on Low PAPR Techniques for NR Uplink Qualcomm Inc., Samsung, MediaTek, Interdigital, Idaho National Lab, IITH, CEWiT, Reliance-jio, Tejas Networks, Oppo, Vodafone, Straightpath, LG Electronics, National Taiwan University, [AT&T], Verizon Wireless, National Instrument, Spreadtrum
Also supported by ZTE, ZTE Microelectronics

Agreement:

- NR uplink should target at least the same link budget (i.e. MCL) as LTE uplink, under the same usage scenarios and similar deployment configurations (e.g., same carrier frequency)
 - Details FFS
 - Techniques can be evaluated for the uplink scenarios
 - E.g., low PAPR/CM techniques (including DFT-s-OFDM)

[R1-168392](#) WF on Guard-Band in NR Samsung, CEWiT, IITH, Tejas Networks, Reliance-jio, MediaTek, Ericsson, Nokia, ASB, CMCC, KDDI

Agreement: RAN1 should continue study whether/how to support guard-band for inter-subband interfering scenarios (e.g., cases 2/3/4) with considerations of the specification/performance impact

[R1-168525](#) Way forward on the waveform for above 40GHz Nokia, ASB, Intel, InterDigital, Mitsubishi Electric, Qualcomm, MediaTek, Ericsson, NTU, National Instruments

Agreements:

- When considering DL and UL waveforms for spectrum band above 40GHz, RAN1 should at least consider the impact of
 - Low PA efficiency
 - Phase Noise and Doppler impairments

[R1-166090](#) Waveform evaluation results for case 3

Huawei, HiSilicon

[R1-166091](#) Waveform evaluation results for case 4

Huawei, HiSilicon

R1-166093	Waveform evaluation updates for case 1a and 1b	Huawei, HiSilicon
R1-166119	Summary of email discussion on calibration for NR waveform	Huawei, HiSilicon
R1-166120	Waveform evaluation updates for case 2	Huawei, HiSilicon
R1-166121	Summary on NR waveform evaluation results	Huawei, HiSilicon
R1-166226	UW DFTsOFDM link level evaluation results below 6GHz	Mitsubishi Electric
R1-166227	UW DFTsOFDM link level evaluation results above 30GHz	Mitsubishi Electric
R1-166348	PA model measurements and F-OFDM/WOLA measurements	Qualcomm Incorporated
R1-166350	NR Spec implication for Filter/windowing OFDM	Qualcomm Incorporated
R1-166351	Updated simulation assumptions for Cases 3 and 4	Qualcomm Incorporated
R1-166352	Simulation results for Cases 3 and 4	Qualcomm Incorporated
R1-166353	Waveform proposal for > 6GHz	Qualcomm Incorporated
R1-166354	OFDM and SC-FDM support for Uplink	Qualcomm Incorporated
R1-166356	Simulation assumptions for OFDM and SC-FDM waveform comparison	Qualcomm Incorporated
R1-166400	Simulation results of new waveform in case 1 and high speed	ZTE
R1-166401	Simulation results of new waveform in case 2, 3 and 4	ZTE
R1-166594	Discussion on the window processing of FC-OFDM and WOLA	ORANGE
R1-166595	FC-OFDM enhanced receiver design for very long delay spread	ORANGE
R1-166650	Discussion on OFDM based waveform	Sony
R1-166669	Discussion on real domain OFDM for mMTC	Fujitsu
R1-166746	Discussion on multi-window OFDM for NR waveform	Samsung
R1-166747	Evaluation results of OFDM-based waveform in DL and UL single numerology case (case 1a and 1b)	
	Samsung	
R1-166749	Evaluation results of OFDM-based waveform in UL single numerology and asynchronous case (case 3)	
	Samsung	
R1-166869	Waveform evaluation results in case 3	LG Electronics
R1-166870	Waveform evaluation results in case 4	LG Electronics
R1-166999	Detailed configuration of f-OFDM and W-OFDM for LLS evaluation	Spreadtrum Communications
R1-167000	LLS evaluation results of NR waveforms	Spreadtrum Communications
R1-167001	Link-level simulation cases for evaluating waveforms in mMTC UL with relaxed synchronization	Spreadtrum Communications
	Communications	
R1-167029	On NR spectral confinement	Ericsson
R1-167030	Mixed Numerology with PA impairment	Ericsson
R1-167031	On OFDM in NR for Coverage-Limited Scenarios	Ericsson
R1-167032	On OFDM in NR for Non-Coverage Limited Scenarios	Ericsson
R1-167033	On resource allocation and guard subcarriers for mixed numerologies	Ericsson
R1-167034	On PA impact to in mixed numerology with narrow band allocation	Ericsson
R1-167035	On PA impact to in mixed numerology with wide band allocation	Ericsson
R1-167036	On PAPR and CM reduction in NR	Ericsson
R1-167086	GPO Based BPSK and QPSK modulation schemes with Low PAPR	IITH
R1-167125	Single carrier based waveform for high frequency bands above 40 GHz	Intel Corporation
R1-167126	Further discussion on GI-DFT-s-OFDM for high frequency bands above 40 GHz	Intel Corporation
R1-167193	Views on multiple NR waveform proposals for high bands	Intel Corporation
R1-167201	Further evaluation for NR waveforms	Huawei, HiSilicon
R1-167241	Summary of email discussion on collecting information for NR waveform	Huawei, HiSilicon
R1-167243	On uplink waveform below 40 GHz	Nokia, Alcatel-Lucent Shanghai Bell
R1-167244	Uplink performance results with extended settings for the New Radio waveforms below 6 GHz	Nokia, Alcatel-Lucent Shanghai Bell
R1-167245	Downlink performance results for the New Radio waveforms below 6 GHz including PA models	Nokia, Alcatel-Lucent Shanghai Bell
R1-167246	On independent design of Tx and Rx units for NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-167337	NR waveform evaluation and proposals	Panasonic Corporation
R1-167530	Spectral Efficiency Evaluation for NR Uplink Waveforms Operating at High Frequency	MediaTek Inc.
R1-167558	Comparison of UW DFT-s-OFDM and windowed OFDM	InterDigital Communications
R1-167559	Simulation set-up for email discussion [85-17] on UW DFT-s-OFDM	InterDigital Communications
R1-167560	Channel estimation and phase tracking for UW DFT-s-OFDM	InterDigital Communications
R1-167593	Performance evaluation of OTFS waveform in single user scenarios	Cohere Technologies
R1-167594	Performance evaluation of OTFS waveform in multiuser scenarios	Cohere Technologies
R1-167604	Evaluation of OFDM with companding	Qualcomm Incorporated
R1-167746	Guardband for mixed numerologies	Ericsson
R1-167778	Spectrum emission considerations for 5G NR waveform proposals	Nokia, Alcatel-Lucent Shanghai Bell
R1-167779	On DL Rapp PA model for waveform evaluation below 6 GHz	Nokia, Alcatel-Lucent Shanghai Bell
R1-167791	Performance Evaluation of Cyclic-Prefix-less Precoded OFDM	KDDI Corporation
R1-167795	Potential for system level gains with low PAPR waveforms	Nokia, Alcatel-Lucent Shanghai Bell
R1-167796	On the RAN1 goals for waveform design	Nokia, Alcatel-Lucent Shanghai Bell

R1-167808	flexi-OFDMA, a new waveform for NR	CEWiT
R1-167820	Fundamentals of CPS-OFDM waveform for 5G new radio	National Taiwan University
R1-167874	Evaluation results of OFDM-based waveforms in Case 1a and Case 1b	National Taiwan University
R1-167875	Preliminary evaluation of CPS-OFDM waveform in Case 2, Case 3, and Case 4	National Taiwan University
R1-167905	Generalized Root Raised Cosine (GRRCC) Nyquist Filters for Filtered Modulation	National Instruments Corp.
R1-167915	Tx&Rx structure of FB-OFDM	ZTE

8.1.2.2 Multiple access scheme

Including remaining evaluation assumptions for multiple access scheme evaluation

R1-166094	LLS Results for UL MA schemes Huawei, HiSilicon	
R1-166405	Discussion on grant free concept for UL mMTC	ZTE
R1-166493	Low Latency Scheduling-based UL Access	Idaho National Laboratory
R1-166551	Views on UL multiple access for NR	Intel Corporation
R1-167253	On system level evaluation of multiple access schemes for mMTC and eMBB use cases	Nokia, Alcatel-Lucent Shanghai Bell
R1-167554	General framework for efficient access in NR	Ericsson

[R1-168073](#) WF on UL LLS for MA Huawei, HiSilicon, CATR, CATT, Fujitsu, Spreadtrum, China Telecom, InterDigital

[R1-168427](#) WF on UL LLS for MA Huawei, HiSilicon, CATR, CATT, Spreadtrum, Fujitsu, CMCC, InterDigital, China Telecom

Observations:

- The following non-orthogonal multiple access schemes have been reported up to RAN1#86 for at least UL NR MA (listed in the order of proposed time, i.e., increasing tdoc number)
 - Sparse code multiple access (SCMA) (e.g., [R1-162153](#))
 - Multi-user shared access (MUSA) (e.g., [R1-162226](#))
 - Low code rate spreading (e.g., [R1-162385](#))
 - Frequency domain spreading (e.g., [R1-162385](#))
 - Non-orthogonal coded multiple access (NCMA) (e.g., [R1-162517](#))
 - Non-orthogonal multiple access (NOMA) (e.g., [R1-163111](#))
 - Pattern division multiple access (PDMA) (e.g., [R1-163383](#))
 - Resource spread multiple access (RSMA) (e.g., [R1-163510](#))
 - Interleave-Grid Multiple Access (IGMA), (e.g., [R1-163992](#))
 - Low density spreading with signature vector extension (LDS-SVE) (e.g., [R1-164329](#))
 - Low code rate and signature based shared access (LSSA), (e.g., [R1-164869](#))
 - Non-orthogonal coded access (NOCA), (e.g., [R1-165019](#))
 - Interleave Division Multiple Access (IDMA), (e.g., [R1-165021](#))
 - Repetition division multiple access (RDMA), (e.g., [R1-167535](#))
 - Group Orthogonal Coded Access (GOCA), (e.g., [R1-167535](#))
- Based on the contributions and the assumptions listed in Tables 1/2/3 in [R1-168427](#), it is observed that non-orthogonal MA outperforms OFDMA in terms of UL link-level sum throughput ([R1-163560](#)) and overloading capability in the evaluated scenarios

Agreement: NR should target to support UL non-orthogonal multiple access, in addition to the orthogonal approach, targeting at least for mMTC

Proposal:

- In the UL LLS evaluation of non-orthogonal multiple access for mMTC, it is recommended to consider at least the following
 - MA signature (e.g., code, codebook, sequence, interleaver, etc) collision
- FFS Channel correlation between UEs
 - FFS detailed channel correlation model

Continue offline discussion

[R1-168074](#) WF on support of UL grant-free for N Huawei, HiSilicon, China Telecom, Fujitsu, InterDigital
[R1-168067](#) WF on Clarification of Grant-free Transmission for mMTC ZTE, ZTE Microelectronics, Qualcomm, LGE
Revised in [R1-168257](#)

Agreement: NR should target to support UL “autonomous/grant-free/contention based” at least for mMTC

Conclusion: In RAN1 discussion for MA, grant-free is used to represent “autonomous/grant-free/contention based”

[R1-168257](#) WF on Clarification of Grant-free Transmission for mMTC ZTE, ZTE Microelectronics, Qualcomm, LGE, Convida, InterDigital

Agreement:

- At least the following options for “autonomous/grant-free/contention based” UL transmission should be studied
 - Opt. 1: a UE performs random resource selection
 - Details FFS
 - Opt. 2: a UE’s resource is pre-configured by eNB or pre-determined
 - Details FFS
 - Other options are not precluded

[R1-168075](#) WF on further considerations of UL grant-free for mMTC Huawei, HiSilicon, CMCC, Fujitsu

[R1-168428](#) WF on study of UL grant-free Huawei, HiSilicon, CATR, CATT, China Telecom, CMCC, Convida Wireless, Fujitsu, Intel, Spreadtrum, InterDigital, Oppo, Orange, ZTE, Also supported by Nokia, NTT DoCoMo

Agreements:

- Continue study at least the following:
 - Handling of potential collisions of MA signatures
 - Retransmission/repetition and potential combining, e.g. HARQ
 - Potential link adaptation, e.g. MCS/signature re-assigning
 - Relationship between grant-free and grant-based transmissions and associated UE behavior
 - Advanced receiver capabilities including complexity analysis

[R1-168426](#) WF on definition of UL grant-free resource Huawei, HiSilicon, CATR, CATT, China Telecom, CMCC, Convida Wireless, Fujitsu, Intel, Spreadtrum, InterDigital, Oppo, Orange

[R1-168423](#) WF on some definition of terminologies for “autonomous/grant-free/contention-based” MA LG Electronics, ETRI

[R1-168325](#) WF on MA resource clarification ZTE, ZTE Microelectronics, Qualcomm

Agreements:

- A MA physical resource for “grant-free” UL transmission is comprised of a time-frequency block
 - Note: spatial dimension is not considered as a physical resource in this context
- A MA resource is comprised of a MA physical resource and a MA signature, where a MA signature includes at least one of the following:
 - Codebook/Codeword
 - Sequence
 - Interleaver and/or mapping pattern
 - Demodulation reference signal
 - Preamble
 - Spatial-dimension
 - Power-dimension
 - Others are not precluded
- Details on MA physical resource and MA signature resource FFS

[R1-168538](#) WF on further clarification on grant-free transmission for mMTC LG Electronics, Huawei, HiSilicon, ETRI

Continue discussion next meeting

[R1-168076](#) Way forward on physical layer abstraction for UL non-linear receiver Huawei, HiSilicon, CMCC, Samsung, CATT

Agreement:

- For calibration purpose ONLY:
 - For ML-type receiver, the PHY abstraction method discussed [R1-168076](#) can be used at least for some MA schemes

- If a different PHY abstraction method is used by a company, it has to be stated clearly and individually verified
- Otherwise, the PHY abstraction method is up to each company
 - The PHY abstraction method is to be stated and individually verified by each company
- For evaluation purpose, PHY abstraction method is up to each company
 - A same method is used for calibration and evaluation by a given company, unless a single method can be agreed in RAN1 during evaluation phase

[R1-168068](#) **WF on UL Multiple Access Scheme Categorization for mMTC** **ZTE, ZTE Microelectronics, Qualcomm**

[R1-168069](#) **WF on System Level Simulation Parameters for mMTC** **ZTE, ZTE Microelectronics, Qualcomm**

[R1-168326](#) **WF on System Level Simulation Parameters for grant-free MA** **ZTE, ZTE Microelectronics, Qualcomm**

Continue discussion next meeting especially regarding the motivation for overhead modeling and how to model the overhead

[R1-168123](#) **Way forward on non-orthogonal multiple access evaluation** **Samsung, Qualcomm, LGE**
Revision of [R1-168116](#)

Agreement:

- For NR non-orthogonal multiple access evaluation, realistic channel estimation is prioritized and the following aspects are considered
 - The proposed DMRS pattern(s), if any, for channel estimation
 - FFS: DMRS overhead. E.g., LTE UL DMRS overhead can be used as a reference.
 - FFS: DMRS contamination due to inter-cell interference
 - FFS: Impact of DMRS collision in case of “autonomous/grant-free/contention based” multiple access
- Note: companies report the DMRS settings used for the LLS/SLS evaluation.

[R1-168115](#) **Way Forward on SLS assumptions for autonomous/grant-free/contention-based MALG Electronics,**
ZTE, ZTE Microelectronics

[R1-168540](#) **WF on SLS baseline for NR MA** **Huawei, HiSilicon**

Agreements:

- For providing absolute system level evaluation results for UL mMTC, for calibration purpose only
 - CP-OFDM as the UL waveform
 - UL DMRS overhead, 1 OFDM symbol out of 7 OFDM symbols
 - A UE selects a MA physical resource randomly from a pool of orthogonal MA physical resources
 - There is no partial overlapping between the MA physical resources selected by more than one UE
 - All orthogonal MA physical resources are of same size
 - Rx MMSE receiver, assuming realistic channel estimation
 - No blind decoding assumed
 - Same MCS for all UEs,
 - MCS is reported by each company
 - Open loop power control
 - Alpha=1, P0= -90 dBm
 - Packet size is fixed by 20 bytes
 - FFS other parameters, if any
 - **Email discussion on any other potential parameters until 9/2 – Yi Wang (Huawei)**
- Note: The above assumptions only apply to the calibration purpose, i.e. other assumptions can be used for evaluation of proposed non-orthogonal multiple access scheme(s)

[R1-168541](#) **WF on work plan for NR MA** **Huawei, HiSilicon**

Conclusion:

- Target the following in RAN1#86bis:
 - Summary of preliminary LLS comparisons
 - Summary of preliminary SLS comparisons

Friday

[R1-168551](#) **Email discussions on NR MA** **Huawei, HiSilicon**

- Huawei will provide initial template for preliminary simulation results summary by Sept 9th, template for email discussion Sept 16th (Huawei)
 - Note that SLS and LLS will have different templates
- Email discussion on SLS calibration until Sept 16th – (Huawei).
- Email discussion on potential categorization of NR MA schemes until RAN1 #86bis – (ZTE)

R1-166095	Discussion on grant-free transmission	Huawei, HiSilicon
R1-166096	SLS methodology for MA evaluation in mMTC scenario	Huawei, HiSilicon
R1-166097	SLS Results for MA evaluation in mMTC scenario	Huawei, HiSilicon
R1-166098	Discussion on the feasibility of advanced MU-detector	Huawei, HiSilicon
R1-166111	On traffic model and evaluation method for mMTC evaluation	Huawei, HiSilicon
R1-166357	mMTC B2024UE battery life evaluation assumption and methodologies	Qualcomm Incorporated
R1-166358	RSMA and SCMA comparison	Qualcomm Incorporated
R1-166359	Resource spread multiple access	Qualcomm Incorporated
R1-166402	Remaining issues on multiple access evaluation assumption	ZTE
R1-166403	Grant-free multiple access schemes for mMTC	ZTE
R1-166404	Receiver details and link performance for MUSA	ZTE
R1-166466	Usage scenarios of non-orthogonal multiple access	CATT
R1-166467	Discussion on traffic model of mMTC	CATT
R1-166468	Remaining issues on evaluation assumption and methodology of MA	CATT
R1-166470	Initial SLS results of PDMA	CATT
R1-166552	On UL non-orthogonal multiple access schemes	Intel Corporation
R1-166651	Non-orthogonal multiple access for uplink	Sony
R1-166670	Further LLS results for UL non-orthogonal multiple access	Fujitsu
R1-166671	DM-RS considerations for UL non-orthogonal multiple access	Fujitsu
R1-166672	Filter design for filtered OFDM	Fujitsu
R1-166750	Link level performance evaluation for IGMA	Samsung
R1-166751	System level performance evaluation for non-orthogonal multiple access	Samsung
R1-166752	Discussion on grant-free/contention-based non-orthogonal multiple access	Samsung
R1-166871	NoMA scheme based on NCMA	LG Electronics
R1-166872	Traffic model for evaluation of contention based MA	LG Electronics
R1-166873	Discussion on Categorization of MA schemes and target scenarios	LG Electronics
R1-166874	Discussion on Non-orthogonal Spreading Sequences for NoMA	LG Electronics
R1-166875	Considerations on the receiver types and NoMA schemes	LG Electronics
R1-166876	Performance evaluation of NCMA	LG Electronics
R1-166877	Considerations on contention based MA	LG Electronics
R1-167002	Performance analysis on the effect of spreading signature matrix in NR MA schemes	Spreadtrum
Communications		
R1-167105	Results and Remaining Issues of LLS evaluation on Multiple Access	CMCC
R1-167206	HARQ timing relationships for grant-free transmission	Huawei, HiSilicon
R1-167247	Overview of the proposed non-orthogonal MA schemes	Nokia, Alcatel-Lucent Shanghai Bell
R1-167248	Contention-based non-orthogonal multiple access with frequency hopping for mMTC uplink	Nokia, Alcatel-Lucent Shanghai Bell
R1-167249	Non-orthogonal coded access (NOCA)	Nokia, Alcatel-Lucent Shanghai Bell
R1-167250	Receiver considerations on UL MA	Nokia, Alcatel-Lucent Shanghai Bell
R1-167251	Synchronization requirement and performance analysis on UL MA	Nokia, Alcatel-Lucent Shanghai Bell
R1-167252	Basic principles of Contention Based access	Nokia, Alcatel-Lucent Shanghai Bell
R1-167254	Channel structure for contention based access	Nokia, Alcatel-Lucent Shanghai Bell
R1-167255	Procedure design for contention based access	Nokia, Alcatel-Lucent Shanghai Bell
R1-167256	Collision handling for contention based access	Nokia, Alcatel-Lucent Shanghai Bell
R1-167257	Preamble transmission procedures for the mMTC uplink	Nokia, Alcatel-Lucent Shanghai Bell
R1-167335	LLS Results for DL MA schemes	Huawei, HiSilicon
R1-167336	SLS Results for SCMA in DL eMBB scenario	Huawei, HiSilicon
R1-167339	Signature pattern generation of LSSA	ETRI
R1-167340	LLS results for UL low-rate code and signature based shared access scheme	ETRI
R1-167392	Discussion on multiple access for UL mMTC	NTT DOCOMO, INC.
R1-167393	Discussion on multiple access for eMBB	NTT DOCOMO, INC.
R1-167444	Usage scenario and physical layer design for UL non-orthogonal MA	China Telecommunications
R1-167445	Classification of candidate UL non-orthogonal MA schemes	China Telecommunications
R1-167517	Uplink Multiple Access for 5G mMTC	Lenovo
R1-167518	Discussion on contention based UL transmission	Lenovo
R1-167524	Downlink Multiple Access in NR	MediaTek Inc.
R1-167535	New uplink non-orthogonal multiple access schemes for NR	MediaTek Inc.

R1-167536	LLS results for RDMA,GOCA,RSMA and IDMA schemes	MediaTek Inc.
R1-167538	Evaluation on PAPR for UL multiple access schemes	MediaTek Inc.
R1-167555	NR Multiple Access	Ericsson
R1-167561	On the performance of IDMA and RSMA multiple access schemes	InterDigital Communications
R1-167562	Further performance evaluation of UL NOMA	InterDigital Communications
R1-167563	On categorization of MA schemes for NR	InterDigital Communications
R1-167602	Link level simulation results of new multiple access scheme	CATR
R1-167615	Multiple access schemes for NR	SHARP Corporation
R1-167698	Grant-less and non-orthogonal UL transmissions in NR	Intel Corporation
R1-167700	Link-level analysis of UL NOMA transmissions	Intel Corporation
R1-167742	Discussion on multiple access for mMTC	III
R1-167870	Update of LLS results of PDMA	CATT
R1-167872	Evaluation on SC-FDMA (NB-IoT) based multiple access scheme	MediaTek Inc.
R1-167894	Modeling of timing offsets for UL non-orthogonal multiple access	Intel Corporation

8.1.3 Numerology and frame structure for new radio interface

8.1.3.1 Numerology

Focus on the set of scale factors n in $fc=15*2^n$ that will be supported in Phase I, whether we have symbol alignment across the scalings or not

Tuesday

[R1-168090](#) WF on alignment among different numerologies LG Electronics, Qualcomm

The document was presented by Yunjung Yi from LGE.

- For different numerology alignment, define the following two cases
 - Inband case: different numerologies are multiplexed in the same NR carrier
 - Outband case: different numerologies are not multiplexed in the same NR carrier
- Symbol level alignment is assumed in the following cases
 - Different subcarrier spacings with the same CP overhead in inband case
- In other cases, symbol level alignment is not assumed.
 - FFS: Slot/subframe level alignment for outband case
- For normal CP family, choose one option from the followings for symbol-level alignment
 - For $F_s = F_0 * 2^n$ (n is a positive integer, $F_0 = 15$ kHz),
 - Each symbol length (including CP) of F_0 equals the sum of the corresponding 2^n symbols of F_s
 - Option 1: The first 2^n symbols of F_s have equal symbol length
 - Option 2: Except for the first symbol of F_s , all symbols of F_s have equal symbol length. The length of first symbol of F_s is sum of length of the second symbol and 0.51 us
 - Option 2-1. 0.51us can be reserved, and all symbols have the equal length

Discussion: Intel requested looking at 6553.

Decision: The document is noted.

[R1-166553](#) Time interval alignment between different numerologies Intel Corporation

The document was presented by Joonyoung Cho from Intel.

- Proposal 1 (even split of 1 ms duration)
 - Duration of a time interval X for a given subcarrier spacing for cases of 15 kHz or larger is identical throughout the 1ms duration.
- Proposal 2 (single numerology for each subcarrier spacing and CP type)
 - Time interval X for a given subcarrier spacing and CP type has a single and identical numerology in all instances of the time interval X within the 1ms duration.
- Proposal 3 (1 ms boundary alignment for <15 kHz subcarrier spacing cases)
 - The start and end of a time interval X for a subcarrier spacing smaller than 15 kHz are aligned with 1 ms boundaries of 15 kHz subcarrier spacing subframes.

Decision: The document is noted.

Possible agreements:

- Symbol level alignment across the different subcarrier spacing is assumed in the case of the same CP overhead in the same subframe duration on the same NR carrier
- Extended CP is supported in NR

Continue offline discussion until Wednesday – (Qualcomm, Huawei)

Wednesday

R1-168321 Way forward on Cyclic Prefix Huawei, HiSilicon, LGE, Sony, Vodafone, Intel, CATR, CMCC Ericsson, Orange, Mediatek, Verizon, InterDigital, OPPO, CATT, China Telecom, AT&T

The document was presented by Zhenfei Tang from Huawei.

- More than one CP length should be supported for a given sub-carrier spacing
 - The different CP lengths for a given sub-carrier spacing should be of substantially different lengths.
 - For 60 kHz subcarrier spacing, at least one CP length is similar to the normal CP length of 15 kHz corresponding to LTE numerology
- Note: FFS whether all of sub-carrier spacings support more than one CP length or not
- Note: FFS whether supporting more than one CP length for a given sub-carrier spacing is mandatory or optional for a given UE

Decision: The document is noted.

R1-168338 WF on CP overhead ZTE, ZTE Microelectronics, Qualcomm

The document was presented by Thorsten Schier from ZTE.

- CP overhead should be studied, especially for the case of 60 kHz subcarrier spacing.
- NR should support solutions with the same or better performance than LTE in all channel conditions

Decision: The document is noted.

Agreements:

- NR design should allow potentially defining multiple CP lengths for a given subcarrier spacing in Phase I or later
 - Multiple CP lengths do not mean the normal CP have 2 different CP lengths in the LTE
- It should be possible to deploy NR with 60 kHz subcarrier spacing in the channel that have the same delay spread that LTE can handle with the normal CP length as one use case
 - Other subcarrier spacing solution can be considered with an equal priority in the further study
- More than one CP length should be studied for a given subcarrier spacing
 - The different CP lengths for a given subcarrier spacing can be of substantially different lengths
 - For 60 kHz subcarrier spacing, at least one CP length can be similar to the normal CP length of 15 kHz corresponding to LTE numerology
 - Other proposals are not precluded
- Note: FFS whether all of subcarrier spacings support more than one CP length or not
- Note: FFS whether supporting more than one CP length for a given subcarrier spacing is mandatory or optional for a given UE

R1-168305 WF on alignment among different numerologies LG Electronics, Intel, Ericsson, Qualcomm, Samsung, Verizon

Agreements: Subframe duration in ms for a reference numerology with subcarrier spacing (2^m*15)kHz is exactly 1/2^m ms

Working assumption:

- Alignment within a subframe
 - Symbol level alignment across different subcarrier spacings with the same CP overhead is assumed within a subframe duration in a NR carrier
 - FFS: Unlicensed spectrum case

R1-168503 Way forward on slot alignment Huawei, HiSilicon, MediaTek

R1-168524 Way forward on slot alignment Huawei, HiSilicon, MediaTek

R1-168548 Way forward on slot alignment Huawei, HiSilicon, MediaTek

Agreement: RAN1 strives how to enable efficient time alignment between transmissions with different CP overheads

R1-167040 On scalable numerology Ericsson

R1-167394 Views on NR numerology NTT DOCOMO, INC.

R1-167527 Discussion on NR Numerology MediaTek Inc.

R1-167106 Phase Noise Measurement/Modeling and LLS for High Frequency Numerology CMCC

Agreements:

- NR numerology scalability should allow at least from [3.75 kHz] to 480 kHz subcarrier spacing
- Necessity of support for less than 15 kHz subcarrier spacing (e.g., 3.75 kHz) should be studied
- Note that scalability does not mean everything should be scalable (e.g., RS density, UE/gNB processing time, signalling overhead)

R1-166100 Evaluation on CP types for NR Huawei, HiSilicon

R1-166101 Comparison and evaluation on scaling factors for subcarrier spacing Huawei, HiSilicon

R1-166225	Considerations on numerology for support of flexible guard lengths	Mitsubishi Electric
R1-166360	URLLC numerology and frame structure design	Qualcomm Incorporated
R1-166363	Scaled Numerology Control Design for NR	Qualcomm Incorporated
R1-166406	Consideration of cyclic prefix for NR	ZTE
R1-166471	Discussion of NR numerology	CATT
R1-166490	Numerology impact on power efficiency for mMTC	ZTE
R1-166491	Considerations about symbol boundary alignment	ZTE
R1-166492	Frequency multiplexing of numerologies	ZTE
R1-166554	Capability to support multiple numerologies	Intel Corporation
R1-166609	Subcarrier spacing design for data and reference signal	Guangdong OPPO Mobile Telecom.
R1-166614	Discussion of the UE support of multiple numerologies	Guangdong OPPO Mobile Telecom.
R1-166637	Discussion on numerology multiplexing	NEC
R1-166652	Discussion on multiple CP types	Sony
R1-166753	Discussion on symbol alignment across scaled numerology	Samsung
R1-166754	Discussion on numerology support	Samsung
R1-166755	Discussion on candidate subcarrier spacing values in NR	Samsung
R1-166878	Discussion on alignment for different numerology multiplexing	LG Electronics
R1-166879	Further evaluation results on different numerology	LG Electronics
R1-166938	High speed train scenario at 30GHz: link level evaluation results for RRH and relay	Mitsubishi Electric Co.
R1-166939	Numerology evaluation results for high speed scenario	ETRI
R1-167004	Discussion on numerology	Spreadtrum Communications
R1-167027	NR numerologies	KT Corp.
R1-167041	On extended CP	Ericsson
R1-167107	Discussion and Evaluation on Numerology Design for High Speed Train Scenario	CMCC
R1-167108	Discussion and evaluation of CP design for NR	CMCC
R1-167258	On System Design for Multiple Numerologies - Initial Access	Nokia, Alcatel-Lucent Shanghai Bell
R1-167259	On symbol boundary alignment in New Radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-167260	Resource block and guard band arrangement supporting mixed numerology	Nokia, Alcatel-Lucent Shanghai Bell
R1-167328	UE support for multiple numerologies with NR	INTERDIGITAL COMMUNICATIONS
R1-167329	Symbol alignment across numerologies	INTERDIGITAL COMMUNICATIONS
R1-167439	Use of multiple numerologies in NR	Panasonic Corporation
R1-167528	On the alignment of OFDM symbol boundary	MediaTek Inc.
R1-167564	Impact of numerology on the non-CP based waveforms	InterDigital Communications
R1-167673	Impact of multiplexing multiple numerologies on initial access	ASUSTEK COMPUTER (SHANGHAI)
R1-167730	Study of PN Models for above 6 GHz with experimental data	National Instruments Corp.
R1-167770	CP length for NR VODAFONE Group Plc	
R1-167969	WF on Scalable Numerology Symbol Boundary Alignment	Qualcomm Incorporated

8.1.3.2 Frame structure

[R1-166364](#) NR numerology scaling and alignment Qualcomm Incorporated

The document (Sections 3 and 4 only) was presented by Qualcomm.

- Proposal 2: tones of scaled numerology have center of subcarrier aligned on the grid of base numerology with wider SCS being a subset of narrower SCS in a nested manner
- Proposal 3: fixed number of tones per RB regardless of numerology
- Proposal 4: RB partition is fixed for each numerology, and schedule allocates RB based on user-specific numerology in the unit of integer number of RBs for that numerology

Decision: The document is noted.

[R1-166765](#) Discussion on resource block size in NR Samsung

The document was presented by Young Han Nam from Samsung.

- Observations
 - NR should support much wider range of transmission bandwidth than LTE
 - Minimum payload size gives an impact on determining the PRB size and the minimum size of payload could be different depending on the potential applications and use cases to be identified.
 - Fixed time and frequency granularity approach would provide limited scalability and flexibility.
 - Scalable time and frequency granularity would sufficiently provide scalability and flexibility.
- Proposal: PRB size to be specified in NR should support scalable time/frequency granularity.

Decision: The document is noted.

[R1-167338](#) Discussion on physical resource block for NR numerologies Panasonic Corporation

The document was presented by ... from Panasonic.

- Proposal 1: The number of REs in a PRB is roughly same as LTE regardless of subcarrier spacing for eMBB and mMTC.
- Proposal 2: The number M of subcarriers in a PRB is same regardless of subcarrier spacing for eMBB and mMTC.
- Proposal 3: PRB boundary is aligned among numerologies. Possible guard is realized by rate matching and/or puncturing..
- Proposal 4: Centre DC subcarrier handling is same among downlink, uplink and sidelink.
- Proposal 5: PRB boundary position should not be influenced by DC subcarrier insertion. If one carrier needs to be nulled, it is realized by rate matching and/or puncturing.
- Proposal 6: Common PRB boundary position should be used regardless of the system bandwidth is odd number of PRBs or even number of PRBs.
- Proposal 7: PRB size well aligned with channel raster could be consider to simplify the RF component of UE.

Decision: The document is noted.

R1-167261 On resource block grouping and multicell coordination aspects for mixed numerology support
Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by Karri Ranta-aho from Nokia.

- Observation 1: Previous results indicate performance benefits when using UE/service-specific numerology, e.g. for mixing use cases with different velocities or latency requirements.
- Proposal 1: Grouping of resources into resource block groups (RBG) with same numerology should be considered as a solution for enabling mixed numerology and a configurable air interface.
- Proposal 2: The RBG has a common absolute size in both time and frequency and it defines the minimum granularity for variable numerology within a same NR carrier bandwidth.
- Proposal 3: The size of one physical resource block (PRB) in terms of number of resource elements is common for all numerologies.
- Observation 2: Different levels of coordination of numerology among cells are possible. The need for coordination depends on the processing technique.
- Proposal 4: New Radio should provide possibilities of at least partial numerology coordination via the inter-base-station interface (the NR variant of the X2 interface).
- Proposal 5: New Radio should provide possibilities of reference- and sounding symbol numerology alignment across multiple cells. For those reference and sounding symbols time-multiplexing with the option of full numerology alignment across different cells should be considered.

Decision: The document is noted.

R1-166941 On design of mixed numerology in a NR carrier ETRI

The document was presented by ... from ETRI and investigates several issues in the NR carrier design under the mixed numerology framework.

Decision: The document is noted.

R1-166104 Discussion on time domain structures Huawei, HiSilicon

The document was presented by David Mazzaresse from Huawei.

Proposal 1: Three time domain structures should be supported for the new radio.

- DL-only time domain structure composed of a DL transmission part
- UL-only time domain structure composed of an UL transmission part
- Mixed DL and UL time domain structure composed of a DL transmission part (located at the beginning), a guard and an UL transmission part (located at the end)
 - DL-dominant: a DL transmission part (mainly for data assignments and data), a guard, a configurable short UL transmission part (mainly for UCI and SRS).
 - UL-dominant: a configurable short DL transmission part (mainly for data assignments), a guard, a UL transmission part (mainly for data, UCI and SRS)

Proposal 2: NR should support both dynamic TDD operation and semi-static TDD operation.

- Candidate TDD UL/DL configurations could be defined in NR for semi-static TDD operation. FFS the detailed candidate TDD UL/DL configurations.
- The “direction” (uplink or downlink) of a subframe can change on subframe basis for dynamic TDD operation. FFS the indication of the “direction” of a subframe.

Proposal 3: The basic length of a time domain structure is equal to the subframe duration, which is defined from a basic time unit of 1 ms corresponding to a basic subcarrier spacing f_0 with a given number of OFDM symbols for a given CP length, and the subframe duration scales with subcarrier spacing.

- Shorter subframe durations with 0.5ms, 0.25ms and 0.125ms are supported with the subcarrier spacing increasing.
- Longer subframe duration with the subcarrier spacing decreasing is FFS.

Proposal 4: A first DL control channel located at the front of each time interval of a basic length (i.e. subframe) of a time domain structure should be supported in NR. A second DL control channel embedded in the data region in DL subframe or DL-dominant structure can also be considered for NR.

Proposal 5: The reference signals used for demodulating a control channel or a data channel are contained only within the same time/frequency resource for that channel, and are transmitted only when that channel is present.

Decision: The document is noted.

R1-166365 Advanced frame structure Qualcomm Incorporated

The document was presented by ... from Qualcomm.

- Observation 1. Advanced frame structures should allow for low priority links to yield to higher priority links to enable dynamic and decentralized UL-DL switching.
- Observation 2. Advanced frame structures should allow some gaps for sensing to enable control interval transmission on unlicensed spectrum.
- Observation 3. Advanced frame structures should allow for UE's to establish sidelink and exchange traffic while managing interference. This may apply to both broadcast and unicast sidelink transmissions.

Decision: The document is noted.

R1-166664 Frame Structure Design for NR Sony

The document was presented by Martin Beale from Sony.

- Proposal 1: RAN1 agree on (1) basic atomic building blocks of NR and (2) the time to process the building blocks.
- Proposal 2: During the NR study phase, RAN1 create some reference physical structures that are used for the purposes of evaluation.
- Proposal 3: Combinations of building blocks that span an Interval-X should be signaled semi-statically.
- Proposal 4: The DL transmission part, guard and UL transmission part can exist in any order within an Interval-X.
- Proposal 5: Within an Interval-X, there can be a guard region after the uplink transmission region.
- Proposal 6: RAN1 evaluates UE timing constraints before defining bidirectional self-contained TDD physical structures (Interval-X).
- Proposal 7: The basic physical structure of NR should allow the creation of NR subframes of a length that is either an integer multiple of the LTE subframe length or a common divisor of the LTE subframe length.

Decision: The document is noted.

R1-167946 Outcome of off line discussion NTT DOCOMO, Inc.

The document was presented by Fred Takeda from NTT DOCOMO.

- A subframe duration is defined by x OFDM symbols for a given CP overhead.
 - x is the same for all subcarrier spacing values.
 - This does not preclude multiple scheduling occasions within a subframe duration.
 - This does not preclude that one scheduling occurs over multiple subframe durations.
- A UE assumes at least one reference numerology in a given NR carrier which defines subframe duration.
- Specification supports multiplexing numerologies in TDM and/or FDM within/across (a) subframe duration(s).

Decision: The document is noted, modified as follows:

Agreements:

- A subframe duration is defined by the duration of x OFDM symbols given a reference numerology
 - With the same CP overhead, a single value of x is specified irrespective of the subcarrier spacing value chosen for the reference numerology
 - This does not preclude multiple data transmission opportunities in time within a subframe duration
 - This does not preclude multiple control transmission opportunities in time for both DL and UL within the subframe duration
 - This does not preclude one data transmission to span over multiple subframe durations
- A UE has one reference numerology in a given NR carrier which defines subframe duration for the given NR carrier
 - FFS: In a given NR carrier, whether different UEs may have different reference numerologies or may not
- Specification supports multiplexing numerologies in TDM and/or FDM within/across (a) subframe duration(s) from a UE perspective

Agreement:

- PRB definition where the number of subcarriers per PRB is the same for all numerologies is supported
 - Examples of the number of subcarriers per PRB for NR study are 12, 16, 40
 - Additional PRB definition with the different number of subcarriers is not precluded

Agreement: The number of subcarriers per PRB for NR study are 12, 16

Conclusion: RAN1 will down select the number of subcarriers per PRB in the next meeting

Agreement:

- For subcarrier spacing of $2^n * 15\text{kHz}$, subcarriers are mapped on the subset/superset of those for subcarrier spacing of 15kHz in a nested manner in the frequency domain

R1-167956 Way Forward on RB allocation for mixed numerologies ZTE, ZTE Microelectronics, Ericsson, Qualcomm

The document was presented by Patrick Svedman from ZTE.

- Subcarriers from scaled numerologies are aligned such that their center frequencies coincide
- RBs for different numerologies have a fixed grid
- Resources are allocated in integer numbers of resource blocks (RBs)
- For numerologies that are derived by sub-carrier spacing scaling from the same basic numerology, their RB grids are allocated according to the enclosed figure

Decision: The document is noted. Continue offline discussion until Tuesday

Tuesday: Revised in

R1-167978 Way Forward on RB allocation for mixed numerologies ZTE, ZTE Microelectronics, Ericsson, Qualcomm, Nokia, Alcatel-Lucent Shanghai Bell

- For one NR carrier
 - Each numerology has a fixed RB grid
 - Resources are allocated in integer numbers of resource blocks (RBs).
 - For subcarrier spacing of $2^n * 15\text{kHz}$, RBs are mapped on the subset/superset of RBs for subcarrier spacing of 15kHz in a nested manner in the frequency domain

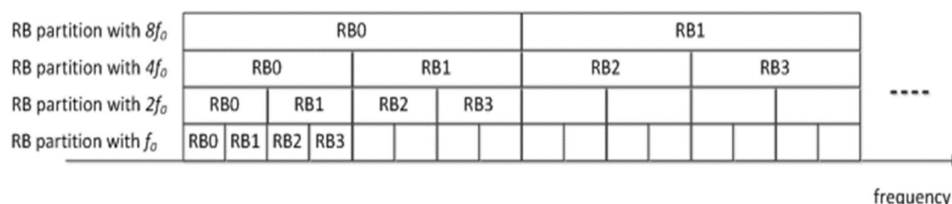
Decision: The document is noted. Further revised in:

R1-168140 Way Forward on RB allocation for mixed numerologies ZTE, ZTE Microelectronics, Ericsson, Qualcomm, Nokia, Alcatel-Lucent Shanghai Bell, Panasonic

Decision: The document is noted

Agreements:

- In one carrier when multiple numerologies are time domain multiplexed,
 - RBs for different numerologies are located on a fixed grid relative to each other
 - For subcarrier spacing of $2^n * 15\text{kHz}$, the RB grids are defined as the subset/superset of the RB grid for subcarrier spacing of 15kHz in a nested manner in the frequency domain
 - Note that following numbering in the figure is just an example
 - FFS: frequency domain multiplexing case



Continue offline discussion until Wednesday – Thorsten (ZTE)

R1-168309 Way Forward on RB grid definition for mixed numerologies ZTE, ZTE Microelectronics, Ericsson, Qualcomm, Nokia, Alcatel-Lucent Shanghai Bell, Panasonic, Convida Wireless

Conclusions:

- Proponents are encouraged to study followings
 - Alt. 1: Adopt RB grid for FDM as it is agreed in TDM
 - Alt. 2: Use RB grid corresponding to the reference numerology for FDM, applied the same grid to TDM, and revisit above agreements for TDM

Possible agreements:

- No explicit DC subcarrier reserved
- DL and UL have the same DC subcarrier handling

Continue offline discussion until Tuesday

Tuesday Agreement: No explicit DC subcarrier is reserved both for DL and UL

R1-166362 Self-contained subframe timeline analysis Qualcomm Incorporated

The document was presented by Jing Jiang from Qualcomm.

- Observation 1: A fundamental sustainability threshold for UE modem processing throughput on the downlink is one symbol processed per symbol time.

- Observation 2: In a self-contained DL subframe, the amount of gap between the end of the data channel to the beginning of ACK/NACK heavily impacts modem processing pipeline architecture and the hardware capability requirement.
- Observation 3: Even with symbol-by-symbol processing, the pipeline depth may span more than one symbol time. This in turn imposes a requirement for the amount of gap. Reducing the payload towards the end of the data channel is an effective way to decouple pipeline design and the amount of gap required.
- Proposal 1: UE capability framework should be designed to be flexible to facilitate hardware-efficient support for self-contained subframe.
- Observation 4: Scaled numerology facilitates better pipelined processing and offers significant timeline advantage, which is especially crucial for self-contained UL centric subframe.
- Proposal 2: Scaled numerology for the downlink control channel should be studied with applicability for uplink-centric and downlink centric self-contained subframe types.
- Observation 5: Symbol-by-symbol construction and transmission of uplink data is crucial for reducing the latency in UE responses.
- Proposal 3: Uplink reference signal and data channel should be designed to facilitate symbol-by-symbol processing on the UE. This study should extend up the protocol stack to ensure there is no roadblock and to identify potential cross-layer optimizations.
- Proposal 4: UL burst channel structure should be designed with considerations for processing timeline to feedback ACK/NACK.
- Observation 6: Self-contained subframe operation may be feasible with gaps on the order of ~1 OFDM symbol, and equivalently with X and Y on the order of 10s of us.
- Proposal 5: Downlink control and data channels should be designed with flexibility to support single-interlace transmission to allow time-critical processing on the eNB side for immediate ACK processing and potential retransmission.

Decision: The document is noted.

R1-167523 Timing Relationship for NR Frame Structure MediaTek Inc.

The document was presented by Peikai Liao from MediaTek.

- Proposal 1: For eMBB, the time separation, X, between the end of the DL data transmission and the beginning of corresponding acknowledgement reporting should be $\geq 160\mu\text{s}$.
- Proposal 2: For eMBB, the time separation, Y, between the end of UL grant transmission and the beginning of the corresponding uplink data transmission should be $\geq 160\mu\text{s}$.
- Proposal 3: For eMBB, the following timing relationship should be the baseline.
 - Timing relationship between DL data reception and its corresponding acknowledgement in UL: Subframe $N \rightarrow N+2+K$ or $N+4+K$, where K is signalled to a UE dynamically and/or semi-statically; FFS K values
 - Timing relationship between UL assignment and its corresponding UL data transmission: Subframe $N \rightarrow N+2+K$ or $N+4+K$, where K is signalled in DCI; FFS K values
 - Timing relationship between DL scheduler and its corresponding DL data: Subframe $N \rightarrow N$
- Proposal 4: For URLLC, further evaluate whether self-contained operation is necessary.
- Proposal 5: For self-contained operation, DL physical data channel structure should enable on-the-fly decoding with the following design considerations.
 - Demodulation pilots for the physical DL control channel should be located at the beginning of the physical DL control channel.
 - Decoding complexity of physical DL control channel should be reduced with high reliability, compared to LTE.
 - Demodulation pilots for the physical DL data channel should be located at the beginning of the physical DL data channel but other additional demodulation pilots at later location are not precluded.
 - Demodulation pilots for the physical UL data channel should be located at the beginning of the physical UL data channel but other additional demodulation pilots at later location are not precluded.
 - Coded bit to RE mapping should be frequency first and then time in DL data channel.
 - Code block size for DL data should be equal to or less than 3000 bits.
- Proposal 6: For self-contained operation, UL physical data channel structure should enable on-the-fly encoding with the following additional design considerations.
 - Demodulation pilots for the physical UL data channel should be located at the beginning of the physical UL data channel but other additional demodulation pilots at later location are not precluded.
 - Coded bit to RE mapping should be frequency first and then time in UL data channel.
 - Code block size for UL data should be equal to or less than 3000 bits.

Decision: The document is noted.

R1-167299 Timing requirements and scenarios for 5G NR Hybrid ARQ Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by Karri Ranta-aho from Nokia.

- Observation 1: The timing of ACK/NACK's and the number of SAW channels shall be configurable to efficiently support for different network implementations (e.g. to account for L1-L2 latencies for C-RAN implementations). The range of timing values from uplink data transmission until reception of the corresponding ACK/NACK by the UE should be configurable to equal values of sub-ms up to values of ~6 ms.

- Observation 2: The HARQ scheme shall support asymmetric link operation, where the transmission time interval (TTI) and/or time of ACK/NACK transmissions can be configured differently for the uplink and downlink per UE.
- Observation 3: For URLLC, various HARQ enhancements such options for early ACK/NACK feedback, automatic retransmissions until reception of ACK, and potential joint UL/DL HARQ design shall be supported.
- Observation 4: For mMTC use cases, options for simplified HARQ operation are desirable, including support for low cost mMTC devices with half-duplex capabilities and relaxed timing requirements.
- Observation 5: The minimum supported timing relationship between DL data reception and the corresponding UL ACK/NACK transmission, as well as the minimum timing relationship between the UE receiving an UL scheduling assignment and corresponding UL data transmission, could be UE category dependent.
- Proposal 1: The following timing relationships shall be flexibly configurable per UE; (i) timing relationship between DL data reception and corresponding ACK/NACK, (ii) time-duration of the ACK/NACK transmission, and (iii) timing relationship between the UL assignment and corresponding UL data transmission. Configured per UE, using either dedicated RRC-, MAC-, or PHY-level control signalling,
- Proposal 2: It shall be studied if there are attractive complexity and cost tradeoffs from having UE categories with different minimum timing relationships for DL data reception and the corresponding UL ACK/NACK transmission, and between the UE receiving an UL scheduling assignment and corresponding UL data transmission.

Decision: The document is noted.

Observations:

- At least followings are potentially identified as mean to realize the short processing delay and RAN1 will continue to study it
 - Frequency-first and time-second mapping
 - Code block segmentation that facilitates symbol-by-symbol processing
 - Reduce symbol durations
 - DL assignment and UL grant before and/or at the beginning of its scheduled data duration
 - TBS restriction
 - Timing advanced restriction
 - Channel coding
 - Front loaded RS mapping for control channel
 - Grant free transmission

Tuesday

Agreements:

- Unless otherwise specified or indicated to the UE, the UE shall make no assumption on whether to transmit or to receive at least within the data region(s) in a given time interval X
 - Indication to the UE may include
 - Dynamic L1 signaling
 - RRC configuration
 - Broadcast signaling
 - ...

Agreements:

- The following is supported for NR
 - From UE perspective, HARQ ACK/NACK feedback for multiple DL transmissions in time can be transmitted in one UL data/control region is supported
 - Some or all of the following timing relationships can be indicated to a UE dynamically by the L1 DL signaling (FFS: explicit or implicit)
 - Timing relationship between DL data reception and corresponding acknowledgement
 - Timing relationship between UL assignment and corresponding UL data transmission
 - Note: Default value, if any, for each timing relationship is FFS (agreement from RAN1 #85)
 - Note: Potential values for each timing relationship has to be studied further considering e.g., UE processing capability, gap overhead, UL coverage, and etc. (agreement from RAN1 #85)
 - Note: Other means of indicating the timing relationship are not precluded
 - Some or all of the following timing relationships can be indicated to a UE semi-statically (FFS: explicit or implicit)
 - Timing relationship between DL data reception and corresponding acknowledgement
 - Timing relationship between UL assignment and corresponding UL data transmission
 - Note: Default value, if any, for each timing relationship is FFS (agreement from RAN1 #85)
 - Note: Potential values for each timing relationship has to be studied further considering e.g., UE processing capability, gap overhead, UL coverage, and etc. (agreement from RAN1 #85)
 - Note: Other means of indicating the timing relationship are not precluded

Possible agreements:

- NR design at least supports the following
 - Fixed default timing relationship between DL assignment and corresponding DL data transmission
 - FFS: Additionally, a UE is indicated dynamically and/or semi-statically on timing relationship between DL assignment and corresponding DL data reception
 - Note: This additional signalling can override the fixed default timing
 - FFS: A UE is indicated dynamically and/or semi-statically on the duration for DL data reception and UL data transmission

Continue offline discussion within Wednesday – (LGE)

Wednesday

R1-168304 WF on Data Scheduling LG Electronics, Qualcomm

The document was presented by Yunjung Yi from LGE.

- NR design supports the following
 - A UE is indicated dynamically and/or semi-statically on timing relationship between DL assignment and corresponding DL data reception
 - FFS whether there is a fixed timing relationship between DL assignment and corresponding DL data transmission
 - A UE is indicated dynamically and/or semi-statically on the duration for DL data reception and UL data transmission

Decision: The document is noted.

R1-168290 WF on Legacy UEs Blank Resource Indication Qualcomm Incorporated, Samsung, Ericsson

The document was presented by Tingfang Ji from Qualcomm.

- Proposal 1: Study signalling describing blank resources in time- and/or frequency-domains in each “slot”.
- Proposal 2: Consider broadcast and unicast signalling options
 - Unicast signalling could be in the DCI for scheduled legacy UEs to implicitly describe blank resources
 - Broadcast signalling could be used for scheduled and non-scheduled UEs

Decision: The document is noted.

Continue offline discussion until Thursday – Yunjung (LGE), Tingfang (Qualcomm)

Thursday

R1-168434 WF on Resources for data scheduling LG Electronics, Qualcomm

R1-168502 WF on Resources for data scheduling LG Electronics, Qualcomm

Conclusion: Further study

- how to multiplex mini slot and slot
- the benefit and mechanism of indicating blank resources at least for forward compatibility perspective

R1-168058 Way Forward on Slot Types Huawei, HiSilicon, Docomo, Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by David Mazzaresse from Huawei.

- Basic slot types are shown in enclosed figure (seen from the network)
 - Basic slot type is defined by the number of (N) OFDM symbols using the same numerology
 - $N=7$ for normal CP, $N=6$ for extended CP
 - This means there can be 0, 1 or 2 DL/UL switching points within 1 ms at 15 kHz subcarrier spacing, depending on network choice
 - Shorter slots are obtained with larger subcarrier spacing
- Additional slot types are not precluded

Decision: The document is noted.

R1-167441 Comparison of time domain frame structure Panasonic Corporation

The document was presented by Hidetoshi Suzuki from Panasonic.

- Proposal: For 15 kHz subcarrier spacing of self-contained allocation with sufficient DL or UL data length cases, 2 HARQ process within 1ms and 1 DL to UL switching point should be used. In the other cases, 1 HARQ process within 1ms and 0 or 1 DL to UL switching period should be used.

Decision: The document is noted.

R1-168108 WF on time-domain structure in NR LGE, Panasonic

The document was presented by Yunjung Yi from LGE.

- Within a subframe of x OFDM symbols, at least the following are supported
 - DL portion
 - DL portion size can be from 0 to 14 symbols from the start of the subframe
 - UL portion
 - UL portion size can be from 0 to 14 symbols
 - The time-location of UL portion within a subframe can be flexible
- $x = 14$ with 15 kHz normal CP

Decision: The document is noted.

Possible agreements:

- Within a time transmission duration of y OFDM symbols, at least the following are supported
 - DL portion
 - DL portion size can be from 0 to y time transmission duration from the start of the time transmission duration
 - At least 0 and y are supported
 - UL portion
 - UL portion size can be from 0 to y time transmission durations
 - At least 0 and y are supported
 - The time-location of UL portion within a time transmission duration can be flexible
 - DL/UL portion is contiguous

Possible agreement:

- $x = 14$ with 15 kHz normal CP

Continue offline discussion within Tuesday – (Panasonic)

R1-168154 WF on time-domain structure in NR Panasonic

The document was presented by Hidetoshi Suzuki from Panasonic.

Decision: The document is noted and:

Possible agreements:

- In case of the same numerology between DL and UL, within a time duration of y OFDM symbols, the following are supported
 - DL portion
 - DL portion size can be from 0 to y symbol time duration from the start of the time duration
 - At least 0 and y are supported
 - UL portion
 - UL portion size can be from 0 to y symbol time duration
 - At least 0 and y are supported
 - The time-location of UL portion within a time transmission duration can be flexible
 - y symbols are contiguous
- FFS: Start from UL portion case
- At least following is supported.
 - $y = 14$ in 15 kHz subcarrier spacing in normal CP
 - FFS: $y = 7$ with 15 kHz subcarrier spacing in normal CP
- FFS: a time duration y is same as a subframe duration or multiple time duration present in a subframe duration.
- FFS: different numerology between DL and UL

Continue offline discussion within Tuesday – (Panasonic)

Wednesday

R1-168167 WF on time-domain structure in NR Panasonic, LGE

Decision: The document (update of [R1-168154](#)) is noted. Further revised in:

R1-168341 WF on time-domain structure in NR Panasonic

Decision: The document is noted.

Possible agreements:

- In case of the same numerology between DL and UL, within a time duration of y OFDM symbols, the following are supported
 - DL portion
 - DL portion size can be from 0 to y symbol time duration from the start of the time duration
 - At least 0, y , one value within the range $(0, y)$ are supported
 - Within a DL portion, one or multiple mini slots can be available.
 - UL portion
 - UL portion size can be from 0 to y symbol time duration
 - At least 0, y , one value within the range $(0, y)$ are supported
 - The time-location of UL portion within a time transmission duration can be flexible
 - Within a UL portion, one or multiple mini slots can be available.
 - Each of DL portion and UL portion is contiguous.
 - The spec should allow DL portion and UL portion is TDMed with a gap (in case of non-full duplex)
- At least following is supported.
 - $y = 14$ in 15 kHz subcarrier spacing in normal CP
 - FFS: $y = 7$ with 15 kHz subcarrier spacing in normal CP

- FFS: The time duration y is the same as the subframe duration and/or a multiple of the time durations present in the subframe duration.
- FFS: different numerology between DL and UL
- FFS: time duration of y starts from UL
- FFS: whether and how to extend the discussion on DL portion/UL portion length required for the coexistence with LTE TDD

Continue offline discussion until Thursday – Suzuki (Panasonic)

Thursday

[R1-168368](#)

WF on time-domain structure in NR

Panasonic

Agreements:

- A slot can contain all downlink, all uplink, or {at least one downlink part and at least one uplink part}
 - FFS regarding the number of switching points, multiplexing of different use cases (e.g., multiplexing eMBB and URLLC use cases) and/or numerologies in the time domain

[R1-168469](#)

WF on slot and time interval X

Huawei, HiSilicon, Sharp, Panasonic

[R1-168294](#)

WF on Frame Structure Ericsson, Huawei, Qualcomm, Nokia, Sony, DoCoMo, MediaTek, Fujitsu, CATT, Intel, ZTE, InterDigital

The document was presented by Stefan Parkvall from Ericsson.

- › Subframe
 - Already agreed upon
 - Assume $x=14$ in the reference numerology for subframe definition (for normal CP)
 - FFS: $y=x$ and/or $y=x/2$
- › Slot
 - Slot of duration y OFDM symbols in the numerology used for transmission
 - An integer number of slots fit within one subframe duration (at least for transmission numerologies shorter than or equal the reference numerology)
 - The structure allows for ctrl at the beginning
 - The structure allows for ctrl at the end
 - The structure allows for ctrl at the end and at the beginning
 - One possible scheduling unit
- › Mini-slot
 - Should at least support transmission shorter than y OFDM symbols in the numerology used for transmission
 - May contain ctrl at the beginning and/or ctrl at the end
 - The smallest mini-slot is the smallest possible scheduling unit (FFS: smallest number of symbols)
- › Note: the names are for the purpose of discussion. Whether some terms can be merged or not is FFS

Decision: The document is noted and modified as follows:

Agreements:

- Followings are considered as starting points of NR frame structure at least within the CP overhead
 - Subframe
 - Already agreed upon
 - Assume $x=14$ in the reference numerology for subframe definition (for normal CP)
 - FFS: $y=x$ and/or $y=x/2$ and/or y is signalled
 - Slot
 - Slot of duration y OFDM symbols in the numerology used for transmission
 - An integer number of slots fit within one subframe duration (at least for subcarrier spacing is larger than or equal the reference numerology)
 - The structure allows for ctrl at the beginning only
 - The structure allows for ctrl at the end only
 - The structure allows for ctrl at the end and at the beginning
 - Other structure is not precluded
 - One possible scheduling unit
 - Mini-slot
 - Should at least support transmission shorter than y OFDM symbols in the numerology used for transmission
 - May contain ctrl at the beginning and/or ctrl at the end
 - The smallest mini-slot is the smallest possible scheduling unit (FFS: smallest number of symbols)
 - Note: the names are for the purpose of discussion. Whether some terms can be merged or not is FFS
 - FFS whether NR frame structure needs to support both slot and mini-slot or these can be merged

R1-168191 WF on different time intervals for NR frame structure ZTE, ZTE Microelectronics, Qualcomm

- For a reference numerology, multiple durations are defined in number OFDM symbols for time interval
 - A minimum duration is defined in x_1 OFDM symbols
- At least from network perspectives, different durations of time intervals can be multiplexed in TDM and/or FDM
 - FFS: Whether or not NR support nested time interval structure for different duration.
 - Resources already allocated for a longer time interval may also be used for a shorter time interval
 - E.g. for URLLC operation

Decision: The document is noted. Further revised in:

R1-168331 WF on different time intervals for NR frame structure ZTE, ZTE Microelectronics, Qualcomm, Sharp, InterDigital

Discussion: Also supported by MTI

Decision: The document is noted.

Possible agreements:

- At least for DL, it should be possible to override the ongoing transmission with a short transmission at least from NW perspective

Possible agreements:

- For a reference numerology, multiple durations are defined in number OFDM symbols for time interval
 - A minimum duration is defined in x_1 OFDM symbols

Possible agreements:

- At least from network perspectives, different durations of time interval can be multiplexed in TDM and/or FDM
 - FFS: Whether or not NR supports nested time interval structure for different duration
- Resources already scheduled for a longer time interval may be rescheduled for a shorter time interval , e.g. for URLLC operation
 - Option1: Ongoing transmission for longer interval is punctured
 - Option2: Ongoing transmission for longer interval is dropped
 - Other solutions are not precluded

Continue offline discussion until Thursday – Zhisong (ZTE)

R1-168438 WF on Supporting URLLC in NR LG Electronics, ZTE

R1-168499 WF on different time intervals for NR frame structure ZTE, ZTE Microelectronics, Qualcomm, LGE Sharp, MTI, InterDigital, CATT

R1-168545 WF on Supporting URLLC in NR LG Electronics, ZTE, Sharp, MTI

R1-168550 WF on Supporting URLLC in NR LG Electronics, ZTE, Sharp, MTI

Agreements:

- At least the following potential options should be considered
 - At least for shorter transmission UL, semi-static resource sharing between URLLC and eMBB
 - FDM and/or TDM manner
 - UL grant-free transmission for URLLC
 - Other schemes are not precluded
 - Dynamic resource sharing between URLLC and eMBB
 - For DL, mechanisms to schedule a transmission where the resources of it can overlap with resources of ongoing/scheduled longer transmission at least from network perspective
 - FFS: A similar or same mechanism applicability to UL
 - Preemption or superposition
 - Other schemes are not precluded
 - Scheduling based approaches (e.g., by adapting transmission duration or by using different subbands) to allow multiplexing of different durations of transmission
 - UL grant-free transmission for URLLC
 - Other schemes are not precluded
 - Other mechanisms are not precluded

R1-166488 Wireless backhaul/relay for NR AT&T GNS Belgium SPRL

R1-166368 UE Power Consideration based on Days-of-Use Qualcomm Incorporated

R1-168352 WF on NR UE Power Consumption Reduction Qualcomm

Agreements:

- Impact of UE DL reception energy consumption should be studied also considering the total power consumption mainly focusing on DoU

- e.g., UE decoding power consumption in the physical layer DL control blind decoding in lack of grant
- e.g., UE decoding power consumption in the slot with the data
- e.g., UE decoding power consumption in the data reception process
- e.g., UE decoding power consumption in the measurement
- e.g., UE decoding power consumption in the SS
- UE power reduction techniques also should be studied

[R1-168430](#) **WF on number of HARQ processes for NR** **Qualcomm, DCM, ZTE, Verizon**
[R1-168342](#) **Way Forward on HARQ Process for NR** **MediaTek, Intel, Samsung, Nokia, ASB**

[R1-168532](#) **Way Forward on HARQ Process for NR** **Mediatek**

[R1-168395](#) **WF on DL and UL transmission for NR** **CMCC, China Telecom, China Unicom, Softbank, CATT, Huawei, HiSilicon, OPPO, Nokia, Alcatel-Lucent Shanghai Bell, MediaTek, Qualcomm, Samsung, ZTE, ZTE Microelectronics, LG Electronics, CATR**
Also supported by Ericsson, Convida, Xiaomi

Agreements:

- NR supports at least semi-statically assigned DL/UL transmission direction as gNB operation
 - The assigned DL/UL transmission direction can be signalled to UE by higher layer signalling

[R1-168347](#) **WF on additional RS for NR** **LG Electronics, Samsung, NTT DOCOMO**

Agreements:

- In addition to the front-loaded RS agreed to study in RAN1#85, same or extended/additional RS is studied in NR of at least the following:
 - Estimate/compensate Doppler parameters
 - Compensate phase rotation and frequency offset
 - Note that RS may or may not be UE-specific

[R1-168489](#) **Use Cases/Scenarios for Slot Structure Discussion** **Qualcomm**

[R1-168531](#) **WF on Use Case Discussion for Time Domain Structure Use Cases** **Qualcomm**

- Email discussion for proponents to provide further input on use cases with completion target by Sept 15th – (Qualcomm);
e.g.,
 - What specific cases to support the particular numerologies such as 15 kHz subcarrier spacing
 - How often can DL control appear? UL control?
 - How is this associated with the transmission duration mentioned in [R1-168489](#)?
 - How often can user be scheduled?
 - What is smallest possible scheduled duration?
 - How often may gaps appear w/in transmission duration? How much overhead?
 - Note: please provide all lengths in terms of symbols for each intended SCS.
 - SCS as provided (or updated from) [R1-168489](#) “Use Cases/Scenarios for Slot Structure Discussion”
 - Absolute times (e.g, ms or us) should also be supplied for clarification
 - Any other questions may be added

[R1-168534](#) **Way forward on time-domain structure** **NTT DOCOMO**

[R1-168491](#) **Way forward on control channel for NR** **LG Electronics, Samsung, Panasonic**

[R1-168429](#) **WF on Integrated Backhaul and Access** **Huawei, HiSilicon, AT&T, Samsung, Qualcomm, Ericsson, ASTRI**

Conclusions:

- Mechanisms for joint operation of backhaul link and access link should be studied by NR, including
 - Study dynamic resource allocation among backhaul and access links, including TDM and FDM and SDM approaches under half-duplex constraint
 - Study multi-hop backhauling and multi-site connectivity in backhauling
 - Mechanism for integration of new TRPs/RNs carrying integrated backhaul and access functionalities
 - Mechanisms for discovery and management of backhaul links for the connected TRP/relay nodes (if supported) with integrated backhaul and access links

- Other aspects/functionalities such as forward compatibility to study full duplex operation on backhaul and/or access links are FFS
- RAN1 should strive for a common mobility handling and beam management framework for mobile TRP/relay nodes (if supported) carrying joint operation of backhaul and access functionalities and the usual UEs
- Note: No assumption on particular RAN architecture

R1-166102	Overview of frame structure for NR	Huawei, HiSilicon
R1-166103	Discussion on flexible frame structure with different numerologies	Huawei, HiSilicon
R1-166105	Discussion on timing relations for NR frame structure	Huawei, HiSilicon
R1-166106	Support of flexible bandwidth	Huawei, HiSilicon
R1-166117	Wideband support for NR	Huawei, HiSilicon
R1-166122	Evaluation parameters for unified duplex study	Huawei, HiSilicon
R1-166361	Control interval and scheduling interval	Qualcomm Incorporated
R1-166367	Multi-TTI frame structure and utility for short subframes in MMW	Qualcomm Incorporated
R1-166407	Uplink data scheduling and transmission for NR frame structure	ZTE
R1-166408	Multiplexing of eMBB and URLLC	ZTE
R1-166409	UL part in NR Frame structure for the unlicensed spectrum	ZTE
R1-166410	Consideration on URLLC in NR frame structure	ZTE
R1-166472	NR frame structure design CATT	
R1-166555	Frame structure design for NR	Intel Corporation
R1-166556	Requirements and solutions for LTE/NR Coexistence	Intel Corporation
R1-166610	On DL HARQ for NR	Guangdong OPPO Mobile Telecom.
R1-166613	Pairing or combining the two types of self-contained subframes	Guangdong OPPO Mobile Telecom.
R1-166615	Discussion of the UE processing time on the support of multiple numerologies and frame structures	Guangdong OPPO Mobile Telecom.
R1-166638	Proposals for frame structure	NEC
R1-166662	MU-MIMO impact on frame structure for NR	Sony
R1-166673	NR Frame structure considerations for low latency TDD operation	Fujitsu
R1-166674	Discussion on flexible/dynamic TDD	Fujitsu
R1-166675	Guard period setting in TDD based NR frame structure	Fujitsu
R1-166676	TDD frame structure with mixed numerology	Fujitsu
R1-166756	Discussion on UL control channel structure for NR	Samsung
R1-166757	Discussion on frame structure and HARQ timing	Samsung
R1-166758	Discussion on time interval X	Samsung
R1-166759	Discussion on URLLC support in NR	Samsung
R1-166760	Discussions on reference signal design for NR	Samsung
R1-166761	Dynamic TDD for NR	Samsung
R1-166762	PDCCH Design Considerations	Samsung
R1-166763	Discussion on wireless backhaul support	Samsung
R1-166764	Discussion on NR subframe structure and control signaling	Samsung
R1-166766	Discussion on measurement support for single/multi-beam NR operation	Samsung
R1-166767	Framework for multiplexing different verticals	Samsung
R1-166880	Discussion on minimum HARQ-ACK and retransmission timing	LG Electronics
R1-166881	Subframe and mini-subframe definition for frame structure of NR	LG Electronics
R1-166882	Overall discussion on URLLC	LG Electronics
R1-166883	Discussion on flexible duplex operation in NR design	LG Electronics
R1-166884	Inter-cell interference coordination for flexible duplex operation	LG Electronics
R1-166886	Handling URLLC in new RAT	LG Electronics
R1-166887	Discussion on relay operation in NR	LG Electronics
R1-166888	Discussion on multi-carrier operation between LTE and NR	LG Electronics
R1-166889	On MBMS support in NR	LG Electronics
R1-166940	Discussion on numerology multiplexing in NR	ETRI
R1-166942	Frame structure for new radio interface	ETRI
R1-167005	Discussion on frame structure	Spreadtrum Communications
R1-167037	Demodulation reference signal design principles	Ericsson
R1-167038	DMRS reuse for data and control	Ericsson
R1-167039	On different HARQ reporting modes	Ericsson
R1-167042	On FDD frame structure	Ericsson
R1-167043	On sidelink frame structure	Ericsson
R1-167044	On dynamic TDD	Ericsson
R1-167045	On low-latency frame structure	Ericsson
R1-167046	Summary ofn NR subframe design	Ericsson
R1-167047	On smallest schedulable unit	Ericsson

R1-167048	On subframe description	Ericsson	
R1-167049	On subframe scaling	Ericsson	
R1-167050	On symbol scaling	Ericsson	
R1-167051	On time interval X	Ericsson	
R1-167052	On multi-subframe scheduling for uplink transmissions	Ericsson	
R1-167053	On the number of HARQ processes	Ericsson	
R1-167079	Frame structure and DMRS positions	Ericsson	
R1-167080	Concatenated block RS design	Ericsson	
R1-167089	Discussion on NR operation in unlicensed spectrum	ZTE	
R1-167109	Discussion on frame structure design for NRCMCC		
R1-167110	Discussion on Time Interval and TTI for NRCMCC		
R1-167127	Frame structure considerations for URLLC	Intel Corporation	
R1-167203	Discussion on control channel design	Huawei, HiSilicon	
R1-167204	Discussion on reference signal design	Huawei, HiSilicon	
R1-167218	Numerology and Frame Structure for NR-Unlicensed	Huawei, HiSilicon	
R1-167262	Basic frame structure principles for New Radio	Nokia, Alcatel-Lucent Shanghai Bell, Verizon Wireless	
R1-167263	On HARQ and scheduling timing for New Radio	Nokia, Alcatel-Lucent Shanghai Bell	
R1-167264	On flexible RS design principles	Nokia, Alcatel-Lucent Shanghai Bell	
R1-167265	Frame Structure Support for Beam Based Common Control Plane	Nokia, Alcatel-Lucent Shanghai Bell, Verizon Wireless	
R1-167266	On the unlicensed band operation in NR	Nokia, Alcatel-Lucent Shanghai Bell	
R1-167267	On the wireless relay / self-backhauling operation in NR	Nokia, Alcatel-Lucent Shanghai Bell	
R1-167268	On the sidelink operation in NR	Nokia, Alcatel-Lucent Shanghai Bell	
R1-167269	On the URLLC transmission formats for New Radio TDD	Nokia, Alcatel-Lucent Shanghai Bell	
R1-167330	Frame structure in NR	INTERDIGITAL COMMUNICATIONS	
R1-167331	Efficient multiplexing of traffic for different use cases	INTERDIGITAL COMMUNICATIONS	
R1-167395	Views on NR frame structure	NTT DOCOMO, INC.	
R1-167397	Views on NR demodulation RS	NTT DOCOMO, INC.	
R1-167440	NR time domain structure	Panasonic Corporation	
R1-167521	Latency Analysis for NR Frame Structure	MediaTek Inc.	
R1-167522	Flexible Frame Structure for New Radio Access Technology	MediaTek Inc.	
R1-167584	Frame Structure for Channel Reciprocity Based Downlink MIMO in NR	National Instruments Corp.	
R1-167600	Discussions on the frame structure design for URLLC	CATR	
R1-167616	The feasible gap duration and association timing in NR	SHARP Corporation	
R1-167632	Signalling Framework to enable flexible Frame Structure for NR	Motorola Mobility	
R1-167732	Design Considerations on Guard Period for NR Frame Structure	National Instruments Corp.	
R1-167733	Discussion on NR frame structure	CHTTL	
R1-167739	Discussion on frame structure for NR	III	
R1-167744	IC friendliness vs configurable DMRS	Ericsson	
R1-167754	On Frame Structure for NR	Innovative Technology Lab Co.	
R1-167777	Considerations on Frame Structure for NR	KT Corp.	
R1-167975	WF on Dynamic TDD in NR	Intel, Ericsson, MediaTek, Sharp, NTT Docomo, Qualcomm, Samsung, Verizon, Nokia, ETRI	
R1-167976	WF on NR Frame Structure	Intel, Ericsson, Huawei, Sharp, Interdigital, Nokia, CATT, Verizon, Samsung, ETRI	
R1-167979	Way Forward on Ack/Nack feedback of DL HARQ for NR	ZTE, ZTE Microelectronics, Ericsson, Qualcomm, NTT Docomo, InterDigital	
R1-168092	WF on number of HARQ processes to support for NR	Qualcomm	
R1-168265	WF on subframes and slots	Ericsson	
R1-168435	WF on SLS evaluation methodologies for autonomous/grant-free/contention-based MA	LG Electronics	

8.1.4 Channel coding and modulation for new radi'o interface

[R1-168418](#) **Chairman's notes of AI 8.1.4 on channel coding and modulation for NR** **Ad-Hoc chair (Nokia)**

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and incorporated as follows.

8.1.4.1 Channel coding

Complexity comparisons

R1-166372	Channel coding evaluation of performance and implementation for EMBB	Qualcomm Incorporated
R1-166557	Comparison of channel coding schemes for NR	Intel Corporation
R1-166774	Discussion on complexity of NR candidate FECs	Samsung
R1-166932	Implementation Consideration of Channel Coding Candidates for NR	Ericsson

[R1-166936](#) Survey of Channel Decoder Implementations Ericsson
[R1-167213](#) Computational and implementation complexity of channel coding schemes Huawei, HiSilicon
[R1-167272](#) Implementation aspects of eMBB coding schemes Nokia, Alcatel-Lucent Shanghai Bell, Verizon Wireless, Xilinx
[R1-167531](#) Area, Power and Latency Comparison for NR High Throughput Decoder MediaTek Inc.

[R1-166413](#) Consideration on channel coding for NR ZTE
Revised in R1-17901

[R1-168103](#) WF on implementation complexity for eMBB coding scheme Nokia, ASB, Samsung, Ericsson, LG

Performance comparisons

[R1-167895](#) Performance evaluation on channel coding candidates for NR ZTE

Revision of [R1-166411](#)

[R1-166559](#) Performance of channel coding schemes for NR Intel Corporation

[R1-167212](#) Performance of polar and LDPC codes for eMBB scenarios Huawei, HiSilicon

[R1-167239](#) Field test results of channel coding schemes Huawei, HiSilicon

[R1-167270](#) Performance of eMBB channel coding candidates Nokia, Alcatel-Lucent Shanghai Bell

[R1-167601](#) Some simulation results for different coding schemes CATR

[R1-168163](#) WF on further channel coding simulation data sharing InterDigital, Qualcomm, Huawei, Ericsson, Samsung, MediaTek, LG, Nokia, ASB, ZTE, Intel, Sharp

Conclusion:

- Combined channel coding simulation data sharing is needed by filling in the base excel spreadsheets from participating companies
 - Example base excel spreadsheets are attached
 - Participating companies may add their data upon the combined excel spreadsheet and update the file version
 - Offline emails can be used to track the updates: Moderator: Chunxuan Ye, Interdigital
 - Simulation curves may not be aligned given the same configuration, probably due to different codes or decoding algorithms
 - May need to specify further details of different channel codes
- Companies encouraged to further contribute, update and align their simulation results for RAN1 #86bis

[R1-168285](#) WF on channel code evaluation for URLLC Qualcomm

Other comparisons

[R1-168169](#) WF on Flexibility of Channel Coding Techniques Ericsson, Nokia, ASB, LG, Orange, IMT
Also supported by NEC.

Agreement:

- Channel coding techniques for NR, should support the following:
 - Info block size K flexibility:
 - Granularity at lower end of range of $K = \lceil D1 \rceil$ bits
 - D1 may be different for control and data channels
 - FFS whether D1 may be different for different code rates
 - FFS whether the granularity is coarser at higher values of K
 - Shortening (i.e. assigning info bits to known values, e.g. 0) may be used to provide info block size flexibility
 - Codeword size flexibility:
 - Basic code design with rate matching (i.e., puncturing and/or repetition) supports 1-bit granularity in codeword size

[R1-167999](#) WF on Channel Coding Selection Qualcomm Incorporated, Samsung, Nokia, ASB, ZTE, MediaTek, Intel, Sharp, MTI, Interdigital, Verizon Wireless, KT Corporation, KDDI, IITH, CEWiT, Reliance-jio, Tejas Networks, Beijing Xinwei Telecom Technology, Vivo, Potevio, WILUS, Sony, Xiaomi

Also supported by Oppo.

Revision of [R1-166376](#)

Proposal:

- LDPC should be selected for eMBB data channel to provide performance and implementation advantages at high rate and large blocklength

[R1-168040](#) **WF on channel coding selection** Huawei, HiSilicon, CMCC, CUCC, Deutsche Telekom, Orange, Telecom Italia, Vodafone, China Unicom, Spreadtrum

Not supported by Orange.

Proposal:

- Polar code is a candidate channel coding technique for NR for eMBB, URLLC, mMTC

[R1-168164](#) **WF on turbo code selection** LG Electronics, Ericsson, CATT, NEC, Orange, IMT

Proposal:

- LTE turbo code should be supported for NR for at least low throughput including eMBB, mMTC, and URLLC
 - It can support flexibilities of information block sizes and code rates
 - Turbo code enhancement can be considered
- FFS: high throughput

Conclusion:

- The eMBB data channel coding scheme will be chosen at RAN1#86bis
 - including agreeing on the observations that led to the decision.
- Companies are encouraged to:
 - continue analysis and comparison in order to inform the final decision at RAN1#86bis
 - provide any remaining details, especially focusing on LDPC (in view of the situation in this meeting)
 - provide any remaining details of the flexibility requirements and how they can be satisfied, and corresponding implementation complexity and any impact on performance
- Note that consideration of combinations of coding schemes is not precluded.
- In case of changes to proposals already available, companies are encouraged to provide them at least 1 week before the normal submission deadline for RAN1#86bis.

[R1-168171](#) **WF on HARQ for NR** Ericsson, Nokia, ASB, LG, CATT, ZTE, Qualcomm, MediaTek, InterDigital, Intel, Orange, IMT

Agreement:

- Channel coding technique(s) designed for data channels of NR support both Incremental Redundancy (IR) (or similar) and Chase Combining (CC) HARQ

LDPC details

[R1-166771](#) **Preliminary evaluation results on Quasi-Cyclic LDPC codes** Samsung
[R1-166890](#) **LDPC code design** LG Electronics

Coding for small blocks

[R1-167277](#) **Evaluation criteria for control channel coding** Nokia, Alcatel-Lucent Shanghai Bell
[R1-166373](#) **Short blocklength design** Qualcomm Incorporated
[R1-166926](#) **Further Discussion on Performance and Complexity of Enhanced TBCC** Ericsson
[R1-167992](#) **Evaluation of Enhanced TBCC and Polar Codes** Ericsson
Revision of [R1-166927](#)
[R1-166935](#) **Channel Coding Techniques for Control Information in NR** Ericsson
[R1-167216](#) **Channel coding for control channels** Huawei, HiSilicon
[R1-167703](#) **Channel coding scheme for URLLC, mMTC and control channels** Intel Corporation

[R1-168170](#) **WF on coding technique for control channel of eMBB** Ericsson, Nokia, ASB, LG, NEC, Orange, IMT

Proposal:

- At least for control channel of eMBB UL and DL, tail-biting convolutional code (TBCC) is adopted as channel coding technique for NR
 - FFS: enhancements to LTE TBCC
 - FFS: if other coding techniques should also be included for control channel with info block size outside of 10-100 bits

[R1-168024](#) **WF on code selection for control channel** Huawei, HiSilicon, CMCC, CUCC, Deutsche Telekom, Vodafone, MTK, Interdigital, Spreadtrum

Revision of [R1-168042](#)

Proposal:

- Polar code is considered as channel coding technique for NR for control channel UL and DL
 - Even a low complexity small list size polar decoder is shown to have a performance advantage over TBCC
- Further comparison of Polar and TBCC is encouraged

[R1-168298](#) **WF on control channel coding** **Nokia, ASB, LG, CATT, MediaTek**

Revision of [R1-168102](#)

Agreement:

- Simulation Assumptions for eMBB control channel coding
 - Evaluate the block error rate (BLER) performance versus SNR
 - Evaluate the false alarm rate versus SNR

Channel	AWGN						
Modulation	QPSK						
Coding Scheme	Repetition	Simplex	TBCC	Turbo	LDPC	Reed-Muller	Polar
Code rate (for evaluation purposes)	1/24*, 1/12, 1/6, 1/3, 1/2, 2/3						
Decoding algorithm**	ML	ML	List-Viterbi	Scaled max log MAP	Adjusted min-sum	FHT	SC list
Info. block length (bits w/o CRC) (for evaluation purposes) ***	1, 2, 4, 8, 16, 32, 48, 64, 80, 120, 200						

* Code rate 1/24 is valid for info block length of 1-2 bits

** Other variants of agreed algorithms can be used for encoding and decoding (Complexity details should be illustrated)

*** Each of these info. block lengths shall be evaluated at at least one of the code rates. Other info. block lengths and code rates are not precluded. Similar info. and encoded block lengths should be used for the evaluation. Total coded bits = info. Block length/code rate. Note: these info. block length and code rate are only for initial performance evaluations. They are not interpreted as design targets or assumptions for complexity analysis.

- Companies are encouraged to provide information on complexity of their decoders, and on decoding latency.

Outer coding

[R1-166374](#) **Erasure coding and HARQ design** **Qualcomm Incorporated**

[R1-166375](#) **Erasure coding evaluation methodology** **Qualcomm Incorporated**

[R1-166416](#) **Discussion on outer codes for NR** **ZTE**

[R1-166898](#) **Discussion on outer coding on eMBB data** **LG Electronics**

[R1-167913](#) **Channel coding schemes for eMBB and URLLC Coexistence** **SHARP Corporation, MTI**

Revision of [R1-167617](#)

[R1-168120](#) **WF on URLLC impact handling** **ZTE, ZTE Microelectronics, Qualcomm, Sharp, MTI, InterDigital, Sony, Verizon Wireless, CATR, MediaTek**

Conclusion:

Await outcome of eMBB/URLLC multiplexing discussions.

R1-166369	LDPC HARQ	Qualcomm Incorporated
R1-166371	Polar HARQ	Qualcomm Incorporated
R1-166414	Discussion on LDPC codes for NR	ZTE
R1-166415	Discussion on polar codes for NR	ZTE
R1-166473	Low complexity decoding algorithm for Turbo codes	CATT
R1-166474	Evaluation of dual-binary Turbo code for NR	CATT
R1-166475	Evaluation of binary LDPC codes for NR	CATT
R1-166476	Evaluation of non-binary LDPC codes for NR	CATT
R1-166477	Evaluation of TBCC codes for NR	CATT
R1-166558	Channel coding scheme for eMBB	Intel Corporation
R1-166768	Summary of channel coding for NR	Samsung
R1-166769	Discussion on length compatible Quasi-Cyclic LDPC codes	Samsung
R1-166770	Discussion on rate compatible Quasi-Cyclic LDPC codes	Samsung
R1-166772	Performance analysis on Polar codes	Samsung
R1-166773	Discussion on flexible Polar codes	Samsung

R1-166775	Discussion on throughput and latency of NR candidate FECs	Samsung
R1-166891	Performance evaluation of LDPC codes	LG Electronics
R1-166893	Discussion on polar code design	LG Electronics
R1-166894	Polar code performance evaluation	LG Electronics
R1-166895	TBCC design	LG Electronics
R1-166896	TBCC performance evaluation	LG Electronics
R1-166897	Turbo code enhancement and performance evaluation	LG Electronics
R1-166928	HARQ Schemes for NR	Ericsson
R1-166929	LDPC Code Design for NR	Ericsson
R1-166930	Turbo Code for NR Scenarios	Ericsson
R1-166931	Impact of Shortening and Puncturing to LDPC Performance	Ericsson
R1-166933	Latency Consideration of Channel Coding Candidates	Ericsson
R1-166934	Flexibility Consideration of Channel Coding Candidates	Ericsson
R1-167006	Performance comparison of channel coding schemes in the eMBB scenario	Spreadtrum Communications
R1-167209	Polar code design and rate matching	Huawei, HiSilicon
R1-167210	HARQ scheme for polar codes	Huawei, HiSilicon
R1-167211	LDPC codes for eMBB	Huawei, HiSilicon
R1-167214	Channel coding schemes for URLLC scenario	Huawei, HiSilicon
R1-167215	Channel coding schemes for mMTC scenario	Huawei, HiSilicon
R1-167240	On polar decoders	Huawei, HiSilicon
R1-167271	Performance of mMTC and URLLC channel coding candidates	Nokia, Alcatel-Lucent Shanghai Bell
R1-167273	LDPC design for eMBB	Nokia, Alcatel-Lucent Shanghai Bell
R1-167274	IR HARQ schemes for LDPC	Nokia, Alcatel-Lucent Shanghai Bell
R1-167275	Design and Performance of polar codes for eMBB	Nokia, Alcatel-Lucent Shanghai Bell
R1-167276	Evaluation criteria for URLLC and mMTC coding schemes	Nokia, Alcatel-Lucent Shanghai Bell
R1-167413	Enhanced Turbo Codes for NR: Implementation Details	ORANGE
R1-167414	Enhanced Turbo Codes for NR: Performance Evaluation	ORANGE
R1-167532	Discussion on LDPC Coding Scheme of Code Structure, Granularity and HARQ-IR	MediaTek Inc.
R1-167544	Data sharing on NR Channel Coding Simulation Result	MediaTek Inc.
R1-167565	Performance evaluation of channel coding for URLLC and mMTC	InterDigital Communications
R1-167566	Performance evaluation of puncturing schemes for Polar Codes	InterDigital Communications
R1-167567	Complexity comparison of channel coding candidates	InterDigital Communications
R1-167568	Channel coding simulation data sharing	InterDigital Communications
R1-167659	Double QC-LDPC codes with degree-3 for NR	National Taiwan University
R1-167871	Examination of NR Coding Candidates for Low-Rate Applications	MediaTek Inc.
R1-167884	Comparison of throughput and complexity for Turbo and LDPC codes	LG Electronics
R1-167885	Consideration points for implementation of flexible channel decoder	LG Electronics Inc.
R1-167889	Design of Flexible LDPC Codes	Samsung
R1-167896	Complexity, throughput and latency analysis on channel coding candidates for NR	ZTE
R1-167901	Consideration on channel coding for NR	ZTE
R1-167921	Channel Coding for NR	NTT DOCOMO, INC.
R1-168041	WF on Performance Verification of ME-LDPC	Huawei, HiSilicon

8.1.4.2 Modulation

[R1-168515](#) **Chairman's notes of AI 8.1.4.2 on modulation for NR** **Ad-Hoc chair (Nokia)**

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and incorporated as follows.

R1-166377	NR modulation requirements	Qualcomm Incorporated
R1-167054	On modulation schemes for NR	Ericsson
R1-166899	Discussion on modulation schemes and maximum supported modulation order in NR	LG Electronics
R1-166776	Discussion on modulation for NR	Samsung
R1-166777	Modulation scheme for MIMO	Samsung
R1-166560	Power efficient modulation and waveform processing	Intel Corporation
R1-166649	Performance of NU-QAM with Turbo codes for the NR	Sony
R1-167569	Performance evaluation of Spatial Modulation for New Radio	InterDigital Communications
R1-167570	Performance evaluation of Dual Carrier Modulation for New Radio	InterDigital Communications
R1-167578	On Fractional N-ary Modulation for NR	InterDigital Communications
R1-166099	Advanced modulation for NR	Huawei, HiSilicon
R1-167278	Digital Modulation for 5G New Radio	Nokia, Alcatel-Lucent Shanghai Bell

R1-166378	Evaluation assumptions for NR modulation schemes Qualcomm Incorporated
R1-168281	WF on Modulation for NR InterDigital, Qualcomm, Mediatek, Sony, Orange and Samsung
R1-168095	WF on modulation scheme for NR LGE, Nokia, ASB, Intel

8.1.5 Multi-antenna scheme for new radio interface

Discuss initial views on multi-antenna scheme including analog/digital/hybrid beam-forming

[R1-167291](#) Digital subsystem with hybrid beamforming Nokia, Alcatel-Lucent Shanghai Bell, Verizon Wireless

The document was presented by Mihai Enescu from Nokia.

- Observation 1: Operating using hybrid transceiver architecture suffers from increased scheduling latency and system overhead compared to digital architectures. Especially UL control signaling is expensive with hybrid architecture.
- Observation 2: Widening the RX beams for UL control may be used in some situations but would be far from optimal solution.
- Observation 3: Full digital subsystem could be implemented in cost efficient manner along with hybrid architecture.
- Observation 4: Full digital subsystem has high potential to improve hybrid architecture operation significantly.
- Proposal 1: Define UL control signal and channel and RS structures in a way to allow optimizing BS hybrid implementation with full digital RX subsystem:
 - narrowband resource allocation structures with flexible allocation and scheduling possibility
 - signal design to enable high multiplexing capability for the control signals like scheduling request

Decision: The document is noted.

[R1-166089](#) Beam Management Procedure for NR MIMO Huawei, HiSilicon

The document was presented by Leiming Zhang from Huawei.

- Proposal 1: The following beam refinement procedures should be studied in NR, including reliability performance, overhead and so on.
 - DL or UL based joint TRP and UE beam refinement
 - DL or UL based UE beam refinement only
 - DL or UL based TRP beam refinement only
- Proposal 2: Beam probing for best beam(s) and angle estimation should be considered in NR.
- Proposal 3: A mechanism and signaling for fast link recovery among TRPs should be supported in NR.
- Proposal 4: Control beam(s) derived from the data beam(s) and using the refinement beams for control signal transmission should be considered in NR
- Proposal 5: Beam management procedures taking LF assisted control signalling transmission for HF should be taken into considerations in the overall beam management.

Decision: The document is noted.

[R1-167466](#) Key principles for beam management Ericsson

The document was presented by Mattias Frenne from Ericsson.

- Beam management is handled by L1/L2 procedures
- Strive to handle beam management within the CSI framework in NR (i.e. the framework used for link adaptation of data transmission).
- In the beam management procedures, one or multiple beam pair links (BPLs) are monitored by the network using uplink measurements by the TRPs and/or downlink measurements from the UE
- Support a sweep of BMRS in different TRP beams to allow for a measurement per TRP beam in the UE.
- Consider supporting a repetition of BMRS in the same TRP beam to allow for measurement of the TRP beam in different UE receive beams.

Decision: The document is noted.

[R1-166379](#) Downlink MIMO transmission schemes Qualcomm Incorporated

The document was presented by ... from Qualcomm.

- Proposal 1: The NR DL MIMO shall support CLSM using antenna ports with UE RSs.
- Proposal 2: For CLSM, the precoding granularity can be a single RE.
- Proposal 3: The NR MIMO shall support open-loop spatial multiplexing using antenna ports with UE RSs.
- Proposal 4: Study performance benefit of UE RS based open-loop spatial multiplexing with precoder cycling and small cyclic delay diversity.
- Proposal 5: Study performance benefit of UE RS based open-loop spatial multiplexing with implicit and explicit precoding.
- Proposal 6: The NR MIMO shall support transmit diversity using antenna ports with UE RSs.
- Proposal 7: Study performance benefit of UE RS based SFBC with transparent FSTD and non-transparent FSTD.
- Proposal 8: The NR MIMO shall support reciprocity based spatial multiplexing using antenna ports with UE RS.
- Proposal 9: For reciprocity based spatial multiplexing, the precoding granularity can be a single RE.

- Proposal 10: The NR MIMO may consider dynamic switching between close-loop and open-loop operations in addition to dynamic switching between spatial multiplexing and transmit diversity.

Decision: The document is noted.

WFs on Beam Management

R1-167951 WF on digital sub-system with hybrid beamforming Nokia, ASB

The document was presented by Mihai Enescu from Nokia.

- Support enhancing hybrid architecture operation using digital RX subsystem consisting of the same (or similar) amount of RxRUs as the number of antenna elements.
- UL Signal design and UL control channel design needs to follow the following principles:
 - Transmission bandwidth of the UL control signal and associated demodulation UL RS is significantly smaller than the system bandwidth, e.g. 10/20 MHz bandwidth.
 - UL Signal design to enable high multiplexing capability for the UL control signals like scheduling request.
 - Efficient joint operation of hybrid RX and digital RX, e.g. efficient utilization of UL data and UL control channels.

Discussion: Interference between narrowband and wideband should also be listed

Decision: The document is noted. Continue offline discussion until Tuesday – (Nokia)

R1-167962 WF on NR MIMO calibration ZTE Corporation, ZTE Microelectronics, Intel Corporation, Samsung

The document was presented by Ruyue Li from ZTE.

- RAN1 starts NR MIMO calibration to reach common ground for MIMO related evaluation:
- Link-level calibration
 - Support the subsequent link-level evaluation for candidate designs/approaches, e.g., reference signals;
 - Calibration assumptions and metrics are FFS;
- System-level calibration
 - Support the subsequent system-level evaluation for candidate designs/approaches, e.g., multi-beam sweeping/selection/reporting;
 - Calibration assumptions and metrics are FFS;
- Approve the following scenario/channel model for link and system levels calibration:
- Link-level: CDL model with random angular offset, e.g.,
 - 3GPP TR38.900 CDL-A model (Delay spread = 10 ns)
 - 3GPP TR38.900 CDL-D model (Delay spread = 10 ns)
 - Mobility: 3km/h
 - Other details FFS
 - Notes: The angles should be wrapped around to be uniformly within 0-360 degrees in azimuth and clipped within 0-180 degrees in zenith angle via applying uniform-distribution translation angle in Section 7.7.5.1 in TR 38.900 accordingly.
- System-level: Indoor hotspot, urban macro, dense urban
 - Other details FFS

Discussion: Also supported by ASTRI, Xinwei, Mediatek

Decision: The document is noted. Continue offline discussion until Tuesday – (ZTE: [R1-168273](#))

Thursday

R1-168487 WF on NR MIMO calibration ZTE Corporation, ZTE Microelectronics, Intel Corporation, Samsung, ASTRI, Xinwei, MediaTek, Nokia, ASB, Ericsson, NTT DOCOMO, Qualcomm, CATT

Revision of [R1-168273](#)

Agreements:

- For the purpose of calibration, companies are encouraged to provide baseline results for NR MIMO in the following meetings, including link-level and system level simulations
 - Discuss further on baseline simulation assumptions and metrics for calibration in email discussion after RAN1#86
 - Thereafter, email reflector is used to collect results (no online time for calibration discussions, similar to channel model calibration)
- **Email discussion till Sept 8th - (ZTE)**
 - Including detailed simulation parameters for UE movement, rotation and/or channel/beam blockage is FFS – (to be included in Ruyue's email discussion)

R1-167950 WF on beam management Intel Corporation, Ericsson

The document was presented by Yuan Zhu from Intel.

- Distinguish two beam related procedures:
 - **Procedure A** is used to support beam based mobility
 - Main purpose is to discover TRP TX beams and perform mobility related measurements
 - UE RX beam training support may also be considered
 - Searching and discovering TRP TX beams from neighbor TRPs which are non-synchronized is supported
 - Note: TRPs may still be synchronized but the UE shall not make such assumption
 - L3 reporting
 - **Procedure B** is used to support beam management
 - Purpose is to track TRP TX beams and support UE to select UE RX beams
 - RS (beams) to measure on are explicitly configured to the UE
 - Note: No search/discovery procedure is involved
 - L1/L2 reporting

Discussion: Samsung asked for more time, not a simple change.

Decision: The document is noted.

R1-167961 WF on aperiodic beam sweeping and CSI reporting ZTE

The document was presented by Ruyue Li from ZTE.

- Study the following aspects of aperiodic beam sweeping:
 - Three types of beam sweeping for both UL and DL:
 - TRP beam sweeping only, keeping a fixed UE beam
 - supporting measuring multiple TRP beams by the same UE beam
 - UE beam sweeping only, keeping a fixed TRP beam
 - supporting measuring the same TRP beam with multiple UE beams
 - E.g. by time domain replica waveform. TRP Tx using the same TRP beam and UE receives using one UE beam per replica
 - E.g. by multiple wider sub-carrier spacing based OFDM symbols. TRP Tx using the same TRP beam and UE receives each symbol with different UE beam
 - Joint TRP and UE beam sweeping
 - Indication of TX and/or RX beam on control/feedback signaling:
 - Indication is per beam or per beam group
 - Content of aperiodic CSI report e.g. RSRP, RI/PMI/CQI, beam ID
 - NOTE: support various mobility scenarios
 - Others are not precluded
- Study aperiodic CSI in conjunction with aperiodic RS transmission:
 - Dynamic indication of aperiodic reference signal and interference measurement resource including
 - Aperiodic reference signal for channel measurement for CSI feedback and beam selection/training
 - Aperiodic interference measurement resource for interference measurement, including using non-zero power reference signal
 - Resource pool sharing for aperiodic channel and interference measurement resources
 - DMRS based CSI feedback including CQI adjustment and beam refinement
 - Study the timing requirement among aperiodic CSI triggering, aperiodic RS transmission and CSI feedback.
 - Timing between CSI triggering and aperiodic RS transmission X
 - Timing between aperiodic RS transmission and CSI/beam feedback Y
 - Others are not precluded

Decision: The document is noted.

R1-167947 WF on Beam Management Huawei, HiSilicon, Potevio

The document was presented by Leimin Zhang from Huawei.

- Study on the following aspects for beam management
 - TRP(s) used to transmit beam management RS is transparent to UE
 - Beam management procedure based on L1 and L2 procedure
 - Beam management procedure based on LF assisted HF
 - Beam management includes the following two stages:
 - Coarse beam alignment, i.e., periodic beam sweeping without prior acquired beam(s) information
 - Fine beam alignment, i.e., periodic/aperiodic beam sweeping with prior acquired beam(s) information
 - Strive to handle this procedure within a unified CSI framework in NR
 - Fast link recovery procedure due to UE movement/rotation/blockage
 - » E.g., Monitoring multiple beam pairs for link recovery
 - Beam probing based beam refinement/tracking
 - » E.g., beam selection, or angle estimation
- RS design principle of Beam Management

- DL beam management can be based on DL DMRS in addition to DL RS dedicated to CSI acquisition and beam management
- UL beam management can be based on SRS, UL DMRS and energy-efficient UE-specific tracking signals

Decision: The document is noted.

R1-167966 WF on Beam Management CATT, Samsung

The document was presented by Rakesh Tamrakar from CATT.

- RAN1 should study beam management procedures under different channel reciprocity assumptions
 - At a TRP or UE, with TX and RX channel reciprocity (e.g., beam reciprocity), TX beam (or RX beam) can be obtained from RX beam (or TX beam) to reduce overhead and latency
 - Without TX and RX channel reciprocity, beam management procedure may require TX and RX beam sweeping in both DL and UL links
- RAN1 should study different methods of determining a beam pair for communication, e.g.,
 - Joint determination: Tx beam and Rx beam of the beam pair are determined jointly
 - Separate determination: Tx beam or Rx beam of the beam pair are determined sequentially
- Study beam management procedure with and without explicit indication of beam(s) used for data/control channel or reference signal transmission

Decision: The document is noted.

Continue offline discussion until Tuesday – (Intel, ZTE, CATT, Huawei)

R1-168119 WF on beam management Intel Corporation, Nokia, Alcatel-Lucent Shanghai Bell, Verizon

- The following two DL beam management procedures are supported:
 - Procedure A for beam selection without prior acquired beam(s) information (can be called as beam acquisition)
 - For initial beam acquisition and maintenance
 - UE RX beam training is also supported
 - [for TRPs not necessarily having common baseband/sync or having non-ideal backhaul.
 - option 1: Measurement reports on L3; option 2: Measurement reports can be L2/L1 and/or L3]
 - Procedure B for beam selection with prior acquired beam(s) information (can be called beam adjustment)
 - B-1: to support inter/intra-TRP Tx beam change within an NR cell for the same UE Rx beam
 - B-2: to support UE Rx beam change for the same TRP Tx beam
 - Intra-TRP and inter-TRP beam management follow the same procedure
 - Note: UE may or may not need to know the TRP has changed for inter-TRP Tx beam change
 - [option 1: L1/L2 procedure; option 2: L3 is involved as well]
 - Note: Procedures B-1&B-2 can be performed jointly
 - Note: Procedures B-1&B-2 can be performed multiple times to achieve e.g. TRP Tx/UE Rx beam change simultaneously
- Support managing multiple Tx/Rx beam pairs for a UE for fast link recovery
- Assistant information from another carrier (e.g., LF carrier) can be utilized in procedures A&B
 - E.g., LF carrier is used to feedback the measurement for HF

Decision: The document is noted.

Possible agreements:

- The following two DL beam management procedures are supported:
 - Procedure A for initial beam acquisition without prior acquired beam(s) information (can be called as beam acquisition)
 - TRP TX beam and UE RX beam sweeping are supported
 - [Procedure A can be considered for mobility]
 - Procedure B for beam change with prior acquired beam(s) information (can be called beam adjustment)
 - B-1: to support inter/intra-TRP Tx beam change [within multiple TRPs] for the same UE Rx beam
 - B-2: to support UE Rx beam change for the same TRP Tx beam
 - Strive for the same procedure design for intra-TRP and inter-TRP beam management
 - Note: UE may not know the TRP has changed for inter-TRP Tx beam change
 - Note: Procedures B-1&B-2 can be performed jointly
 - Note: Procedures B-1&B-2 can be performed multiple times to achieve e.g. TRP Tx/UE Rx beam change simultaneously
 - [Procedure B can be considered for mobility]
 - Support managing multiple Tx/Rx beam pairs for a UE for fast link recovery
 - Assistant information from another carrier (e.g., LF carrier) can be utilized in procedures A&B
 - E.g., low frequency carrier is used to feedback the measurement for high frequency
 - [Procedure A can be used for beam maintenance]

Continue offline discussion until Wednesday – Yuan (Intel)

Thursday

[R1-168278](#) **WF on DL beam management** Intel Corporation, Huawei, HiSilicon, Ericsson, Nokia, Alcatel-Lucent
Shanghai Bell, Verizon, MTK, LGE, NTT DoCoMo, Xinwei

Agreements:

- The following DL L1/L2 beam management procedures are supported within one or multiple TRPs:
 - P-1: is used to enable UE measurement on different TRP Tx beams to support selection of TRP Tx beams/UE Rx beam(s)
 - For beamforming at TRP, it typically includes a intra/inter-TRP Tx beam sweep from a set of different beams
 - For beamforming at UE, it typically includes a UE Rx beam sweep from a set of different beams
 - FFS: TRP Tx beam and UE Rx beam can be determined jointly or sequentially
 - P-2: is used to enable UE measurement on different TRP Tx beams to possibly change inter/intra-TRP Tx beam(s)
 - From a possibly smaller set of beams for beam refinement than in P-1
 - Note: P-2 can be a special case of P-1
 - P-3: is used to enable UE measurement on the same TRP Tx beam to change UE Rx beam in the case UE uses beamforming
 - Strive for the same procedure design for Intra-TRP and inter-TRP beam management
 - Note: UE may not know whether it is intra-TRP or inter TRP beam
 - Note: Procedures P-2&P-3 can be performed jointly and/or multiple times to achieve e.g. TRP Tx/UE Rx beam change simultaneously
 - Note: Procedures P-3 may or may not have physical layer procedure spec. impact
 - Support managing multiple Tx/Rx beam pairs for a UE
 - Note: Assistance information from another carrier can be studied in beam management procedures
 - Note that above procedure can be applied to any frequency band
 - Note that above procedure can be used in single/multiple beam(s) per TRP
 - Note: multi/single beam based initial access and mobility treated within a separate RAN1 agenda item

[R1-168322](#) **Definitions supporting beam related procedures** Nokia, Qualcomm, CATT, Intel, NTT DoCoMo, Mediatek, Ericsson, ASB, Samsung, LG

The document was presented by Mihai Enescu from Nokia.

- **Beam management** = a set of procedures to acquire and maintain a set of TRP(s) and/or UE beams that can be used for DL and UL transmission/reception, which include at least following aspects:
 - **Beam selection** = for TRP(s) or UE to select of its own beam(s).
 - **Beam measurement** = for TRP(s) or UE to measure characteristics of received beamformed signals
 - **Beam reporting** = for UE to report a property/quality of beamformed signal(s) based on beam measurement
 - **Beam sweeping** = operation of covering a spatial area, with beams transmitted and/or received during a time interval in a predetermined way.

Discussion: Ericsson → can a note be added that these are not related to mobility?

Decision: The document is noted and agreed in:

[R1-168468](#) **Definitions supporting beam related procedures** Nokia, Qualcomm, CATT, Intel, NTT DoCoMo, Mediatek, Ericsson, ASB, Samsung, LGE

[R1-167965](#) **WF on CSI measurement and reporting in NR** Huawei, HiSilicon

The document was presented by Ming Lei from Huawei.

- A unified CSI acquisition framework should be studied in NR, which shall support
 - CSI measurement based on CSI-RS
 - Beam measurement based on RS for beam management
 - Implicit and explicit CSI feedback
 - Reciprocity based CSI acquisition
- The implicit CSI feedback methods should be studied in NR
 - Codebook design
 - Interference measurement results obtained from
 - ZP CSI-RS
 - NZP CSI-RS
 - DMRS
 - Beam measurement results
- The explicit CSI feedback methods should be studied in NR
 - Feedback of channel covariance matrix

- E.g. based on Kronecker-product
- Feedback of channel matrix or channel eigenvector
 - E.g. based on multi-beam combination
- Both quantized and unquantized/analog feedback
- Multi-level CSI measurement and reporting with the following features should be supported in NR
 - Joint feedback of wideband/long-term and subband/short-term CSI
 - Based on hybrid non-precoded and beamformed CSI-RS
 - Joint feedback of explicit CSI and implicit CSI
- At least the following CSI measurement and reporting mechanisms should be studied by NR
 - Aperiodic CSI measurement and reporting
 - Semi-persistent CSI measurement and reporting
- Self-contained CSI triggering, measurement and reporting in a 'time interval X' should be studied in NR
 - Note: here the definition of 'time interval X' follows the agreements in RAN1#85 meeting

Decision: The document is noted. Continue offline discussion until Tuesday – (Huawei)

R1-168179 WF on CSI measurement and reporting in NR Huawei, HiSilicon, Ericsson, China Telecom

Decision: The document is noted and modified as follows:

Agreements:

- A simplified CSI acquisition framework should be studied in NR, which could support
 - CSI measurement based on CSI-RS (if supported)
 - Implicit and explicit CSI feedback
 - CSI acquisition based on different degree of reciprocity
 - Other features to be supported
- The implicit CSI feedback methods should be studied in NR
 - Codebook design
 - Interference measurement based on interference measurement resource which could be one or more of the following options
 - ZP CSI-RS (if supported)
 - NZP CSI-RS (if supported)
 - DMRS (if supported)
 - Other resources are not precluded
 - CSI feedback based on DMRS (if supported)
- The explicit CSI feedback methods should be studied in NR
 - Feedback of channel covariance matrix
 - Feedback of channel matrix
 - Feedback of channel eigenvector
 - Both quantized and unquantized/analog feedback
 - Other methods are not precluded
- CSI measurement and reporting with the following components should be studied in NR
 - Wideband/long-term CSI
 - Subband/short-term CSI
 - Explicit CSI
 - Implicit CSI
 - Configuration of the above components individually or jointly is FFS

R1-167964 WF on DL Transmission Scheme Huawei, HiSilicon, NEC

- NR should support the multiplexing of different transmission schemes to different UEs at the same time-frequency resource (an example is shown by Figure 1)
- NR should support beam based transmit diversity
 - Beam based transmit diversity based on single-TRP transmission should be supported in NR
 - Beam based transmit diversity based on multi-TRP transmission should be supported in NR (an example is shown by Figure 2)
 - Beam based transmit diversity is based on DM-RS for demodulation
 - Beam based transmit diversity should be the fallback scheme of the multi-antenna based transmission mode
- The dynamic switching between different transmission schemes should be supported in a transmission mode

Decision: The document is noted.

R1-166788 Discussion on DL MIMO transmission schemes and modes in NR Samsung

- Study a unified MIMO transmission chain framework to support various transmission techniques (including DMRS based SM, TxD and RE-level precoder cycling), considering the following aspects:
 - Number of CWs

- Whether to reuse CW-to-layer mapping and precoding framework or to design a new framework
- DCI design alternatives – modular vs format-based

Decision: The document is noted.

Possible agreements:

- NR should support the multiplexing of different transmission schemes to different UEs at the same time-frequency resource (an example is shown by Figure 1)
- NR should support beam based transmit diversity
 - Beam based transmit diversity based on single-TRP transmission should be supported in NR
 - Beam based transmit diversity based on multi-TRP transmission should be supported in NR (an example is shown by Figure 2)
 - Beam based transmit diversity is based on DM-RS for demodulation
 - Beam based transmit diversity should be the fallback scheme of the multi-antenna based transmission mode
- The dynamic switching between different transmission schemes should be supported in a transmission mode

Continue offline discussion until Wednesday – (Huawei, Samsung)

Wednesday

R1-168271 WF on DL Transmission Scheme Huawei, HiSilicon, NEC, Intel

- RAN1 to study multiplexing of different transmission methods to different UEs at the same time-frequency resource
- RAN1 to study transmit diversity
 - SFBC
 - SFBC-FSTD
 - Other schemes are not precluded
 - Demodulation reference for transmit diversity is DM-RS
 - QCL with other types of RS should be studied
- Support dynamic switching between different transmission methods
 - One of the transmission methods shall be transmit diversity
- Note: the multiple antenna ports used for transmit diversity can be on different beams and/or on different TRPs and/or different polarizations

Decision: The document is noted.

R1-168394 WF on DL Transmission Scheme Huawei, HiSilicon, NEC , Intel, Samsung

R1-168476 WF on DL Transmission Scheme Huawei, HiSilicon, NEC , Intel, Samsung

Agreements:

- RAN1 to study transmit diversity for both data and control channels
 - Aspects to related to QCL (if any), # of ports, polarizations, etc.
- Demodulation reference signal for transmit diversity, if supported, could be
 - UE-specific RS (if supported by NR)
 - Shared (by two or more UEs)-RS (if supported by NR)
 - Other types of RS are not precluded

R1-168105 WF on Framework for NR MIMO Samsung, Ericsson

- Strive to design a unified CSI framework, avoiding introducing multiple classes/subclasses and unnecessary (equally performing) configurations, while still covering a wide variety of use cases
- Strive to remove tight coupling (e.g. fixed timing relationships, joint configuration) between the following modular functions
 - CSI-RS transmission
 - CSI measurement
 - CSI reporting
 - Multi-antenna transmission method
 - Downlink control signaling
- Consider supporting independent scheduling/configuration of CSI-RS, CSI report and data transmission
- At least for DL and except for non-spatial transmit diversity, per layer DMRS is supported
 - Note: the precoding is assumed to be the same for the layer and the associated DMRS
- At least 8 orthogonal DMRS ports is supported for SU-MIMO scheduling
 - Consider further the need for more than 8 orthogonal DMRS ports for MU-MIMO scheduling
- Support dynamic switching between transmission methods, e.g. between
 - Spatial transmit diversity (e.g. for control channels)
 - Spatial multiplexing

Decision: The document is noted.

Agreements:

- Strive to design a unified CSI framework, avoiding introducing multiple classes/subclasses and redundant (equally performing) configurations, while still covering a wide variety of use cases and frequency bands
- Coupling/Decoupling (e.g. fixed timing relationships, joint configuration) between the following functions should be studied
 - RS transmission used for CSI acquisition (CSI-RS transmitted in DL and SRS transmitted in UL)
 - Use of other RS(s) is not precluded (e.g., DMRS)
 - Note that CSI-RS and SRS may or may not have the same physical signal design
 - Note that the reference signal naming can be revisited later
 - CSI measurement/reporting
 - Multi-antenna transmission method/scheme
 - Downlink control signaling
- Study flexible scheduling/configuration of CSI-RS, CSI report and transmission method/scheme for data and control
- DL DMRS and UL DMRS based spatial multiplexing (SU-MIMO/MU-MIMO) is supported
 - FFS: Necessity of sidelink spatial multiplexing
- At least 8 orthogonal DL DMRS ports is supported for SU-MIMO scheduling
- At least 8 orthogonal DL DMRS ports is supported for MU-MIMO scheduling
- Support dynamic switching between transmission methods/schemes, e.g. between
 - Transmit diversity
 - Spatial multiplexing

R1-168173 WF on Frequency Selective Precoding for NR UL MIMO Samsung, Intel, NTT DOCOMO, Huawei

- Frequency selective UL precoding (at least for digital beamforming) should be studied in NR
 - Study UL precoder signaling
 - Example 1: Signaling of multiple PMIs (subband) via single or two-level DCIs
 - Example 2: Signaling of multiple PMIs via Data channel
 - Example 3: For TDD, precoder calculation at the UE based on DL RS
 - For TDD and reciprocity calibrated UE, UE recommends candidates UL precoders to BS based on the DL RS measurement, BS determines the final precoder
 - Study the use of UL frequency selective precoding for both dynamic beamforming and semi-dynamic beamforming
 - Study UL subband size (i.e. UL precoding granularity) considering following aspects
 - Implicit (defined by spec.) or explicit (by eNB/UE decision) signaling support
 - Whether to Align with DL or not

Decision: The document is noted.

R1-168254 WF on UL MIMO transmission Huawei, HiSilicon, China Unicom, Samsung, NTT DOCOMO

The following aspects for UL MIMO transmission should be supported:

- Transmission schemes for both reciprocity calibrated UEs, reciprocity non-calibrated UEs, and non-reciprocity case
 - UE capability which indicates calibration accuracy for UL reciprocity based operation should be introduced
- Codebook based transmission
 - Frequency selective precoding should be considered for large system bandwidth
 - E.g., UE-aided and eNB-centric
- Non-codebook based transmission
 - E.g., reciprocity based (based on DL RS) transmission only for calibrated UEs
 - E.g., UE-aided and eNB-centric: UE recommends candidate UL precoders to eNB based on DL RS measurement, and BS determines the final precoder.

Decision: The document is noted.

Agreements:

The following aspects for UL MIMO transmission should be supported:

- Transmission schemes/methods for reciprocity calibrated UEs, reciprocity non-calibrated UEs, and non-reciprocity/partial reciprocity cases
 - If needed, signalling associated with UL reciprocity based operation is introduced, e.g. UE capability which indicates calibration accuracy
 - Whether to differentiate reciprocity non-calibrated UEs from non-reciprocity or not is to be studied

- Note: the number of transmission schemes/methods can be further discussed
- At least one of the following candidate schemes/methods is to be supported
 - Candidate 1: Codebook based transmission
 - Frequency selective and frequency non-selective precoding in digital domain can be considered for large system bandwidth
 - The support for frequency selective precoding is conditioned on decision on NR waveform(s)
 - FFS: The values of the large system bandwidth
 - E.g., BS-centric mechanism analogous to LTE
 - E.g., UE-aided and BS-centric mechanism: UE recommends candidate UL precoders from a predefined codebook to BS based on DL RS measurement, and BS determines the final precoder taken from the codebook.
 - E.g., UE-centric and BS-aided mechanism: BS provides CSI (e.g. channel response, interference-related information) to the UE, and the UE determines the final precoder based on the information from the BS
 - Candidate 2: Non-codebook based transmission
 - Frequency selective and frequency non-selective precoding in digital domain can be considered for large system bandwidth
 - The support for frequency selective precoding is conditioned on decision on NR waveform(s)
 - FFS: The values of the large system bandwidth
 - E.g., reciprocity based (based on DL RS) transmission only for calibrated UEs
 - E.g., UE-aided and BS-centric mechanism: UE recommends candidate UL precoders to BS based on DL RS measurement, and BS determines the final precoder.
 - E.g., UE-centric and BS-aided mechanism: BS provides CSI (e.g. channel response, interference-related information) to the UE, and the UE determines the final precoder based on the information from the BS
 - Note: Other transmission schemes/methods are not precluded.

R1-168173 WF on Frequency Selective Precoding for NR UL MIMO Samsung, Intel, NTT DOCOMO, Huawei

- Frequency selective UL precoding (at least for digital beamforming) should be studied in NR
 - Study UL precoder signaling
 - Example 1: Signaling of multiple PMIs (subband) via single or two-level DCIs
 - Example 2: Signaling of multiple PMIs via Data channel
 - Example 3: For TDD, precoder calculation at the UE based on DL RS
 - For TDD and reciprocity calibrated UE, UE recommends candidates UL precoders to BS based on the DL RS measurement, BS determines the final precoder
 - Study the use of UL frequency selective precoding for both dynamic beamforming and semi-dynamic beamforming
 - Study UL subband size (i.e. UL precoding granularity) considering following aspects
 - Implicit (defined by spec.) or explicit (by eNB/UE decision) signaling support
 - Whether to Align with DL or not

Decision: The document is noted and modified as follows:

Agreements:

- Study UL precoder signaling for frequency selective/non-selective precoding
 - Example 1: Signaling of single or multiple PMIs via DL control and/or data channels
 - Multiple PMIs can be signaled via a single DCI or multi-level DCI (1st level DCI contains a location indication to the 2nd level DCI)
 - Example 2: For TDD, precoder calculation at the UE based on DL RS
 - Notes:
 - The feasibility of frequency selective precoding is conditioned RAN1 decision on, e.g. NR frame structure, waveform(s)
 - Impact on other system design aspects (e.g. DL control channel decoding performance/complexity) should be considered.
- Study the use of UL frequency selective precoding for precoded transmission including precoder cycling
- For frequency selective precoding, study UL precoding granularity (i.e. UL subband size) considering following aspects
 - Implicit (defined by spec.) or explicit (by eNB/UE decision) signaling support
 - Whether to align with DL or not
- Evaluation should include UL specific aspects such as CM analysis according to UL waveform, etc.
- Study of frequency non-selective precoding is of higher-priority

[R1-167970](#) **WF on the antenna ports QCL in NR** Intel, LGE, Ericsson, Samsung, InterDigital, Huawei/HiSilicon
Decision: The document is noted.

Agreements:

- All physical channels and reference signals in NR are transmitted using antenna ports
- Agree as **working assumption** the following antenna port definition for NR (same as in LTE)
 - An antenna port is defined such that the channel over which a symbol on the antenna port is conveyed can be inferred from the channel over which another symbol on the same antenna port is conveyed.
- **Working assumption** – Parameters for antenna port QCL in NR includes at least **(if QCL is supported)**
 - Average gain, average delay, delay spread, Doppler shift and Doppler spread (same as in LTE)
 - Additional parameters are FFS
- FFS whether the QCL or other means can be used for UE beamforming management
- The following QCL assumptions for DM-RS antenna ports in NR are for further study
 - QCL across DM-RS antenna ports
 - All the DMRS antenna ports are QCL-ed with each other
 - Not all the DMRS antenna ports are QCL-ed with each other
 - QCL across scheduled PRBs for DM-RS antenna port
 - QCL among DM-RS antenna port groups
 - QCL of DM-RS antenna ports with antenna ports of other reference signals (RS to be defined in NR)
 - Other assumptions are not precluded
- Note: The antenna ports of demodulation reference signal (DM-RS) in NR are used to transmit at least physical data and, possibly, control channels and used at the UE for demodulation.

[R1-168272](#) **WF on QCL assumptions in NR** Huawei, HiSilicon, China Telecom, DoCoMo, CATR, Intel
Decision: The document is noted.

Possible agreements:

- No QCL by default in NR unless otherwise specified

Possible agreements:

- For the QCL assumptions and configurations, the following should be supported:
 - By default, no QCL assumptions in NR for the following cases unless otherwise indicated
 - FFS: between synchronization signals and CSI-RS (if supported)
 - between synchronization signals and DMRS (if supported)
 - By default, no QCL assumptions for antenna ports transmitted in different time occasions (e.g. different subframes or TTIs) in NR unless otherwise indicated
 - With explicit or implicit indications, NR should
 - support multiple QCL configurations
 - support flexible QCL configurations at least for the following cases:
 - FFS: Among CSI-RS ports (if supported)
 - Between different types of antenna ports
 - FFS: among other types of RS ports in addition to CSI-RS and DMRS (if supported)
 - Note: The definition of explicit indication is NR BS notifies the UE by the signaling about QCL configuration
 - Note: QCL configuration is defined as the different sets of large-scale channel properties and, in case of explicit signaling, the supporting signaling mechanism to notify the UE

Continue offline discussion until Thursday – Ming (Huawei)

[R1-168360](#) **WF on QCL assumptions & configurations in NR** Huawei, HiSilicon, China Telecom, DoCoMo, CATR, Intel

[R1-168436](#) **WF on QCL assumptions & configurations in NR** Huawei, HiSilicon, China Telecom, DoCoMo, CATR, Intel

Agreements:

- All QCL assumptions that a UE is allowed to make among antenna ports should be identified and explicitly specified
- QCL is defined as follows:
 - Two antenna ports are said to be quasi co-located if properties of the channel over which a symbol on one antenna port is conveyed can be inferred from the channel over which a symbol on the other antenna port is conveyed.
 - Future refinement on QCL definition is not precluded

[R1-168388](#) **WF on beam management** CATT, Samsung, National Instruments, ZTE

Agreements:

- Consider different channel reciprocity assumptions in beam management procedures
 - At a TRP or UE, with TX and RX channel reciprocity (full or partial) (e.g., beam reciprocity), TX beam (or RX beam) can be obtained from RX beam (or TX beam) to reduce overhead and latency
 - Without TX and RX channel reciprocity, beam management procedure may require TX and RX beam sweeping in both DL and UL links
- RAN1 study different methods of determining Tx and Rx beam(s) for communication on one link direction (uplink or downlink), e.g.,
 - Joint determination: Tx beam and Rx beam are determined jointly
 - Separate determination: Tx beam or Rx beam are determined sequentially.
 - Multi-stage determination: for instance, coarse Tx-Rx beam determination followed by fine Tx-Rx beam determination
- Study beam management procedure with and without explicit signaling of beam(s) or beam group(s) used for transmission

Aperiodic CSI

[R1-168386](#) **WF on aperiodic CSI reporting** ZTE Corporation, ZTE Microelectronics, ASTRI, Intel Corporation, Samsung, CATT

Agreements:

Study aperiodic CSI reporting in conjunction with aperiodic RS transmission:

- Dynamic indication of aperiodic RS and interference measurement resource including
 - Aperiodic RS for channel measurement for CSI reporting
 - Aperiodic interference measurement resource for interference measurement, including using non-zero/zero power RS, demodulation RS;
 - Resource pool sharing for aperiodic channel and interference measurement resources
- Study the timing requirement among aperiodic RS triggering, CSI reporting triggering, aperiodic RS transmission, and CSI reporting.
 - Timing between CSI triggering and aperiodic RS transmission X
 - Timing between aperiodic RS transmission and CSI reporting Y
 - Notes: Consider the single triggering for RS transmission and CSI reporting;
- Others are not precluded
- Note: aperiodic triggering doesn't preclude on-demand (using activate/release mechanism) triggering

Periodic CSI

[R1-168186](#) **WF on periodic and semi-persistent CSI for NR** Samsung, Ericsson, Qualcomm

Agreements:

- Support at least one of the following schemes for CSI reporting:
 - Scheme 1: periodic CSI reporting analogous to LTE
 - Scheme 2: semi-persistent CSI reporting (e.g. activate/release mechanism analogous to LTE SPS)
 - Scheme 3: aperiodic CSI reporting
 - FFS: Possible signaling support
- Strive to design NR periodic, semi-persistent, and/or aperiodic CSI reporting, considering at least following aspects
 - UL coverage
 - Required RS
 - Reporting information type
 - Forward compatibility
 - Energy efficiency
 - RS and CSI reporting overhead
- Study whether to avoid specifying dependency between CSI reports in different reporting instances
 - Such dependencies, if any, can be different for periodic, semi-persistent, and/or aperiodic CSI reporting

CSI timing

[R1-168135](#) **WF on CSI timing relationship** LG, InterDigital, Intel, Huawei

Agreements:

- Study flexible timings of RS indication/transmission for CSI measurement, CSI feedback triggering/reporting. Following aspects should be considered at least for periodic CSI (where appropriate)/aperiodic/semi-persistent CSI reporting
 - Linkage between each timing
 - Details FFS. Some non-exhaustive exemplary timing relationships include:

- Ex1) RS indication and CSI feedback triggering
- Ex2) RS indication and RS transmission
- Ex3) RS indication, RS transmission, CSI feedback triggering and CSI reporting in the same [SF]
- Signaling method for timing, if needed (if so, details)
- Feasible time gap between RS transmission and CSI reporting taking CSI computation delay/complexity, propagation delay, channel coherence time, and UL timing advance into account
- Signaling overhead needs to be taken into account
- Note: the timing above refers to layer 1 control signaling, higher-layer signaling or a combination thereof
 - Note: RS indication can be RS triggering or RS activation/deactivation, and can include RS resource configuration.
- Note: This doesn't preclude a fixed timing based RS transmission for CSI measurement, CSI feedback reporting.

RS design

[R1-168498](#) **WF on RS for CSI measurement in NR** Huawei, HiSilicon

Revision of [R1-168176](#)

Agreements:

- At least one of following RS configurations for CSI measurement are supported in NR
 - Aperiodic RS
 - Semi-persistent RS
 - Periodic RS
- Study RS pattern for CSI measurement in NR both for DL and UL
 - Study the density of RS
 - Study the position of RS in the [subframe]
 - Study the mapping of RS in one or several symbols

UE rotation

[R1-168308](#) **WF on support of rotatable UE with beamforming in NR** LG, Intel, KT, MediaTek, InterDigital, Samsung

Agreements:

- Study impacts of UE movement, rotation and/or channel/beam blockage w.r.t. following aspects
 - UE/TRP beam change
 - CSI mismatch from CSI reporting instance to data transmission instance
- Study at least the following techniques under the consideration of UE movement, rotation and/or channel/beam blockage including
 - Beam management of UE/TRP Tx/Rx beams
 - Transmission/reception techniques to provide more robustness (e.g. semi-OL MIMO transmission, beam cycling, beam broadening)

[R1-168389](#) **WF on the design of downlink control channel** ZTE Corporation, ZTE Microelectronics, Qualcomm, ASTRI, Intel Corporation

Revision of [R1-168274](#)

Agreements:

- Study the relationship of beam(s) used for L1 control channel and beam(s) used for data channel
 - E.g. Using different beamwidth for data and control
 - E.g. Using different beam directions for data and control
 - E.g. At least one beam is shared by data and control
 - E.g., same beam for data and control

[R1-168486](#) **WF on number of antenna ports for CSI-RS** Ericsson, Samsung, Verizon, Sprint, Deutsche Telekom

Agreements:

- For NR, support DL CSI measurement with X antenna ports
 - Study the values of X = 1,2,4,8,12,16,20,24,28,32
 - Study whether additional values of X are needed, including X > 32 (e.g., 64)
 - Other values of X are not precluded

[R1-168318](#) **Summary of Wednesday Offline Session on NR MIMO** **Samsung**

Decision: The document is noted.

[R1-168448](#) **Summary of Thursday Offline Session on NR MIMO** **Samsung**

[R1-168530](#) **WF on network coordination aspects** **Nokia, Samsung, Mediatek, Intel, ASB**

Agreements:

- Study to support various interference management schemes:
 - Interference management over different time scales:
 - Semi-static/preconfigured interference management
 - Dynamic interference management
 - Interference management where signals/channels from/to UE(s) is
 - Transmitted from/to multiple TRPs
 - Transmitted from/to single TRP
- The above study should consider:
 - Forward compatibility, e.g., for future introduction of additional interference management schemes (if any)
 - Low and high NR frequencies
 - Take into account backhaul/fronthaul latency constraints
 - Both TDD and FDD
 - Both data and control channels
 - Interference measurement/reporting
 - Taking into account interference management for advanced receivers
 - Taking into account various scenarios
 - Taking into account beam management, different antenna structures, etc.

[R1-168536](#) **WF on RS design principle in NR Huawei, HiSilicon**

Agreements:

- NR support NR RS configured on a per UE basis
- FFS whether or not to support always-on non-UE-specific RS in NR
 - Including the details of always-on and non-UE-specific, if supported

[R1-168529](#) **WF on scenario and channel model for NR MIMO link and system level calibration** **ZTE Corporation, ZTE Microelectronics**

[R1-166109](#) Antenna structure: impact on MIMO transmission and remaining modeling issues Huawei, HiSilicon

[R1-166211](#) Unified MIMO framework for NR above and below 6GHz ZTE Corporation, ZTE Microelectronics

[R1-166212](#) Beam selection and CSI acquisition for NR MIMO ZTE Corporation, ZTE Microelectronics

[R1-166213](#) Reference signal design for NR MIMO ZTE Corporation, ZTE Microelectronics

[R1-166214](#) Beam management for NR MIMO ZTE Corporation, ZTE Microelectronics

[R1-166215](#) Beamforming architecture for NR MIMO ZTE Corporation, ZTE Microelectronics

[R1-166216](#) Views on transmission schemes for NR MIMO ZTE Corporation, ZTE Microelectronics

[R1-166217](#) Discussion on Control Channel Design for NR MIMO ZTE Corporation, ZTE Microelectronics

[R1-166218](#) Aperiodic CSI for NR MIMO ZTE Corporation, ZTE Microelectronics

[R1-166219](#) NR beamforming with UE-group-specific beam sweeping ZTE Corporation, ZTE Microelectronics

[R1-166220](#) Beamforming design considering channel characteristics of Above 6-GHz ZTE Corporation, ZTE

Microelectronics

[R1-166380](#) Uplink MIMO transmission schemes Qualcomm Incorporated

[R1-166381](#) Reference Signals and Procedures for CSI Acquisition Qualcomm Incorporated

[R1-166382](#) CSI feedback schemes Qualcomm Incorporated

[R1-166383](#) QCL Considerations Qualcomm Incorporated

[R1-166478](#) MIMO transmission schemes for NR CATT

[R1-166479](#) CSI feedback for NR MIMO CATT

[R1-166480](#) Discussion on beam training CATT

[R1-166481](#) Reference signal design for NR MIMO CATT

[R1-166482](#) Initial evaluation results for NR MIMO CATT

[R1-166561](#) Beamforming for NR PDCCH Intel Corporation

[R1-166563](#) On the need of new QCL parameters in NR Intel Corporation

[R1-166564](#) Discussion on possible QCL and measurement assumptions for NR Intel Corporation

R1-166565	Beam management without prior beam information	Intel Corporation, Verizon Wireless
R1-166566	Beam management with prior beam information	Intel Corporation, Verizon Wireless
R1-166567	UE beamforming impact on control channel design	Intel Corporation
R1-166573	Maximum number of multiplexed layers for NR MIMO	Mitsubishi Electric Co.
R1-166574	Nonlinear precoding schemes for NR MU-MIMO	Mitsubishi Electric Co.
R1-166582	Application of compressive sensing based beam training for NR	Beijing Xinwei Telecom Techn.
R1-166583	Considerations on Beam Management for NR	Beijing Xinwei Telecom Techn.
R1-166584	Considerations on Multi-antenna Schemes for NR Control Channel Design	Beijing Xinwei Telecom Techn.
R1-166585	Multi-antenna related considerations on Initial Access	Beijing Xinwei Telecom Techn.
R1-166611	Discussion on analog beamforming for NR MIMO	Guangdong OPPO Mobile Telecom.
R1-166612	DL PHY procedure issues for multi-beam based approaches	Guangdong OPPO Mobile Telecom.
R1-166657	Views on beam management for NR	Sony
R1-166677	Discussion on CSI Acquisition for Massive MIMO in NR	Fujitsu
R1-166778	Discussions on CSI-RS design for NR MIMO	Samsung
R1-166779	Discussions on CSI reporting for NR	Samsung
R1-166780	Discussions on channel and interference measurements for NR	Samsung
R1-166781	DL MIMO for NR	Samsung
R1-166782	UL MIMO for NR	Samsung
R1-166783	Advanced CSI feedback for NR	Samsung
R1-166784	Simulation results for explicit CSI feedback for NR MIMO	Samsung
R1-166785	Discussion on TRP beamforming and beam management	Samsung
R1-166786	Discussion on CSI acquisition for multi-beam based approaches	Samsung
R1-166787	Discussion on the antenna port and QCL assumption study in NR	Samsung
R1-166789	Analog/digital/hybrid beamforming for massive MIMO	Samsung
R1-166790	Discussion on paging in NR – Multi-beam aspects	Samsung
R1-166791	Discussion on interference management based on advanced transceivers for NR	Samsung
R1-166793	Discussion on interference coordination for NR	Samsung
R1-166900	Views on NR MIMO design principle	LG Electronics
R1-166901	Discussion on CSI-RS design and CSI procedure for NR	LG Electronics
R1-166902	Discussion on reciprocity based transmission for NR MIMO	LG Electronics
R1-166903	Discussion on transmit beam coordination and QCL for NR	LG Electronics
R1-166904	Discussion on the impact of UE rotation	LG Electronics
R1-166905	Discussion on Semi-OL MIMO for NR	LG Electronics
R1-166906	Consideration on UL sounding signal design for NR	LG Electronics
R1-166907	DMRS Design Issues in NR	LG Electronics
R1-166908	Discussion on Performance Evaluation for NR DMRS	LG Electronics
R1-166909	Discussion on Common Phase Error Compensation for above 6GHz	LG Electronics
R1-166943	Discussion on CSI acquisition framework for NR	ETRI
R1-167078	Massive MIMO: Channel State Information (CSI) Acquisition in Angular Domain	Sony
R1-167111	CSI acquisition framework for NR MIMO	CMCC
R1-167112	Initial System Level Evaluation for NR MIMO	CMCC
R1-167128	Discussion on UL beam management in multi-beam operation	Intel Corporation
R1-167129	Discussion on CSI feedback for NR	Intel Corporation
R1-167130	Evaluation results of NR for above 6GHz	Intel Corporation
R1-167197	CSI acquisition mechanism for NR DL MIMO	Huawei, HiSilicon
R1-167198	Discussion on transmission schemes for NR DL MIMO	Huawei, HiSilicon
R1-167199	Evaluation of the impact of QCL assumptions and discussion on potential QCL configurations	Huawei, HiSilicon
R1-167208	Discussion on NR UL MIMO	Huawei, HiSilicon
R1-167224	Principles for Reference Signal Design and QCL Assumptions for NR	Huawei, HiSilicon
R1-167225	Interference Measurement Mechanism for Link Adaptation in NR	Huawei, HiSilicon
R1-167226	Uplink Power Control	Huawei, HiSilicon
R1-167279	On the UE beamforming in new radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-167280	Multi-Beam Common Control Plane Design	Nokia, Alcatel-Lucent Shanghai Bell, Verizon Wireless
R1-167281	Scalability of MIMO operation across NR carrier frequencies	Nokia, Alcatel-Lucent Shanghai Bell
R1-167282	Channel reciprocity support in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-167283	Coverage Enhancement Opportunities at High Carrier Frequencies	Nokia, Alcatel-Lucent Shanghai Bell, Verizon Wireless
R1-167284	CSI feedback mechanisms for multi antenna operation	Nokia, Alcatel-Lucent Shanghai Bell
R1-167285	Unified MIMO transmission mode for 5G new radio interface	Nokia, Alcatel-Lucent Shanghai Bell
R1-167286	Beam management procedures in beam based access	Nokia, Alcatel-Lucent Shanghai Bell
R1-167287	On procedures for beam selection and feedback signalling	Nokia, Alcatel-Lucent Shanghai Bell
R1-167288	On beam training based on periodic DL signals	Nokia, Alcatel-Lucent Shanghai Bell

R1-167290	Reference symbols types in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-167292	Power control for MIMO	Nokia, Alcatel-Lucent Shanghai Bell
R1-167293	Downlink network coordination for New Radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-167332	Beam-based design framework for New Radio	INTERDIGITAL COMMUNICATIONS
R1-167380	Multi-Antenna based Coverage Enhancement	NTT DOCOMO, INC.
R1-167381	CSI acquisition schemes for NR	NTT DOCOMO, INC.
R1-167382	RS structure for NR downlink transmission	NTT DOCOMO, INC.
R1-167383	Simulation results for UE beamforming	NTT DOCOMO, INC.
R1-167384	Initial Performance Investigation of Hybrid Beamforming	NTT DOCOMO, INC.
R1-167385	TDD massive MIMO for NR	NTT DOCOMO, INC.
R1-167386	Discussion on CSI acquisition scheme for Uplink MIMO transmission	NTT DOCOMO, INC.
R1-167460	Overview of CSI framework for NR	Ericsson
R1-167461	Dynamic CSI framework	Ericsson
R1-167462	Unified CSI reporting framework	Ericsson
R1-167463	Pooling of RS resources for CSI reporting	Ericsson
R1-167464	General aspects of spatial multiplexing for NR	Ericsson
R1-167465	Multi antenna transmission principles for data channels in NR	Ericsson
R1-167467	Reference signals and reports to support beam management	Ericsson
R1-167468	On DL RS for CSI measurements	Ericsson
R1-167469	On UL RS for CSI measurements	Ericsson
R1-167470	Multi-antenna aspects for DMRS design	Ericsson
R1-167471	Discussion of multi-antenna and highly directional beam-forming for unlicensed operation	Ericsson
R1-167519	Discussion on hybrid beamforming	Lenovo
R1-167520	Comparison of beam-selection and PMI-based schemes for NR MIMO	Lenovo
R1-167525	Beam Sweeping Design Issues in NR	MediaTek Inc.
R1-167543	Beam Management Considerations for above 6GHz NR	MediaTek Inc.
R1-167548	Discussion on NR beam identification information design	ITRI
R1-167571	On UL channel reciprocity for NR	InterDigital Communications
R1-167572	On CSI feedback for NR	InterDigital Communications
R1-167573	Considerations on Reference Signal Design for NR	InterDigital Communications
R1-167585	Over the Air Reciprocity Calibration and Compensation in NR MIMO	National Instruments Corp.
R1-167756	UL power control in multi-beam based approaches	ASUSTEK COMPUTER (SHANGHAI)
R1-167822	On multi-antenna schemes for New Radio	CEWiT
R1-167827	Considerations on multi-antenna scheme design for NR	China Unicom
R1-167887	Discussion on spatial multiplexing for NR	Samsung
R1-167888	Study of phase noise tracking	Intel Corporation
R1-167903	Evaluation methodology and assumptions for NR MIMO	ZTE Corporation, ZTE Microelectronics
R1-167948	WF on RS for CSI acquisition and demodulation in NR	Huawei, HiSilicon
R1-167952	WF on network coordination aspects	Nokia
R1-167997	WF on frequency selective precoding for NR UL MIMO	Samsung, Intel
R1-168175	WF on RS for beam management	Huawei
R1-168185	WF on aperiodic beam sweeping and CSI reporting	ZTE
R1-168467	WF on digital sub-system with hybrid beamforming	Nokia, Alcatel-Lucent Shanghai Bell

8.1.6 Aspects related to initial access and mobility

Discuss PHY layer aspects related to initial access and mobility, considering beamforming aspects, for standalone and non-standalone operation

[R1-167055](#) Overview on initial access and mobility Ericsson

The document was presented by Asbjorn Grovlen from Ericsson.

- Proposal 1: The initial time synchronization is provided by the Synchronization Signal(synchronization signal) where identical synchronization signal can be transmitted by multiple transmission points.
- Proposal 2: Target 100 ms periodicity for the synchronization signal and system information to limit the always-on signals for forward compatibility and lower energy consumption.
- Proposal 3: Idle-mode mobility measurements are based on the synchronization signals used for initial access.
- Proposal 4: Connected mode mobility measurements are based on specific reference signal unrelated to the synchronization signals used for initial access and idle mode mobility.
- Proposal 5: The reference signals for connected mode mobility can be configured that can be configured on a per-need basis

Decision: The document is noted.

[R1-167294](#) Basic Principles for Initial Access and Mobility Nokia, Alcatel-Lucent Shanghai Bell, Verizon Wireless

The document was presented by Mihai Enescu from Nokia.

- Proposal 1: Periodic synchronization signal(s) are needed for initial search and synchronization.
- Proposal 2: Signal structure used for initial search signal should be common both in single-beam and multi-beam operation.
- Proposal 3: Default numerology is used for synchronization signals (per frequency band).
- Observation 1: Tens to hundreds of beams per cell which needs to be uniquely identifiable by the UEs.
- Observation 2: Hierarchical beam identification structure is needed.
- Observation 3: Synchronization signal needed for beam synchronization.
- Observation 4: Synchronization signal can convey ID that is used as basis to derive beam reference signal for the cell.
- Proposal 4: Physical broadcast channel needs to be defined to deliver essential system information.
- Proposal 5: PBCH should support both single-beam and multi-beam operation.
- Proposal 6: Random access procedure should support both single-beam and multi-beam operation.
- Proposal 7: Default numerology applied for the signals and channels in random access procedure.
- Proposal 8: Periodical downlink beam reference signals are basis for downlink based mobility.
- Proposal 9: Define a periodical discovery signal comprising synchronization signal(s), beam reference signals and physical broadcast channel transmitted by a cell.
- Observation 6: UL signal for UL based mobility may be used triggering downlink mobility measurements.
- Observation 7: UL based mobility likely more feasible at lower carrier frequencies than higher carrier frequencies where UE uses directional transmissions instead of omni-directional.

Decision: The document is noted.

R1-167912 Discussion on initial access and mobility for NR NTT DOCOMO, INC.

The document was presented by Hiroki Harada from NTT DOCOMO.

- Proposal 1: RAN1 should study synchronization signal (SS) design for eMBB/URLLC.
 - Different design of SS for mMTC can be considered and introduced (if necessary) later.
- Proposal 2: NR should support multiple SS numerologies for different frequency bands and different synchronization accuracy requirements.
- Proposal 3: NR should support both single-beam based and multi-beam based approaches for SS transmission.
 - Target number of beams for SS transmission and corresponding resource mapping design should be studied.
- Observation 1: SS transmission periodicity for standalone NR carrier should be short (e.g., 5 or 10 ms) while SS transmission periodicity for non-standalone NR carrier can be longer (including possibility of no transmission) by using assistance from other NR or LTE carrier.
- Proposal 4: Only essential system information required for standalone initial access is transmitted in MIB (and SIB) as always-on signal and other system information can be provided on-demand after random access.
- Proposal 5: Design of identity parameter used for SS generation and MIB decoding should not limit NR deployment flexibility.
- Proposal 6: DL-based measurement should be assumed as baseline for UE controlled mobility.

Decision: The document is noted.

R1-167944 WF on NR initial access NTT DOCOMO, Nokia, ASB, Ericsson

The document was presented by Hiroki Harada from NTT DOCOMO.

- RAN1 should strive for a common framework, including for example structure of synchronization signals, for initial access
- More specifically, especially within a given frequency range, RAN1 should strive for a common framework covering
 - Single beam based and multi-beam based deployments
 - TDD and FDD operations
 - Different/mixed numerologies
 - Standalone and non-standalone operations
 - Licensed band and unlicensed band operations
- RAN1 should take following requirements into account to design synchronization signal(s) and essential system information for initial access
 - Providing at least following functionalities
 - Detection of NR cell and its ID
 - Initial time/frequency synchronization to the cell
 - Providing necessary information for random access
 - Providing sufficient number of identity parameters to allow deployment flexibility

Decision: The document is noted and modified as follows:

Agreements:

- RAN1 should strive for a common framework, including for example structure of synchronization signals, for initial access
- More specifically, especially within a group of frequency bands in the frequency range, RAN1 should strive for an unified framework covering

- Single beam based and multi-beam based deployments
- TDD and FDD operations
- Different/mixed numerologies
- Standalone and non-standalone operations
- Licensed band and unlicensed band operations
- FFS: mMTC use case
- RAN1 should take at least following requirements into account to design initial access
 - Providing at least following functionalities
 - Detection of NR cell and its ID
 - Note: In this context, NR cell corresponds one or multiple TRP(s)
 - Initial time/frequency synchronization to the cell
 - Providing necessary information for random access
 - Providing sufficient number of the identity values to allow deployment flexibility
 - FFS: supporting efficient mobility
 - FFS: supporting efficient inter-RAT measurement
 - Reducing the frequency hypothesis UE needs to search for compared to LTE
 - FFS: detecting beam ID(s)

R1-167957 WF on evaluation assumptions for initial access in NR Intel Corporation

The document was presented by Gregory Morozov from Intel.

Discussion: Huawei requested more time for detailed review.

Decision: The document is noted. Continue offline discussion until Tuesday – (Intel)

Tuesday: Evaluation assumptions have been revised in [R1-168107](#) and **agreed in R1-168162**.

Continue offline discussion until Wednesday – (Intel)

Wednesday: Evaluation assumptions have been revised in [R1-168239](#), all brackets removed and **agreed in R1-168255** by adding the following note in PHY abstraction: “Proponents are allowed to provide PHY abstraction details if used”

Note that [R1-168255](#) supersedes the previously agreed [R1-168162](#).

Thursday

R1-168481 WF on evaluation assumptions for initial access in NR Intel

Agreed in R1-168493 with following updates in channel model

- CDL-C for 4 and 30GHz, CDL-D for 70 GHz (other CDL models are not precluded),

RACH procedure

R1-168124 WF on RACH procedure for NR NTT DOCOMO, Ericsson, Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by Kazuaki Takeda from NTT DOCOMO.

- RACH procedure including RACH preamble (Msg. 1), random access response (Msg. 2), message 3, and message 4 is at least assumed for NR from RAN1 perspective
- Simplified RACH procedure, e.g., Msg. 1 (UL) and Msg. 2 (DL), should be further studied
 - Details on Msg. 1 and Msg. 2 are FFS
- The design of the random access procedure should take into account the possible use of multi-beam DL and multi-beam UL as well as multi-beam DL and single-beam UL
- In case that beam-forming is applied to DL broadcast channels/signals for initial access, association between DL broadcast channels/signals detected by UE for initial access and RACH resource is considered.
 - FFS: Details on association in the context of multi-beam DL - multi-beam UL and multi-beam DL - single-beam UL
- Multiple occasions for RACH preamble transmission in a given time interval is supported
 - FFS: Details on time interval
- Allow for RACH reception/RAR transmission in TRPs other than the one transmitting synchronization signals

Decision: The document is noted. Continue offline discussion until Wednesday – (NTT DOCOMO)

R1-168104 WF on NR multi beam initial access ZTE

The document was presented by Patrick Svedman from ZTE.

- RAN1 should study multi-beam based approaches to enable beamforming gain in each initial access step, considering:
 - Non Rx/Tx reciprocity at BS or UE
 - Full or partial Rx/Tx reciprocity at BS or UE
- RAN1 should strive for a unified initial access framework for different reciprocity cases.

Discussion: Also supported by InterDigital.

Decision: The document is noted. Continue offline discussion until Wednesday – (ZTE)

R1-168260 WF on RACH procedure for NR NTT DOCOMO, ZTE, CATT, Samsung

Decision: The document is noted.

Agreements:

- RACH procedure including RACH preamble (Msg. 1), random access response (Msg. 2), message 3, and message 4 is at least assumed for NR from RAN1 perspective
- Simplified RACH procedure, e.g., Msg. 1 (UL) and Msg. 2 (DL), should be further studied
 - Details on Msg. 1 and Msg. 2 are FFS
 - Study should include comparison with the above procedure (first bullet)
- The design of the random access procedure should take into account the possible use of single-beam and multiple beam operations, including
 - Non Rx/Tx reciprocity at BS or UE
 - Full or partial Rx/Tx reciprocity at BS or UE
- In case that multiple beam-forming is applied to DL broadcast channels/signals for initial access,
 - RACH resource is obtained by UE from detected DL broadcast channels/signals
 - FFS: Details on association
 - Other mechanism w/o association is also considered
- Multiple occasions for RACH preamble transmission in a given time interval are considered
 - Details are FFS
 - Other mechanism is not precluded
- Study further RACH reception/RAR transmission in TRPs/beams other than the one transmitting synchronization signals

About RACH, continue offline discussion until Thursday focusing on evaluation assumptions and signal design – Patrick (ZTE), Kazuaki, (DOCOMO), Seunghee (Intel), Hyunseok (Samsung)

Thursday

R1-168390 **WF on Link Level Evaluation Assumptions for RACH Preamble** **NTT DOCOMO**

Agreed in R1-168492 with following updates in channel model

- CDL-C for 4 and 30GHz, CDL-D for 70 GHz (other CDL models are not precluded),

R1-168127 **WF on RRM measurement in NRELG Electronics, NTT DoCoMo**

- For RRM measurement in NR, DL measurement is supported at least for idle mode UE with the consideration on
 - Both single-beam based operation and multi-beam operation
- FFS: Definition of RRM measurement for multi-beam based operation
- FFS: DL signal for RRM measurement in idle mode

Decision: The document is noted.

R1-166393 High speed mobility performance evaluations Qualcomm Incorporated

- Observation 1: For RRC inactive state, in mobility challenging scenario, DL based mobility can have high paging miss probability
- Observation 2: For RRC inactive state, in mobility challenging scenario, paging missing probability for DL based mobility can be improved at the expense of UE power consumption increase, e.g. more frequent and longer cell-search
- Observation 3: For RRC inactive state, in mobility challenging scenario, UL based mobility can still provide reliable paging because of fast closed-loop L1 handshake at each DRX wakeup (i.e., UE transmitting a reference signal and Network sending back a response signal)
- Observation 4: For RRC inactive state, in mobility challenging scenario, UL based mobility can provide better paging reliability and UE power consumption tradeoff, compared to DL based mobility
- Our proposals are as follows
- Proposal 1: NR shall support UL-based mobility in which UE transmits reference signals and RAN determines a mobility event based on measurements of reference signals of UE's.
- Proposal 2: NR shall consider supporting hybrid/dynamic DL-based and UL-based mobility
- Proposal 3: Evaluate mobility performance. Following are the proposed KPIs.
 - RRC inactive state (similar to LTE_IDLE)
 - Paging-miss rate
 - Call-setup delay (i.e., number of consecutive Network paging miss before UE establishes a connection)
 - Network paging resource utilization (e.g., number of TRPs involved in paging a UE)
 - UE (intra-frequency) cell-search rate (relates to UE power consumption.)
 - Comparative UE power consumption analysis
 - RRC connected state (similar to LTE RRC_CONNECTED)
 - Handover-failure rate
 - Mobility interruption time
 - User experience during the HO

Decision: The document is noted.

Agreements (made on Wednesday further to offline discussions refining [R1-168127](#)):

- For RRM measurement in NR, at least DL measurement is supported with the consideration on
 - Both single-beam based operation and multi-beam based operation
- FFS: Definition of RRM measurement for multi-beam based operation
- FFS: DL signal for RRM measurement
- FFS: When DL measurement is applied
- Note that there is no conclusion that DL measurement is a complete solution for RRM measurement in NR for now

[R1-168137](#) WF on RRM Measurement and Mobility Huawei, HiSilicon, Qualcomm

- For RRM measurement and mobility in NR, the following should be supported:
 - UL measurement can be used for:
 - L1/L2 based intra NR cell TRP mobility
 - L3 based inter NR cell mobility
 - UL signals used for UL measurement includes:
 - At least an energy-efficient UE-specific UL tracking signals
 - DL measurement can be used for
 - intra NR cell TRP mobility and DL beam management
 - NR cell reselection

Note: In this context, NR cell corresponds to one or multiple TRP(s)

Decision: The document is noted.

Conclusions:

- For RRM measurement and mobility in NR, RAN1 needs to study DL and UL based measurements considering following RAN2 study
 - RRC driven at 'cell' level
 - Zero/Minimum RRC involvement (e.g. at MAC /PHY)
 - FFS what is the definition of a cell

Continue offline discussion about the detailed evaluation assumptions until Wednesday – (Huawei, Qualcomm)

Wednesday

R1-168464	Evaluation Scenarios and Assumptions for DL and UL Mobility	Qualcomm, Huawei
R1-168488	Evaluation Scenarios and Assumptions for DL and UL Mobility	Qualcomm Incorporated, Huawei,
Intel		

[R1-166795](#) Discussion on numerology aspects of NR synchronization signal Samsung

Decision: The document is noted. Continue offline discussion about SS numerology – Samsung

[R1-168277](#) WF on numerology for synchronization signals in NR Samsung, ETRI, CATT, NTT DOCOMO, Ericsson

Agreements:

- For subcarrier spacing of each synchronization signal (e.g. NR PSS,SSS) in a NR carrier, the following alternatives should be studied
 - Alt 1: Subcarrier spacing is predefined in the specification for a given frequency range
 - Ex: 15kHz for sub-6GHz, 60kHz for over-6GHz
 - Note that there are more than one frequency ranges
 - Alt 2: Subcarrier spacing is selected by NR BS
 - FFS: Details on the set of possible numerologies
 - Note: Blind detection of multiple numerologies can be considered
 - Alt 3: Single subcarrier spacing is predefined in the specification for all frequency ranges
 - Other alternatives are not precluded
- NR synchronization signal is based on CP-OFDM
 - Note that DFT-spread-OFDM based design is not precluded

[R1-166387](#) Uplink based mobility physical channels Qualcomm Incorporated

Decision: The document is noted.

[R1-167059](#) On the random access procedure Ericsson

The document was presented by Asbjorn Grovlen from Ericsson.

- Proposal 1: NR should support a four message random access procedure in order to support larger distances between UE and TRP

- Proposal 2: Study additional two step random access procedure to reduce the delay of accessing the network
- Proposal 3: If synchronization signals are beamformed, an association between SS and PRACH preambles should be supported.

Decision: The document is noted.

R1-167378 RACH procedures for NR NTT DOCOMO, INC.

The document was presented by Hiroki Harada from NTT DOCOMO.

- Proposal 1: The RACH procedure involving a transmission/reception of RACH preamble, RAR, message 3 and message 4 is at least supported for NR.
- Proposal 2: The simplified RACH procedure including only RACH preamble (and UL control channel/data) and RAR should be further considered.
- Proposal 3: Association between RACH resource and beam index should be considered to support efficient multi-beam operation for RACH procedure.

Decision: The document is noted.

R1-166799 Random access in NR considering flexible UE channel bandwidth Samsung

The document was presented by ... from Samsung.

- Requirements to support different UE bandwidths on the same NR carrier
 - In order to support UEs with different bandwidth capabilities on the same NR carrier, PRACH bandwidth should be larger than or equal to minimum supported UE bandwidth.
 - The NR-PDCCH for RAR and RAR should be transmitted by NR-BS over bandwidth less than or equal to channel bandwidth of UE.
 - The NR-PDCCH for MSG3 retransmission should be transmitted by NR-BS over bandwidth less than or equal to channel bandwidth of UE. Resources for MSG3 transmission should be allocated to UE over bandwidth less than or equal to channel bandwidth of UE.
 - The NR-PDCCH for MSG4 (re)transmissions should be transmitted by NR-BS over bandwidth less than or equal to channel bandwidth of UE. Resources for MSG4 transmission should be allocated to UE over bandwidth less than or equal to channel bandwidth of UE.
- Proposal: The RACH-related signals and channels should be designed to take a benefit from various bandwidth values that NR UEs may support.

Decision: The document is noted.

R1-168091 WF on carrier bandwidth for initial access in NR Mediatek

- The synchronization channel and at least some essential system information are restricted within a certain specified bandwidth.
 - The specified bandwidth may depend on the range of the frequency bands.
 - The specified bandwidth is not larger than the minimum system bandwidth to be supported in the corresponding frequency bands
 - e.g., the specified bandwidth can be 5MHz, 20Mhz, 80Mhz depending on the range of frequency bands.
- FFS: mMTC case
- FFS: uplink bandwidth for RACH.

Decision: The document is noted. Continue offline discussion within Wednesday

Wednesday

R1-168299 WF on carrier bandwidth for initial access in NR MediaTek, SierraWireless

- The synchronization channel and at least some essential system information are restricted within a set of specified frequency resources.
- A set of specified frequency resources may depend on the range of the frequency bands and the numerology.
 - FFS: a set of frequency resources
- FFS: whether the used frequency resource is blindly detected by UE from a set of specified frequency resources or set by default according to the frequency bands.

Discussion: FFS: uplink bandwidth for RACH.

Decision: The document is noted. Continue offline discussion until Thursday

Thursday

R1-168397 WF on carrier bandwidth for initial access in NR MediaTek

R1-168483 WF on carrier bandwidth for initial access in NR MediaTek, Intel

Agreements:

- At least one transmission bandwidth within a carrier bandwidth can be specified for transmission of each synchronization signal and at least some essential system information.
 - The transmission bandwidth may be specified either differently according to the frequency range or the same across the frequency ranges

- FFS: transmission bandwidths for each synchronization signal and at least some system information are same or not
- FFS: the transmission bandwidth and the corresponding numerology
- FFS: whether the used transmission bandwidth is blindly detected by UE from specified bandwidths according to the frequency bands

[R1-168463](#) **Way forward on initial access for NR** **LG Electronics, NTT DOCOMO**

Also supported by Mitsubishi, ZTE

[R1-168512](#) **Way forward on initial access for NR** **LG Electronics, NTT DOCOMO, Panasonic, ETRI**

Agreements:

- In order for the transmission of the information required for the initial access (e.g. configuration of random access resource), at least following options are to be studied:
 - Note: the above information can consist of multiple parts, and different option below can be applied for the transmission of each part
 - Opt 1: the transmission is scheduled by dynamic signaling (e.g. control channel)
 - Opt 2: the transmission is scheduled by semi-static signaling (e.g. via the previous part)
 - Opt 3: the transmission is done alone without associated signaling (e.g. predefined in spec)
- In the above study, at least following aspects should be considered:
 - Resource flexibility (e.g. in terms of ensuring forward compatibility, dynamic TDD operation)
 - Resource overhead
 - UE complexity (e.g. involved with decoding of the information)

[R1-168494](#) **WF on sync and carrier raster** **Huawei, HiSilicon, Qualcomm, Nokia, Alcatel-Lucent Shanghai Bell, NTT Docomo, Ericsson, ETRI, InterDigital**

Email approval until Sept 1st to inform RAN2 on the current RAN1 agreements and WA

[R1-166088](#) Access mechanism for beam based approach Huawei, HiSilicon
[R1-166107](#) Synchronization and initial access mechanism in NR Huawei, HiSilicon
[R1-166114](#) Low frequency assisted high frequency operation Huawei, HiSilicon
[R1-166222](#) Evaluation and analysis on coverage issue of initial access for NR above 6GHz ZTE Corporation, ZTE Microelectronics
[R1-166228](#) Beam control operation for common channels/signals in NR Mitsubishi Electric Co.
[R1-166384](#) Initial access consideration for mmW Qualcomm Incorporated
[R1-166385](#) Initial access consideration for NR sub6GHz Qualcomm Incorporated
[R1-166386](#) DL and UL based mobility procedures Qualcomm Incorporated
[R1-166387](#) Uplink based mobility physical channels Qualcomm Incorporated
[R1-166389](#) Beam management for NR Qualcomm Incorporated
[R1-166417](#) Overview of NR initial access ZTE
[R1-166418](#) Design considerations for DL sweeping time interval in NR ZTE
[R1-166419](#) Beamformed random access in NR ZTE
[R1-166420](#) Performance analysis of cell search in NR ZTE
[R1-166421](#) Multi-TRP aspects of random access ZTE
[R1-166422](#) Unified synchronization structure ZTE
[R1-166483](#) NR Initial Access and Mobility Management CATT
[R1-166586](#) Considerations on Initial Access Design Beijing Xinwei Telecom Techn.
[R1-166639](#) Discussion on initial access and mobility for NR standalone cell NEC
[R1-166653](#) Consideration on synchronization for NR Sony
[R1-166658](#) On RRM measurement for NR Sony
[R1-166678](#) Discussion on initial access in NR Fujitsu
[R1-166794](#) Network topology and system operation for NR Samsung
[R1-166796](#) Overview on issues for NR initial access Samsung
[R1-166797](#) Coverage enhancement of broadcasting channels/signals Samsung
[R1-166798](#) PHY initial access procedure for multi-/single-beam based approaches Samsung
[R1-166910](#) Discussion on DL Synchronization in NR LG Electronics
[R1-166911](#) Discussion on PRACH preamble design and RACH procedure for NR LG Electronics
[R1-166912](#) Discussion on Coverage Enhancement with Multi-beam LG Electronics
[R1-166913](#) RRM measurement and beam procedure in NR LG Electronics

R1-166944	Band-agnostic initial access for NR	ETRI
R1-166945	Aspects related to RRM measurements	ETRI
R1-166946	Aspects related to system informations	ETRI
R1-166947	Beam sweeping for initial access	ETRI
R1-166948	Transmission of synchronization signal on demand	ETRI
R1-166949	Band-agnostic synchronization and cell search	ETRI
R1-167028	Sync and beam acquisition procedure in multi-beam based approach	KT Corp.
R1-167056	Idle mode operation and initial access	Ericsson
R1-167057	Connected mode mobility	Ericsson
R1-167058	On PRACH preamble design	Ericsson
R1-167060	On NR random-access response design	Ericsson
R1-167113	Link level evaluation for single-beam based and multi-beam based initial access	CMCC
R1-167114	Gradual UE-Specific (GUS) initial access and multi-beam-based mobility management	CMCC
R1-167115	Discussion on beam sweeping for Initial Access	CMCC
R1-167200	RRM Measurement for NR	Huawei, HiSilicon
R1-167205	UE-cell-center-like design principles and tracking signal design	Huawei, HiSilicon
R1-167217	A common synchronization signal for a NR carrier supporting different numerologies	Huawei, HiSilicon
R1-167222	Discussion on Multiple Access and Channel Multiplexing for High Frequency	Huawei, HiSilicon
R1-167295	Radio resource management in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-167296	Random access principles for New Radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-167333	Random access aspects for beam-based NR initial access	INTERDIGITAL COMMUNICATIONS
R1-167377	Design for RACH preamble for NR	NTT DOCOMO, INC.
R1-167526	Considerations for Synchronization Signals Design in NR Beamformed Initial Access	MediaTek Inc.
R1-167542	Discussion on initial access for NR	MediaTek Inc.
R1-167574	On beam-based initial access for NR	InterDigital Communications
R1-167631	Cell detection and mobility measurement in NR	Motorola Mobility
R1-167672	Synchronization in NR considering beam sweeping	ASUSTEK COMPUTER (SHANGHAI)
R1-167704	On NR Initial Access and Mobility	Intel Corporation
R1-167705	Design on NR DL Synchronization	Intel Corporation
R1-167706	Simulation assumptions and scenarios for NR initial access	Intel Corporation
R1-167707	Initial performance evaluation of different beamforming options for NR synchronization signals	Intel Corporation
R1-167741	Discussion on System Information Acquisition	III
R1-167772	Localization-Assisted Mobility Support for NR Vehicular Communication	National Taiwan University
R1-167801	Discussion on reference signal design for HF-NR	National Taiwan University
R1-167840	Discussion on Beamforming Initial Access Operations	Convida Wireless LLC
R1-167847	Discussion on Sync Signals Supporting Different Numerologies	Convida Wireless LLC

8.1.7 Remaining details on evaluation and scenarios for new radio interface

Focus on general evaluation assumptions and scenarios including newly introduced scenarios, e.g., satellite, air-to-ground communications. Discuss other evaluation assumptions related to each technique under each A.I.

[R1-168419](#) Chairman's notes of AI 8.1.7 on remaining details on evaluation and scenarios for NR chair (Qualcomm) Ad-Hoc

The document was presented by Wanshi Chen from Qualcomm.

Decision: The document is endorsed and incorporated as follows.

R1-166112	Simulation assumptions on URLLC	Huawei, HiSilicon
R1-166398	URLLC system level simulation assumptions	Qualcomm Incorporated
R1-166484	Discussions on KPI and evaluation configuration for URLLC	CATT
R1-167298	Remaining details on URLLC assumptions	Nokia, Alcatel-Lucent Shanghai Bell
R1-166394	mMTC system level simulation assumptions	Qualcomm Incorporated
R1-167539	Discussion on the channel model for mMTC SLS evaluation	MediaTek Inc.
R1-166396	Extreme long range evaluation assumptions and methodologies	Qualcomm Incorporated
R1-166599	Measurements of Extreme Rural Scenarios	Telstra Corporation Limited
R1-166915	High level view on the study for eV2X	LG Electronics
R1-166916	Remaining issues on the evaluation assumptions for eV2X	LG Electronics
R1-167942	WF on coexistence between NR sidelink and LTE sidelink	LG Electronics, Huawei, HiSilicon, Deutsche Telekom

Conclusion:

- This topic as in [R1-167942](#) is to be revisited next meeting (after V2V WI, expected to be finished this meeting)

[R1-167943](#)
HiSilicon

WF on remaining evaluation assumptions for eV2X

LG Electronics, Deutsche Telekom, Huawei,

Proposal:

- The performance metric agreed in the email discussion [85-15] is captured in TR38.802
- The specific numbers of traffic model, inter-RSU distance, and UE distribution are by the agreed values in the TR 38.913. These values can be further updated modified, after SA1 input.
- Following the agreement in the SLS evaluation assumptions of rural and urban macro, [TBD for TDD] is removed in BS Tx power part for SLS evaluation assumptions of eV2X
- For the in-band emission modeling, RAN1 needs to study the impact of in-band emission and proper modeling for it for NR sidelink operations.
- For the LLS evaluation assumptions for eV2X, those in LTE V2X described in TR38.885 could be reused as start point, and updated if NR study has new proposals
 - Target frequency can be revisited

Further discussion offline

[R1-167931](#)

WF on performance metric for V2X NR

Ericsson, LGE

Agreement:

- For the two alternatives as part of the RAN1#85 email discussion [85-15], the following is agreed:
 - Alt. 2: (1-Y) is the packet reception ratio calculated on a subset of UEs:
 - For one Tx packet, 1-Y is calculated by S/Z , where Z is the number of UEs in the intended set of receivers, and S is the number of UE with successful reception among Z.
 - Unicast is the special case where Z includes a single UE, where the PRR is average of packets of the unicast link

[R1-167932](#)

WF on system level simulations for V2X NR

Ericsson

Proposal:

- Add 63GHz carrier frequency with 1GHz bandwidth (63-64GHz) for UE-UE and for UE-RSU [1]
- FFS UE-UE and UE-RSU channel models at 63GHz
- 40dBm e.i.r.p. Tx power limitation at 63GHz
- Revise the assumptions on RSU antenna pattern.
 - 4 antenna arrays with 2 elements each
 - The arrays point to the 4 streets in the intersection
 - Each antenna element irradiates with halfspherical uniform distribution over a 90deg azimuth angle
 - Antenna gain = 9dBi
- Slide 5 of [R1-167932](#)

Discuss further offline

[R1-166110](#)

On building material distribution modeling and indoor user ratio modeling

Huawei, HiSilicon

[R1-167387](#)

Remaining details of the dense urban scenario

NTT DOCOMO, INC.

Proposal: Regarding TRP dropping:

- Option 1 in Table II of [R1-167387](#) is used for 4GHz case.
- Option 3 in Table II of [R1-167387](#) is used for 30GHz case.
- Modelling of coverage enhancement schemes, e.g., using the multi-beam based transmission shall be considered, at least for 30 GHz case, in order to perform the macro-layer/micro-layer cell association.

Further discussion offline

[R1-167553](#)

On max EIRP values

Ericsson

Agreement:

- Remove the brackets for urban macro scenario to set the EIRP limit to 78 dBm
- In dense urban scenario, set the EIRP limit to 73 dBm and 68 dBm for the macro and micro layers respectively
- In indoor open office scenarios, set the EIRP limit to 58 dBm

[R1-167576](#)

UE Transceiver Architecture and Noise Figure Assumptions for NR with Frequencies Above 6 GHz

Straight Path Communications, Qorvo

[R1-167876](#)

High speed train scenario for RRH and relay at 30GHz: scenario and CDL-D descriptions

Mitsubishi

Electric

Revision of [R1-166937](#)

[R1-167792](#) **Battery Assumptions for NR** **u-blox AG, Sony**
[R1-166885](#) **Evaluation assumptions for flexible duplex operation** **LG Electronics**

[R1-168125](#) **Offline discussion summary** **NTT DoCoMo**

Conclusion:

- The green parts in [R1-168125](#) are endorsed
- Table A.2.1-1, 2, 3, cell E11, is endorsed with the following updates:
 - NOTE1: See Appendix for the derivation of maximum allowed EIRP ([R1-164383](#), [R1-167553](#)).

[R1-168121](#) **Way Forward on O2I Penetration Loss Model Mix for NR Evaluation** **Straight Path, Ericsson,**
Samsung, Nokia, ASB, LGE, Huawei

Agreements:

- The following mix of O2I penetration loss models should be evaluated for high frequency for NR:
 - For Urban Micro and Urban Macro
 - Option1
 - Low loss model – 80%
 - High-loss model – 20%
 - Option2
 - Low loss model – 50%
 - High-loss model – 50%
 - Other mix ratio(s) is not precluded.

[R1-168053](#) **WF on scenarios and evaluation assumptions for flexible duplex** **LG Electronics, Huawei, HiSilicon**

Agreement:

- The WF in [R1-168053](#) is agreed, with the following updates:
 - Channel model:
 - Current entries are used as a starting point
 - Can further discussion whether or not to update the channel model
 - Traffic model
 - Add optional DL/UL ratio of 1:1
 - Add one more packet size of 2Mbytes
 - Add “other FTP model is not precluded”
 - UE receive noise figure:
 - Update according to last meeting’s agreements on the noise figures (i.e., 10dB vs. 13dB)
 - Layout
 - Add: FFS other cluster dropping models for dense Urban

[R1-168391](#) **Offline dicussion updated sumary of evaluation assumptions for NR NTT DOCOMO, INC.**

Agreement: The green entries in the attached spreadsheet in [R1-168391](#) are agreed

[R1-168371](#) **WF on URLLC evaluation parameter and LLS method** **Huawei, HiSilicon, CATR**

Agreements:

- Slide 3 and slide 4 in [R1-168371](#) are agreed
- Slide 5 in [R1-168371](#) is agreed, with the following updates:
 - From “Companies report delay assumption, e.g., processing delay, transmission delay, re-transmission delay.”
 - To “Companies report delay assumptions according to Table 1 in [R1-166485](#)”. For calibration purpose only, the entries 1.1 and 1.4 of the Table 1 are assumed to be zero. In addition, each company reports the max number of HARQ re-transmissions.

[R1-168441](#) **WF on URLLC Evaluation Scenarios** **Intel, Ericsson, Qualcomm Inc.**

Agreements:

- From RAN1 perspective, the following scenarios are used as a starting point for initial URLLC evaluations
 - Indoor Hotspot scenario

- Urban Macro scenario

[R1-168343](#) Extreme Long Range KPI Evaluation Qualcomm Incorporated, Ericsson, Huawei

[R1-168174](#) WF on CDL-D model for high speed train scenario at 30GHz for RRH and relay Mitsubishi Electric, ETRI, Ericsson

Agreement: Slide 3 in [R1-168174](#) is agreed

[R1-168398](#) WF on URLLC System Capacity Definition Clarification Intel, Qualcomm Inc.

Agreements:

- System level evaluation method is used for URLLC system capacity study to analyze impact from inter-cell interference, queueing and scheduling latency, multiplexing with other services
- URLLC system capacity is calculated as follows:
 - $C(L, R)$ is the maximum offered cell load under which $Y\%$ of UEs in a cell operate with target link reliability R under L latency bound
 - $X = (100 - Y)\%$ is the percentage of UEs in outage
 - A UE in outage is defined as the UE can not meet latency L and link reliability R bound
 - Companies report their assumption on X
- Note: definition of latency L and target link reliability R is provided in [R1-168371](#)

[R1-168372](#) WF on channel model issues for flexible duplex evaluation Huawei, HiSilicon, Intel

Agreement:

- Slide 2 in [R1-168372](#) is agreed with the following update:
 - The following assumption is used as starting point for flexible duplex evaluation, and further update might be made ~~after more measurements are available~~.

[R1-168373](#) WF on penetration issues for flexible duplex evaluation Huawei, HiSilicon, LG Electronics

Agreement:

- [R1-168373](#) is agreed with the following update:
 - The following assumption is used as starting point for flexible duplex evaluation, and further update might be made ~~after more measurements are available~~.

[R1-168370](#) WF on Modeling Line-of-Sight Blockage for V2V Huawei, HiSilicon, Volkswagen, Ericsson, General Motors, Vodafone
Continue discussion next meeting

[R1-168547](#) Offline discussion further updated summary of evaluation assumptions for NR NTT DOCOMO

Agreement: The green entries and F14 in the spreadsheet attached in [R1-168547](#) are agreed.

[R1-168510](#) WF on SLS evaluation methodologies for MA LG Electronics, ZTE, ZTE Microelectronics

Agreements: Slide 4 and slide 5 are agreed except the cell “packet size” and “Target packet drop rate”

Email discussion on the two options of the packet size and clarification on Target packet drop rate as listed in [R1-168510](#) until 9/1 – (NTT DOCOMO)

[R1-168485](#) Battery Lifetime Model for NR Sony, u-blox, Sierra Wireless

Email discussion on battery lifetime model in [R1-168485](#) until next meeting – (SONY)

Traffic model for urban coverage for massive connection (UL) (column I and row 21 in the excel sheet) was also discussed based on the draft papers. However, no consensus has been reached on.

Email discussion on traffic model for urban coverage for massive connection (UL) (until 9/15) – (Huawei)

[R1-168517](#) WF on Battery Life Evaluation Methodology for mMTC Qualcomm Inc.

Discuss discussion next meeting

[R1-168543](#) Pathloss calibration between companies Qualcomm Inc.
Email discussion for path loss calibration for 3D UMa at carrier frequency of 700 MHz until 9/9 – (Qualcomm)

[R1-168473](#) WF on evaluation assumptions related to outdoor micro cell TRP ZTE Corporation, ZTE
Microelectronics, Intel Corporation, Samsung, NTT DOCOMO

[R1-168537](#) WF on Dense Urban Scenarios Samsung, Ericsson, Intel, Nokia, ASB, AT&T, CMCC, Softbank,
Verizon, KT, Vodafone, Deutsche Telecom

- Include the 30GHz band in the macro layer for the carrier frequency of dense urban scenario in Table A.2.1-1 in TR38.802.

Decision: The document is noted. Continue discussion next meeting

[R1-168421](#) WF on Indoor TRP Configuration NTT DOCOMO, CATT, Ericsson, Intel
Email discussion on [R1-168421](#) till 9/2 – (NTT DOCOMO)

[R1-166485](#) Discussions on evaluation methodology for URLLC CATT
[R1-166802](#) Dense urban evaluation assumption and results Samsung

[R1-166113](#) On scenarios and evaluation method of eV2X Huawei, HiSilicon
[R1-166390](#) Updated sub6 DL full-buffer KPI evaluation for eMBB Qualcomm Incorporated
[R1-166391](#) Updated sub6 UL full-buffer KPI evaluation for eMBB Qualcomm Incorporated
[R1-166395](#) URLLC system capacity and URLLC-eMBB multiplexing efficiency analysis Qualcomm Incorporated
[R1-166397](#) Sub6 DL bursty traffic evaluation for eMBB Qualcomm Incorporated
[R1-166423](#) Evaluation assumptions for URLLC ZTE
[R1-166568](#) Comparison of different TRP antenna option for indoor deployment Intel Corporation
[R1-166569](#) Remaining issues of evaluation assumptions for URLLC Intel Corporation
[R1-166681](#) Traffic Model assumptions for mMTC Battery Life and Latency Evaluation Sierra Wireless, S.A.
[R1-166800](#) Remaining issues for URLLC evaluation assumptions Samsung
[R1-166801](#) TRP density and antenna modeling for indoor hotspot Samsung
[R1-166803](#) Evaluation results of dense urban on 30GHz frequency band Samsung
[R1-166914](#) Remaining details of evaluation assumptions for URLLC LG Electronics
[R1-166917](#) Evaluation results on mobility enhancement for eV2X LG Electronics
[R1-167116](#) Quantitative metric for network energy efficiency CMCC
[R1-167194](#) Evaluation result of NR for below 6GHz Intel Corporation
[R1-167219](#) Modeling the Evolution of Line-of-Sight Blockage for V2V Channels Huawei, HiSilicon, Volkswagen
[R1-167297](#) [85-18] PA assumptions for NR; Email discussion summary Nokia, Alcatel-Lucent Shanghai Bell
[R1-167447](#) On KPIs for mMTC Ericsson
[R1-167448](#) On evaluation assumptions for mMTC Ericsson
[R1-167449](#) On battery lifetime evaluation for mMTC Ericsson
[R1-167451](#) Channel model of extreme rural scenario Ericsson, Telstra
[R1-167452](#) Path loss model of extreme rural scenario Ericsson, Telstra
[R1-167453](#) User and traffic distribution for extreme rural scenario Ericsson, Telstra
[R1-167454](#) Link budget for extreme rural scenario Ericsson, Telstra
[R1-167455](#) On URLLC reliability evaluation Ericsson
[R1-167457](#) Remaining issues on the indoor office scenario Ericsson
[R1-167458](#) Antenna model for outdoor TRP for micro in dense urban Ericsson
[R1-167459](#) On the use of 30 GHz in macro on all layers in dense urban scenario Ericsson
[R1-167540](#) Remaining Issues on NR System Evaluation for mMTC MediaTek Inc.
[R1-167575](#) URLLC KPI and evaluation assumptions InterDigital Communications
[R1-167603](#) Discussion on URLLC evaluation CATR
[R1-167702](#) Discussion on channel modeling for UE-UE and BS-BS links Intel Corporation
[R1-167904](#) Remaining issues on assumptions related to outdoor micro cell TRP ZTE Corporation, ZTE Microelectronics
[R1-168128](#) WF on Traffic and Battery Models for mMTC NR Sony
[R1-168129](#) WF on URLLC System Outage Evaluation Intel Corporation
[R1-168130](#) WF on URLLC Evaluation Metric Intel Corporation
[R1-168131](#) WF on URLLC Evaluation Scenario Intel Corporation
[R1-168387](#) WF on micro TRP ZTE
[R1-168453](#) WF on URLLC evaluation parameter and LLS method Huawei
[R1-168518](#) WF on Battery Life Evaluation Methodology for mMTC Qualcomm

8.1.8 Other

[R1-167067](#) Observations on 150 ohm and way forward Ericsson

The document was presented by Stefan Parkvall and was intended introducing fun to RAN1 heavy NR session and the famous dammsugare (Swedish cookie), sweet almond chocolate gourmet.

R1-166489 **NR and LTE co-existence** **AT&T GNS Belgium SPRL**

Decision: The document is noted.

R1-166570 **URLLC capacity evaluation** **Intel Corporation**

Decision: The document is noted.

R1-167207 **Sidelink Support & Enhancements for NR** **Huawei, HiSilicon**

Decision: The document is noted.

[R1-166115](#) Support for flexible backhauling for NR Huawei, HiSilicon
[R1-166116](#) Support for energy efficient NR Huawei, HiSilicon
[R1-166118](#) Support for vehicular communications in NR Huawei, HiSilicon
[R1-166804](#) Discussion on co-existence of LTE and NR Samsung
[R1-166805](#) Design aspects of mMTC for NR Samsung
[R1-166806](#) Aggregation of NR Carriers Samsung
[R1-166807](#) Shared spectrum support for NR Samsung
[R1-166918](#) Structure of control and data multiplexing for NR LG Electronics
[R1-166919](#) Consideration on DL control channel design for NR LG Electronics
[R1-166920](#) Consideration on common control signaling for NR LG Electronics
[R1-166921](#) Consideration on UL control channel design for NR LG Electronics
[R1-166922](#) Consideration on UL power control procedure for NR LG Electronics
[R1-166923](#) Consideration on support of CA operation for NR LG Electronics
[R1-166924](#) On coexistence of NR and LTE LG Electronics
[R1-166925](#) Overall discussion on mMTC LG Electronics
[R1-166990](#) On URLLC service characteristics Ericsson LM
[R1-166991](#) On URLLC design Ericsson LM
[R1-167061](#) On URLLC design principles Ericsson
[R1-167062](#) On URLLC characteristics Ericsson
[R1-167063](#) On channel access mechanisms for NR in unlicensed spectrum Ericsson
[R1-167064](#) On physical Layer Design Policies for Unlicensed Operation of NR Ericsson
[R1-167065](#) Technology components for unlicensed operation Ericsson
[R1-167066](#) On autonomous UL transmissions for NR in unlicensed spectrum Ericsson
[R1-167068](#) Aggregation of carriers in NR Ericsson
[R1-167202](#) Discussion on unified duplex for unpaired spectrum - dynamic TDD Huawei, HiSilicon
[R1-167221](#) Discussion on unified duplex for paired spectrum - flexible duplex Huawei, HiSilicon
[R1-167231](#) Work plan for unified duplex Huawei, HiSilicon
[R1-167300](#) Adaptive-length redundancy matching for HARQ transmission Nokia, Alcatel-Lucent Shanghai Bell
[R1-167301](#) HARQ enhancements for large transport block transmission Nokia, Alcatel-Lucent Shanghai Bell
[R1-167302](#) Early Hybrid ARQ Feedback for the 5G New Radio Nokia, Alcatel-Lucent Shanghai Bell
[R1-167303](#) HARQ Pooling for Carrier Aggregation in NR Nokia, Alcatel-Lucent Shanghai Bell
[R1-167304](#) On the utilization of Advanced Receivers in NR Nokia, Alcatel-Lucent Shanghai Bell
[R1-167305](#) On the cross-link interference mitigation Nokia, Alcatel-Lucent Shanghai Bell
[R1-167306](#) On network energy efficiency requirement and evaluation for the 5G new radio Nokia, Alcatel-Lucent Shanghai Bell
[R1-167307](#) Uplink power control for 5G New Radio Nokia, Alcatel-Lucent Shanghai Bell
[R1-167308](#) Punctured Scheduling for Low Latency Transmissions Nokia, Alcatel-Lucent Shanghai Bell
[R1-167309](#) Semi-persistent scheduling for 5G New Radio URLLC Nokia, Alcatel-Lucent Shanghai Bell
[R1-167341](#) In-band full duplexing in NR HTC Corporation
[R1-167388](#) TRP placement for the indoor scenario NTT DOCOMO, INC.
[R1-167389](#) Draft CR on ZoD offset for UMa NLOS in TR 38.900 NTT DOCOMO, INC.
[R1-167390](#) Use case and operational aspects for eV2X NTT DOCOMO, INC.
[R1-167391](#) On co-existence of eMBB and URLLC NTT DOCOMO, INC.
[R1-167396](#) Views on NR dynamic TDD NTT DOCOMO, INC.
[R1-167545](#) mm wave RFFE technology for NR Skyworks Solutions Inc.
[R1-167546](#) mm wave power amplifier AM/AM and AM/PM measurements Skyworks Solutions Inc.
[R1-167708](#) Discussion on multiplexing of eMBB and URLLC Intel Corporation
[R1-167771](#) Discussion on Beam-forming Support in NR Multicast National Taiwan University
[R1-167799](#) Discussion on wireless relay backhauling in HF-NR National Taiwan University
[R1-168484](#) WF on sidelink based UE cooperation in NR Huawei

8.2 Other

Including channel model for frequency spectrum above 6 GHz

[R1-168420](#) Chairman's notes of AI 8.2 Ad-Hoc chair (Nokia)

The document was presented by Matthew Baker from Nokia.

Decision: The document is endorsed and content is incorporated as follows.

Channel model TR38.900

Section 3

[R1-167927](#) Definitions, symbols and abbreviations in Section 3 of TR38.900 Huawei, HiSilicon ([R1-167228](#))

Decision: Revised in [R1-168001](#) with only the changes for sections 3.2 and 3.3.

MCC: post-meeting it is noted that both CR revision number and SI code are wrong – correction will be made before submission to plenary – [CR0002r2 to 38.900 is the agreed CR with SI code FS_6GHz_CH_model](#)

Section 4

[R1-168000](#) Applicability of TR38.900 Huawei, HiSilicon ([R1-167860](#))

1st bullet: Add “For system level simulations”

4th bullet: Add “For the stochastic model”

Remove the changes-on-changes

Decision: [CR0038r2 to 38.900 is agreed in \[R1-168159\]\(#\)](#) with the above changes.

Section 6

[R1-167806](#) TR38.900 CR Section 6 Fraunhofer HHI

Decision: [CR0014r1 to 38.900 is agreed in \[R1-168003\]\(#\)](#) as Cat-F.

Section 7.1

[R1-167809](#) TR38.900 CR Section 7.1 Fraunhofer HHI

Decision: [CR0015r1 to 38.900 is agreed in \[R1-168004\]\(#\)](#) as Cat-F, with comment removed.

Section 7.2

[R1-167811](#) TR38.900 CR Section 7.2 Fraunhofer HHI

Decision: [CR0016 to 38.900 is agreed.](#)

Section 7.3

[R1-167812](#) TR38.900 CR Section 7.3 Fraunhofer HHI

Decision: [CR0017r1 to 38.900 is agreed in \[R1-168005\]\(#\)](#) as Cat-F with correct change-tracking in the table.

Section 7.4

[R1-167818](#) TR38.900 CR Section 7.4 Fraunhofer HHI

Decision: [CR0027 to 38.900 is agreed.](#)

[R1-167229](#) Editorial correction to path loss equations in Section 7.4 of TR38.900 Huawei, HiSilicon

Decision: Covered by [R1-167818](#)

Section 7.5

[R1-168109](#) TR38.900 CR Section 7.5 Fraunhofer HHI ([R1-167819](#))

Decision: Merged into [R1-168023](#).

[R1-167223](#) CR for cluster DS of indoor office in TR 38.900 Huawei, HiSilicon

Decision: Discuss offline what should be the right values - revision in [R1-168007](#).

Decision: [R1-168007](#) is withdrawn. Revisit the topic at RAN1#86bis.

[R1-167230](#) Clarifications and corrections to fast fading model in Section 7.5 of TR38.900 Huawei, HiSilicon

Double-check offline the numbers below Table 7.5-7.

Remove unspecified scenarios from step 1.

Check offline with Samsung regarding the other changes to steps 1-5 and other comments.

Decision: Revision in [R1-168008](#).

Decision: Agreed in principle. Add section 7.6 on the cover sheet. Consider whether any merging with other CRs is needed.

[CR0004r2 to 38.900 is agreed in \[R1-168023\]\(#\).](#)

[R1-167476](#) Correction for mean ZOA Ericsson

Decision: [CR0024 to 38.900 is agreed.](#)

[R1-167232](#) Correction on average ZOA for indoor UTs in TR 38.900 Huawei, HiSilicon

Decision: Covered by [R1-167476](#).

[R1-167478](#) **Correction for RMA shadow fading** Ericsson
Decision: Revised and agreed as CR0022r1 to 38.900 in [R1-168021](#).

[R1-167481](#) **Correction to UMi O2I delay spread** Ericsson
Decision: CR0019 to 38.900 is agreed.

[R1-167482](#) **Correction for ZOA scaling factor** Ericsson
Decision: To be taken into account in revision of [R1-167819](#).

[R1-167234](#) **Correction on the phase difference between antenna panels without calibration** Huawei, HiSilicon
Decision: CR is not pursued. May discuss separately in NR evaluation assumptions.

Section 7.6.1

[R1-166486](#) **Draft CR on oxygen absorption** CATT
Decision: Agreed in [R1-168009](#) as CR0041 to 38.900, with addition of apostrophe in “clusters” below table 7.6.1-1.

Section 7.6.2.1

[R1-167824](#) **TR38.900_CR_Section_7.6.2.1** Fraunhofer HHI, Huawei, HiSilicon
[R1-166809](#) **Correction on large antenna array support in TR38.900** Samsung
Decision: Discuss offline how to merge [R1-167824](#) and [R1-166809](#). Prepare revision in [R1-168010](#).
Decision: CR0029r1 to 38.900 is agreed in [R1-168010](#).

Section 7.6.2.2

[R1-167920](#) **TR38.900_CR_Section_7.6.2.2** Fraunhofer HHI, Huawei, HiSilicon ([R1-167825](#))
Decision: CR0030r1 to 38.900 is agreed.
[R1-166640](#) **Draft CR on reference table to correlation distance for large bandwidth/antenna array** NEC
Decision: Covered by [R1-167920](#).

Section 7.6.3

[R1-168110](#) **TR38.900_CR_Section_7.6.3** Fraunhofer HHI ([R1-167826](#))
Decision: Agreed in principle, but to be revisited after merging any other changes from revision of [R1-167236](#) -> CR0031r2 to 38.900 is agreed in [R1-168012](#).

Section 7.6.3.1

[R1-166808](#) **Draft CR on spatially consistent random variable clarification in TR38.900** Samsung
Decision: Move to an earlier section of the TR - prepare a revision offline.
Decision: CR0042 is agreed in [R1-168478](#).

[R1-167236](#) **Correction to the spatial consistency Section 7.6.3 of TR38.900** Huawei, HiSilicon
Discuss offline with Samsung which changes are agreeable.
Note typos in “maybe 2D processes with Uniformly distributed (delays and angles) or Normaly”
Put references in correct section.
Merge any agreeable changes into [R1-168012](#).

Section 7.6.3.3

[R1-167472](#) **Clarification and correction of the soft LOS state model in TR 38.900** Ericsson
[R1-167479](#) **Correction to soft LOS state** Ericsson, Intel
Already included in [R1-168010](#).

[R1-167480](#) **Correction for spatial consistency of indoor distance** Ericsson
Decision: CR0020 to 38.900 is agreed.

[R1-167623](#) **Corrections on spatial consistency across floors in TR 38.900** ZTE Corporation, ZTE
Microelectronics
Decision: Agreed in [R1-168013](#) as CR0040.

Section 7.6.4

[R1-168151](#) **Correction of blockage modeling** Intel Corporation, Nokia, Alcatel-Lucent Shanghai Bell, Huawei, HiSilicon, InterDigital, Qualcomm, Samsung ([R1-166572](#))
[R1-167918](#) **TR38.900_CR_Section_7.6.4** Fraunhofer HHI ([R1-167829](#))
Includes [R1-168151](#). Discuss offline.
Decision: Revised and agreed as CR0032r2 in [R1-168329](#).

Section 7.6.6

[R1-166571](#) Correction of time varying Doppler definition Intel Corporation, Samsung, InterDigital
[R1-168113](#) TR38.900_CR_Section_7.6.6 Fraunhofer HHI([R1-167836](#))
Discuss offline - revisit on Friday.
Decision: Revised and agreed as CR0037r2 in [R1-168330](#).

Section 7.7.1, 7.7.2

[R1-167237](#) Correction to the TDL-E and CDL-E Huawei, HiSilicon
Decision: CR0009 to 38.900 is agreed.

Section 7.7.2

[R1-167474](#) Correction for Doppler spectrum of TDLs Ericsson
Revise in [R1-168014](#) with definition of fD and changing “frequency” to “shift”.
Decision: Revised and agreed as CR0026r1 in [R1-168014](#).

[R1-167477](#) Correction to MIMO extension of TDLs Ericsson
Decision: CR0023 to 38.900 is agreed.

Section 7.7.3

[R1-166810](#) Draft CR on delay scaling parameters in LLS channel model in TR38.900 Samsung
Discuss offline which values to use, and show the deleted table.
Decision: Revised and agreed as CR0043 in [R1-168479](#).

[R1-167830](#) TR38.900_CR_Section_7.7.3 Fraunhofer HHI
Decision: CR0033 to 38.900 is agreed.

Section 7.7.4

[R1-168111](#) TR38.900_CR_Section_7.7.4 Fraunhofer HHI([R1-167831](#))
Decision: Revised and agreed as CR0034r2 in [R1-168016](#) with correct figure number references and delete the problem description text.

[R1-167238](#) Correction of angular scaling parameters of CDL models in TR38.900 Huawei, HiSilicon
Decision: Superseded by [R1-168016](#). CR is not pursued.

Section 7.7.5

[R1-166811](#) Draft CR on CDL channel models in TR38.900 Samsung
Decision: Covered by [R1-167919](#).
[R1-167919](#) TR38.900_CR_Section_7.7.5 Fraunhofer HHI([R1-167832](#))
Decision: CR0035r1 to 38.900 is agreed.

Section 7.7.6

[R1-167473](#) Identified errors in K-factor scaling for TDL-D/E in TR 38.900 Ericsson
[R1-167475](#) Correction for K-factor scaling of TDL models Ericsson
Decision: Agreed in principle; discuss offline the correct terminology for K_{1stap} -> Revised and agreed as CR0025r1 in [R1-168017](#).

Note that a further modification may be considered at RAN1#86bis to show how the formulae in the last table depend on the figures in the previous table.

[R1-167242](#) Correction to K factor scaling in Table 7.7.6-2 Huawei, HiSilicon
Decision: Covered by [R1-167475](#).

Section 7.7.5.1

[R1-167233](#) Correction on the translation equation for scaling of angles in TR 38.900 Huawei, HiSilicon
Decision: Covered by [R1-167919](#).

Section 7.8

[R1-168138](#) Correction on Calibration Simulation Assumption in TR38.900 Samsung, Intel
Decision: Revised and agreed as CR0044 in [R1-168480](#)

Section 7.8.1 & 7.8.2

[R1-167579](#) CR for TR38.900 to capture large and full scale calibration Samsung
Decision: CR0012 to 38.900 is agreed.

Section 7.6.2.1, 7.8.2, 7.8.3

[R1-167580](#) Draft CR for TR38.900 for editorials and minor corrections Samsung

Changes in only sections 7.8.2 and 7.8.3 are agreed. Other changes are already covered elsewhere.

Decision: Revised and agreed as CR0013r1 in [R1-168477](#).

Section 8.4

[R1-168112](#) **TR38.900_CR_Section_8.4** **Fraunhofer HHI**([R1-167833](#))

Discuss offline how to handle the dependencies with section 7.5 -> [R1-168019](#) - revisit on Friday.

Decision: Revised and agreed as CR0036r3 in [R1-168022](#).

Miscellaneous

[R1-167227](#) **General discussion on the TR38.900** **Huawei, HiSilicon**

Discuss offline any remaining issues and prepare CRs for any remaining corrections that seem agreeable.

2 remaining issues:

1. 2D vs 3D pathloss
2. Multi-frequency simulation clarifications

Decision: Prepare a CR for consideration at RAN1#86bis.

[R1-168153](#) **TR38.900_CR_Consistent_Equation_Numbering** **Fraunhofer HHI, CATT, Huawei, HiSilicon, Ericsson**

Decision: CR0039 to 38.900 is agreed.

[R1-167117](#) Full calibration for channel model above 6GHz CMCC

[R1-168020](#) **E-mail discussion summary on additional feature calibrations** **Samsung** ([R1-167581](#))

Decision: Email discussion until September 30th to collect calibration data for additional features.

Other

[R1-167310](#) Sidelink design for NR Qualcomm Incorporated

9 Closing of the meeting

Mr Chair thanked all for really appreciated hard work during the week. Special thanks to V2V team who closed Thursday session very late (23:55).

V2V rapporteur (LGE) asked for taking the floor and thanked Shailesh Patil (Qualcomm) for his work – the best to Shailesh in his future position out of RAN1.

Thanks also to the European Friends of 3GPP for hosting and organizing meeting room facilities for such big meeting.

Mr Chair thanked Vice chairs and all the chair persons who help managing the number of parallel sessions during the course of the week.

Question was raised clarifying the NR scheduling for upcoming meetings

Mr Chair confirmed that Way Forward (especially on multiple access schemes) are welcome to next meeting. Any contribution submission is welcome but RAN1 chair warned the group that RAN1 had only 3 meetings left before the completion of the NR SI, including January ad-hoc additional meeting. Agenda to next upcoming meetings shall take into account this constraint.

ZTE commented that online discussions do not preclude offline/email discussions to progress further

Ericsson still believe that RAN1 should strive reaching progress online

Meeting was closed at 17:00.

See you all in Lisbon.

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Annex A: List of Tdocs at RAN1 #86

Please see excel file attached to this report

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Annex B: List of CRs agreed at RAN1 #86

TS	CR	Rev	Rel	Title	Cat	Vsn	@ Mtg	TD#	Source to WG	Work Item
25.211	323	-1	Rel-12	On adding the TS 25.321 to the list of references of TS 25.211, which used in the definition of "UL DPCH 10ms Mode"	D	12.1.0	R1#86	R1-168035	Ericsson	UTRA_DCHenh-Core
25.211	324	-1	Rel-13	On adding the TS 25.321 to the list of references of TS 25.211, which used in the definition of "UL DPCH 10ms Mode"	A	13.0.0	R1#86	R1-168036	Ericsson	UTRA_DCHenh-Core
25.214	749	-	Rel-12	Clarifications on UL Discontinuous Transmission with DCH enhancements	F	12.4.0	R1#86	R1-166495	Qualcomm Europe Inc.(France)	UTRA_DCHenh-Core
25.214	750	-	Rel-13	Clarifications on UL Discontinuous Transmission with DCH enhancements (Rel. 13)	A	13.3.0	R1#86	R1-166496	Qualcomm Europe Inc.(France)	UTRA_DCHenh-Core
25.214	751	1	Rel-13	Correction of DCH enhancements	A	13.3.1	R1#86	R1-168032	Huawei, HiSilicon	UTRA_DCHenh-Core
25.214	752	1	Rel-12	Correction of DCH enhancements	F	12.4.0	R1#86	R1-168033	Huawei, HiSilicon	UTRA_DCHenh-Core
25.214	753	1	Rel-13	Correction of Dual Carrier HSUPA enhancements for UTRAN CS	F	13.3.1	R1#86	R1-168031	Huawei, HiSilicon, Ericsson	DC_HSUPA_CS-Core
25.214	754	-	Rel-12	Editorial clarification on the definitions of "UL DPCH 10ms Mode" and "UL DPCH 20ms Mode" of DCH enhancements for UMTS	D	12.4.0	R1#86	R1-167760	Ericsson	UTRA_DCHenh-Core
25.214	755	-	Rel-13	Editorial clarification on the definitions of "UL DPCH 10ms Mode" and "UL DPCH 20ms Mode" of DCH enhancements for UMTS	A	13.3.1	R1#86	R1-167761	Ericsson	UTRA_DCHenh-Core
36.211	253	-	Rel-13	Correction on DMRS for NB-IoT in TS 36.211	F	13.2.0	R1#86	R1-166180	Huawei, HiSilicon	NB_IOT-Core
36.211	254	1	Rel-13	Correction on NPRACH in TS 36.211	F	13.2.0	R1#86	R1-168364	Huawei, HiSilicon	NB_IOT-Core
36.211	255	-	Rel-13	Correction on SC-FDMA signal generation for NB-IoT in TS 36.211	F	13.2.0	R1#86	R1-166182	Huawei, HiSilicon	NB_IOT-Core
36.211	256	-	Rel-13	Corrections to RRC parameter names for NB-IoT in TS 36.211	F	13.2.0	R1#86	R1-166195	Huawei, HiSilicon	NB_IOT-Core
36.211	259	-	Rel-13	MPDCCH search-space with Temporary C-RNTI	F	13.2.0	R1#86	R1-166621	Sequans Communications	LTE_MTCe2_L1-Core
36.211	260	-	Rel-13	Correction on NPBCH in TS 36.211	F	13.2.0	R1#86	R1-167166	Huawei, HiSilicon	NB_IOT-Core
36.211	261	1	Rel-13	Correction on UL collisions in TS 36.211	F	13.2.0	R1#86	R1-167991	Huawei, HiSilicon	NB_IOT-Core
36.211	262	1	Rel-13	Correction on NPSS mapping in TS 36.211	F	13.2.0	R1#86	R1-168293	Huawei, HiSilicon, Rohde & Schwarz	NB_IOT-Core
36.211	263	1	Rel-13	Corrections on the presence of NRS for standalone and guard band operation mode in TS 36.211	F	13.2.0	R1#86	R1-168444	Huawei, HiSilicon	NB_IOT-Core
36.211	264	-	Rel-13	Correction on the determination of EPDCCH starting position	F	13.2.0	R1#86	R1-167402	ITRI	LTE_LAA-Core
36.211	265	-	Rel-13	Corrections on NPDCCH scrambling in TS 36.211	F	13.2.0	R1#86	R1-167419	Huawei, HiSilicon, Intel, Neul, Qualcomm	NB_IOT-Core
36.211	272	1	Rel-13	Frequency hopping for SI and paging messages for BL/CE UE	F	13.2.0	R1#86	R1-167953	Ericsson, Qualcomm	LTE_MTCe2_L1-Core
36.211	275	-	Rel-13	Scrambling of DL DMRS for BL/CE UE	F	13.2.0	R1#86	R1-167852	Ericsson	LTE_MTCe2_L1-Core

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36.211	276	-	Rel-13	Enable cross-subframe channel estimation for BL/CE UE	F	13.2.0	R1#86	R1-167861	Ericsson	LTE_MTCe2_L1-Core
36.211	278	-	Rel-13	Frequency hopping interval for MPDCCH during random access for BL/CE UE	F	13.2.0	R1#86	R1-167909	Ericsson	LTE_MTCe2_L1-Core
36.211	279	-	Rel-13	CR on the correction from SC-FDFMA to SC-FDMA	F	13.2.0	R1#86	R1-167933	Panasonic	LTE_D2D_Prox-Core
36.211	280	-	Rel-13	Correction for PHICH resource reservation on the LAA cell in 36.211 for Rel-13 LAA	F	13.2.0	R1#86	R1-167935	Huawei, HiSilicon	LTE_LAA-Core
36.211	281	-	Rel-13	Correction on MPDCCH transmission without repetition in special subframes	F	13.2.0	R1#86	R1-168155	Huawei, HiSilicon	LTE_MTCe2_L1-Core
36.211	282	1	Rel-13	Introduction of a reserved range of NPRACH sub-carriers for contention based access	F	13.2.0	R1#86	R1-168495	Ericsson, ZTE, Qualcomm	NB_IOT-Core
36.211	283	-	Rel-13	Clarification of valid subframe in eMTC	F	13.2.0	R1#86	R1-168234	Panasonic	LTE_MTCe2_L1-Core
36.211	284	-	Rel-13	Correction of NB-IoT antenna port mapping	F	13.2.0	R1#86	R1-168236	Panasonic, Huawei, HiSilicon, NEC, MediaTek	NB_IOT-Core
36.211	285	-	Rel-13	Clarification on PRACH system frame number	F	13.2.0	R1#86	R1-168508	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.211	286	-	Rel-13	PUCCH retuning with puncturing for BL/CE UE	F	13.2.0	R1#86	R1-168549	Ericsson, Qualcomm, NEC, NTT DoCoMo	LTE_MTCe2_L1-Core
36.211	287	1	Rel-13	Phase difference between NRS and CRS	F	13.2.0	R1#86	1- 168219	Qualcomm Incorporated	NB_IOT-Core
36.212	211	-	Rel-13	Correction on BCH rate matching in TS 36.212	F	13.2.0	R1#86	R1-167183	Huawei, HiSilicon	NB_IOT-Core
36.212	213	1	Rel-13	Correction on bitwidth of CLASS A codebook	F	13.2.0	R1#86	R1-167938	Intel Corporation	LTE_EBF_FDMIMO-Core
36.212	214	1	Rel-13	Corrections on CRI bit width in 36.212	F	13.2.0	R1#86	R1-167939	Huawei, HiSilicon	LTE_EBF_FDMIMO-Core
36.212	215	-	Rel-13	Subband CQI report and TM6	F	13.2.0	R1#86	1- 168287	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.212	216	1	Rel-13	CR for clarification of DCI sizes for format 6-1A (TM6 and TM9) in TS 36.212	F	13.2.0	R1#86	R1-168212	Virtuosys Ltd.	LTE_MTCe2_L1-Core
36.213	689	1	Rel-13	Correction on random access procedure for NB-IoT on TS 36.213	F	13.2.0	R1#86	R1-167989	Huawei, HiSilicon	NB_IOT-Core
36.213	690	-	Rel-13	Correction on NPDCCH related procedure on TS 36.213	F	13.2.0	R1#86	R1-166184	Huawei, HiSilicon	NB_IOT-Core
36.213	691	-	Rel-13	Corrections to RRC parameter names for NB-IoT in TS 36.213	F	13.2.0	R1#86	R1-166196	Huawei, HiSilicon	NB_IOT-Core
36.213	692	1	Rel-13	Corrections on NPDSCH related procedure in TS 36.213	F	13.2.0	R1#86	R1-167990	Huawei, HiSilicon	NB_IOT-Core
36.213	693	-	Rel-13	Correction on FD-MIMO codebook in 36.213	F	13.2.0	R1#86	R1-166337	Nokia, Alcatel-Lucent Shanghai Bell, Samsung	LTE_EBF_FDMIMO-Core
36.213	694	-	Rel-13	Correction on RRC parameters for SRS enhancement in 36.213	F	13.2.0	R1#86	R1-166338	Nokia, Alcatel-Lucent Shanghai Bell	LTE_EBF_FDMIMO-Core
36.213	695	-	Rel-13	Transport block size determination for Msg2	F	13.1.2	R1#86	R1-166623	Sequans Communications	LTE_MTCe2_L1-Core

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36.213	696	-	Rel-13	Correction on NPUSCH related procedure on TS 36.213	F	13.2.0	R1#86	R1-167172	Huawei, HiSilicon	NB_IOT-Core
36.213	698	-	Rel-13	Correction on the reference of narrowband definition in TS 36.213	F	13.2.0	R1#86	R1-167184	Huawei, HiSilicon	LTE_MTCe2_L1-Core
36.213	699	-	Rel-13	Correction on the relationship between IMCS and ITBS for DCI format 6-1A in TS 36.213	F	13.2.0	R1#86	R1-167185	Huawei, HiSilicon	LTE_MTCe2_L1-Core
36.213	700	1	Rel-13	Correction on the scrambling initialization for SIB1-BR and SI for eMTC in TS 36.213	F	13.2.0	R1#86	R1-168157	Huawei, HiSilicon, Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.213	701	-	Rel-13	Corrections on NPDCCH search space for random access in connected mode in TS 36.213	F	13.2.0	R1#86	R1-167188	Huawei, HiSilicon	NB_IOT-Core
36.213	704	1	Rel-11	Correction on storing soft channel bits for different UE categories	F	11.11.0	R1#86	R1-168313	Huawei, HiSilicon, NTT DOCOMO, SoftBank	TEI11
36.213	705	1	Rel-12	Correction on storing soft channel bits for different UE categories in Rel-12	A	12.10.0	R1#86	R1-168314	Huawei, HiSilicon, NTT DOCOMO, SoftBank	TEI11
36.213	706	1	Rel-13	Correction on storing soft channel bits for different UE categories in Rel-13	A	13.2.0	R1#86	R1-168315	Huawei, HiSilicon, NTT DOCOMO, SoftBank	TEI11
36.213	708	-	Rel-13	Correction on the citation of table indexes for mapping of ICRI to MCRI	F	13.2.0	R1#86	R1-167404	ITRI	LTE_EBF_FDMIMO-Core
36.213	710	-	Rel-13	Corrections on Codebooks in 36.213	F	13.2.0	R1#86	R1-167678	Huawei, HiSilicon	LTE_EBF_FDMIMO-Core
36.213	711	-	Rel-13	Default max number of PUSCH repetitions for Msg3 for BL/CE UE	F	13.2.0	R1#86	R1-167853	Ericsson	LTE_MTCe2_L1-Core
36.213	714	1	Rel-13	PDSCH start subframe in TDD for BL/CE UE	F	13.2.0	R1#86	R1-168462	Ericsson	LTE_MTCe2_L1-Core
36.213	715	-	Rel-13	Repetition with aperiodic CSI for BL/CE UE	F	13.2.0	R1#86	R1-167857	Ericsson	LTE_MTCe2_L1-Core
36.213	718	-	Rel-13	Correction on "special subframe" for frame structure type 3 in 36.213 for Rel-13 LAA	F	13.2.0	R1#86	R1-167934	Huawei, HiSilicon	LTE_LAA-core
36.213	719	-	Rel-13	36.213 CR Clarification on HARQ-ACK transmission	F	13.2.0	R1#86	R1-167936	CATT	LTE_CA_enh_b5c
36.213	720	1	Rel-13	Correction for UL grant size in RAR	F	13.2.0	R1#86	R1-168513	Ericsson, Sequans Communications	LTE_MTCe2_L1-Core
36.213	721	2	Rel-13	MBSFN subframes and SIB2 decoding	F	13.2.0	R1#86	R1-168437	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.213	722	1	Rel-13	Overriding of invalid subframe for msg3 PUSCH when R=1	F	13.2.0	R1#86	R1-168424	Nokia, Alcatel-Lucent Shanghai Bell	LTE_MTCe2_L1-Core
36.213	723	-	Rel-13	On the mapping of TPC command field to power correction values in TS 36.213	F	13.2.0	R1#86	R1-168156	Huawei, HiSilicon	LTE_MTCe2_L1-Core
36.213	724	-	Rel-13	Correction on the MPDCCH scheduling Paging in special subframe in TS 36.213	F	13.2.0	R1#86	R1-168158	Huawei, HiSilicon	LTE_MTCe2_L1-Core
36.213	725	1	Rel-13	Clarification of valid subframe in eMTC	F	13.2.0	R1#86	R1-168213	Panasonic	LTE_MTCe2_L1-Core
36.213	726	-	Rel-13	Quasi-colocation of NB-IoT antenna ports	F	13.2.0	R1#86	R1-168237	Panasonic, Huawei, HiSilicon	NB_IOT-Core

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36.213	728	1	Rel-13	PUCCH resource allocation	F	13.2.0	R1#86	R1-168519	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.213	729	1	Rel-13	RV version for PDSCH carrying paging	F	13.2.0	R1#86	R1-168399	Nokia, Alcatel-Lucent Shanghai Bell	LTE_MTCe2_L1-Core
36.213	730	-	Rel-13	Missing definition of higher layer parameter eutra-CRS-SequenceInfo	F	13.2.0	R1#86	R1-168374	NEC, Ericsson	NB_IoT-Core
36.213	731	-	Rel-13	PUSCH timing delay for NB-IoT	F	13.2.0	R1#86	R1-168375	Qualcomm Incorporated	NB_IOT-Core
36.213	732	-	Rel-13	Draft CR on RV Cycling for PUSCH and PDSCH	F	13.2.0	R1#86	R1-168450	Samsung	LTE_MTCe2_L1-Core
36.213	734	-	Rel-13	Clarification of scheduling delay	F	13.2.0	R1#86	R1-168496	ZTE	NB_IoT-Core
36.213	736	-	Rel-13	Clarification on MPDCCH monitoring on SFN rollover and search space overlap	F	13.2.0	R1#86	R1-168509	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.213	737	-	Rel-13	PUCCH transmission and invalid subframes	F	13.2.0	R1#86	R1-168521	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.213	738	-	Rel-13	SRS bit in DCI	F	13.2.0	R1#86	R1-168535	Qualcomm Incorporated	LTE_MTCe2_L1-Core
36.213	739	-	Rel-13	Clarification of NB-IoT DL subframe configuration	F	13.2.0	R1#86	R1-168539	Huawei, HiSilicon	NB_IOT-Core
36.213	740	1	Rel-13	Correction on FD-MIMO codebooks	F	13.2.0	R1#86	R1-168544	Qualcomm Incorporated	LTE_EBF_FDMIMO-Core
36.213	741	-	Rel-13	CR on LAA post transmission backoff	F	13.2.0	R1#86	R1-168555	Broadcom Limited	LTE_LAA-Core
36.214	34	-	Rel-12	Correction to the Beacon RSSI definition	F	12.2.0	R1#86	R1-167547	Nokia, Intel, Alcatel-Lucent Shanghai Bell, Qualcomm Incorporated, Ericsson	UTRA_LTE_WLAN_interw-Core
36.214	35	-	Rel-13	Correction to the WLAN RSSI definition	F	13.2.0	R1#86	R1-167549	Nokia, Intel, Alcatel-Lucent Shanghai Bell, Qualcomm Incorporated, Ericsson	LTE_WLAN_radio-Core
36.214	36	-	Rel-13	Correction on NRS port number mapping	F	13.2.0	R1#86	R1-168199	Huawei, HiSilicon, Panasonic, Samsung	NB_IOT-Core
36.214	37	-	Rel-13	Correction on NRSRQ applicability	F	13.2.0	R1#86	R1-168296	Huawei, HiSilicon	NB_IOT-Core

TS	CR	Rev	Rel	Title	Cat	Vsn	@ Mtg	TD#	Source to WG	Work Item
38.900	2	1	Rel-14	Definitions, symbols and abbreviations in section 3 of TR38.900	F	14.0.0	R1#86	R1-168001	Huawei, HiSilicon, Fraunhofer HHI, Ericsson, Samsung	FS_6GHz_CH_model
38.900	4	2	Rel-14	Clarifications and corrections to fast fading model in Sections 7.5 and 7.6 of TR38.900	F	14.0.0	R1#86	R1-168023	Huawei, HiSilicon, Fraunhofer HHI, Ericsson, Samsung, Intel Corporation	FS_6GHz_CH_model
38.900	9	-	Rel-14	Correction to the TDL-E and CDL-E	F	14.0.0	R1#86	R1-167237	Huawei, HiSilicon	FS_6GHz_CH_model
38.900	12	-	Rel-14	CR for capturing large-scale and full-scale calibration results	F	14.0.0	R1#86	R1-167579	Samsung	FS_6GHz_CH_model

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TS	CR	Rev	Rel	Title	Cat	Vsn	@ Mtg	TD#	Source to WG	Work Item
38.900	13	1	Rel-14	CR for TR38.900 for editorials and minor corrections	F	14.0.0	R1#86	R1-168477	Samsung	FS_6GHz_CH_model
38.900	14	1	Rel-14	TR38.900_CR_Section_6	F	14.0.0	R1#86	R1-168003	Fraunhofer HHI	FS_6GHz_CH_model
38.900	15	1	Rel-14	TR38.900_CR_Section_7.1	F	14.0.0	R1#86	R1-168004	Fraunhofer HHI	FS_6GHz_CH_model
38.900	16	-	Rel-14	TR38.900_CR_Section_7.2	F	14.0.0	R1#86	R1-167811	Fraunhofer HHI	FS_6GHz_CH_model
38.900	17	1	Rel-14	TR38.900_CR_Section_7.3	F	14.0.0	R1#86	R1-168005	Fraunhofer HHI	FS_6GHz_CH_model
38.900	19	-	Rel-14	Correction to UMi O2I delay spread	F	14.0.0	R1#86	R1-167481	Ericsson	FS_6GHz_CH_model
38.900	20	-	Rel-14	Correction for spatial consistency of indoor distance	F	14.0.0	R1#86	R1-167480	Ericsson	FS_6GHz_CH_model
38.900	22	1	Rel-14	Correction for RMa shadow fading	F	14.0.0	R1#86	R1-168021	Ericsson, Fraunhofer HHI	FS_6GHz_CH_model
38.900	23	-	Rel-14	Correction to MIMO extension of TDLs	F	14.0.0	R1#86	R1-167477	Ericsson	FS_6GHz_CH_model
38.900	24	-	Rel-14	Correction for mean ZOA	F	14.0.0	R1#86	R1-167476	Ericsson	FS_6GHz_CH_model
38.900	25	1	Rel-14	Correction for K-factor scaling of TDL models	F	14.0.0	R1#86	R1-168017	Ericsson, Huawei	FS_6GHz_CH_model
38.900	26	1	Rel-14	Correction for Doppler spectrum of TDLs	F	14.0.0	R1#86	R1-168014	Ericsson, Fraunhofer HHI, Huawei	FS_6GHz_CH_model
38.900	27	-	Rel-14	TR38.900_CR_Section_7.4	F	14.0.0	R1#86	R1-167818	Fraunhofer HHI	FS_6GHz_CH_model
38.900	29	1	Rel-14	TR38.900_CR_Section_7.6.2.1	F	14.0.0	R1#86	R1-168010	Fraunhofer HHI, Huawei, HiSilicon, Samsung, Ericsson, Intel Corporation	FS_6GHz_CH_model
38.900	30	1	Rel-14	TR38.900_CR_Section_7.6.2.2	F	14.0.0	R1#86	R1-167920	Fraunhofer HHI, Huawei, HiSilicon, NEC	FS_6GHz_CH_model
38.900	31	2	Rel-14	TR38.900_CR_Section_7.6.3	F	14.0.0	R1#86	R1-168012	Fraunhofer HHI, Ericsson, Huawei, HiSilicon, Samsung, Intel Corporation	FS_6GHz_CH_model
38.900	32	2	Rel-14	TR38.900_CR_Section_7.6.4	F	14.0.0	R1#86	R1-168329	Intel Corporation, Fraunhofer HHI, Ericsson, Samsung, Qualcomm, Nokia, Alcatel-Lucent Shanghai Bell, Huawei, HiSilicon, InterDigital	FS_6GHz_CH_model
38.900	33	-	Rel-14	TR38.900_CR_Section_7.7.3	D	14.0.0	R1#86	R1-167830	Fraunhofer HHI	FS_6GHz_CH_model
38.900	34	2	Rel-14	TR38.900_CR_Section_7.7.4	F	14.0.0	R1#86	R1-168016	Fraunhofer HHI, Ericsson	FS_6GHz_CH_model
38.900	35	1	Rel-14	TR38.900_CR_Section_7.7.5	F	14.0.0	R1#86	R1-167919	Fraunhofer HHI	FS_6GHz_CH_model
38.900	36	3	Rel-14	TR38.900_CR_Section_8.4	F	14.0.0	R1#86	R1-168022	Fraunhofer HHI, Ericsson, ZTE Corp, ZTE Microelectronics	FS_6GHz_CH_model

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38.900	37	2	Rel-14	TR38.900_CR_Section_7.6.6	F	14.0.0	R1#86	R1-168330	Intel Corporation, Fraunhofer HHI, Ericsson, Samsung	FS_6GHz_CH_model
38.900	38	2	Rel-14	Applicability of TR38.900	F	14.0.0	R1#86	R1-168159	Huawei, HiSilicon, Ericsson, Telecom Italia, Fraunhofer HHI	FS_6GHz_CH_model
38.900	39	-	Rel-14	TR38.900_CR_Consistent_Equation_Numbering	D	14.0.0	R1#86	R1-168153	Fraunhofer HHI, CATT, Huawei, HiSilicon, Ericsson	FS_6GHz_CH_model
38.900	40		Rel-14	Corrections on spatial consistency across floors in TR 38.900	F	14.0.0	R1#86	R1-168013	ZTE Corporation, ZTE Microelectronics	FS_6GHz_CH_model
38.900	41		Rel-14	CR on Oxygen Absorption	F	14.0.0	R1#86	R1-168009	CATT, Fraunhofer HHI, Huawei, HiSilicon, Ericsson	FS_6GHz_CH_model
38.900	42	-	Rel-14	CR on spatially consistent random variable clarification in TR38.900	F	14.0.0	R1#86	R1-168478	Samsung	FS_6GHz_CH_model
38.900	43	-	Rel-14	CR on delay scaling parameters in LLS channel model in TR38.900	F	14.0.0	R1#86	R1-168479	Samsung	FS_6GHz_CH_model
38.900	44	-	Rel-14	Correction on Calibration Simulation Assumption in TR38.900	F	14.0.0	R1#86	R1-168480	Samsung	FS_6GHz_CH_model

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Annex C-1: List of Outgoing LSs from RAN1 #86

TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-167914	Reply LS for clarification on MIMO capability	RAN1, Huawei	Rel-10	TEI10	R1-166073	RAN2			
R1-167916	Reply LS on Network Assistance for Network Synchronization in LTE	RAN1, Huawei	Rel-14	FS_LTE_NW_SYNC	R1-166085	RAN3, RAN	RAN4		
R1-167917	LS on Parameters for WP5D sharing and compatibility studies	RAN1, NTT DOCOMO	Rel-14	FS_NR_newRAT		RAN4			
R1-168026	LS on RAN1 agreements for LTE-based V2X	RAN1, LGE	Rel-14	LTE_V2X-Core		RAN2, RAN3, SA2			
R1-168030	LS on Updates on HS-SCCH DRx Feature in Cell Fach	RAN1, Qualcomm	Rel-14	FACH_DTXDRX-Core		RAN2			
R1-168037	LS to RAN2/3 on RAN1 progress on MC enhancements	RAN1, Huawei	Rel-14	UTRA_MCe		RAN2, RAN3			
R1-168214	LS on RAN1 agreements for NR initial access and mobility	RAN1, Ericsson	Rel-14	FS_NR_newRAT		RAN2			
R1-168250	LS on Timing Offset Indication for V2V	RAN1, Ericsson	Rel-14	LTE_SL_V2V-Core		RAN2	RAN4		
R1-168251	LS on RAN1 agreements in sidelink-based V2V	RAN1, LGE	Rel-14	LTE_SL_V2V-Core		RAN2, RAN3, RAN4			
R1-168252	LS on L1 parameters for sidelink-based V2V	RAN1, LGE	Rel-14	LTE_SL_V2V-Core		RAN2			
R1-168256	Reply LS on VoLTE and video quality related enhancements	RAN1, CMCC	Rel-14	FS_LTE_eVoLTE	R1-166075	RAN2			
R1-168258	LS on NR waveform	RAN1, Huawei	Rel-14	FS_NR_newRAT		RAN4			
R1-168300	LS regarding agreements for FeMTC	RAN1, Qualcomm, Huawei	Rel-14	LTE_feMTC-Core		RAN4, RAN2			
R1-168346	LS on further RRC Parameters for Enhanced LAA for LTE	RAN1, Huawei	Rel-14	LTE_eLAA-Core		RAN2			
R1-168377	LS on introducing 1.2Gbps and 1.6Gbps UE categories in Rel-13	RAN1, Huawei	Rel-13	TEI13		RAN, RAN2			
R1-168425	LS to RAN2 regarding valid MBSFN subframes for eMTC	Qualcomm Incorporated	Rel-13	LTE_MTCe2_L1-Core		RAN2			
R1-168459	LS on introduction of new UL categories in Rel-13	RAN1, Qualcomm	Rel-13	TEI13		RAN2, RAN			
R1-168460	LS on introduction of new UL categories in Rel-14	RAN1, Qualcomm	Rel-14	LTE_UL_CAP_enh-Core		RAN2, RAN			
R1-168497	LS on nrs-Power signaling for NB-IoT non-anchor carrier	RAN1, ZTE	Rel-13	NB_IOT-Core		RAN2	RAN4		
R1-168528	Reply LS on RAN2 Agreements on Skipping Uplink Transmission	RAN1, Nokia	Rel-14	LTE_LATRED_L2-Core		RAN2			
R1-168553	LS on NB-IoT positioning	RAN1, Huawei	Rel-14	NB_IOTenh-Core		RAN	RAN2, RAN3, RAN4		

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TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-168554	LS regarding agreement on paging for NB-IoT	RAN1, Qualcomm	Rel-14	NB_IOTenh-Core		RAN2			
R1-168556	LS on SRS Carrier-Based Switching	RAN1, Huawei	Rel-14	LTE SRS switch-Core		RAN2, RAN4			
R1-168557	LS on PRS sequence generation per TP	RAN1, Huawei	Rel-14	UTRA LTE iPos enh2-Core		RAN2, RAN3			
R1-168558	LS on PRS-based Terrestrial Beacon System (TBS)	RAN1, Qualcomm	Rel-14	UTRA LTE iPos enh2-Core		RAN2, RAN3	RAN4		
R1-168559	LS on introducing a new special subframe configuration	RAN1, CMCC	Rel-14	LTE UL CAP enh-Core		RAN2, RAN3			

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Annex C-2: List of Incoming LSs from RAN1 #86

TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-166058	Updated characteristics of terrestrial IMT systems for frequency sharing / interference analysis in the frequency range between 24.25 GHz and 86 GHz	ITU-R WP5D	Rel-14	FS_NR_newRAT		RAN1, RAN4, RAN		LS_EOs_5D_234_temp_112R1	
R1-166059	MODELLING AND SIMULATION OF IMT NETWORKS FOR USE IN SHARING AND COMPATIBILITY STUDIES	ITU-R WP5D	Rel-14	-		RAN1, RAN4, RAN		LS_EOs_5D_234_temp_125R1	
R1-166060	LS to RAN1 on RAN2 agreements related to V2X	RAN2, LGE	Rel-14	FS_LTE_V2X		RAN1		R2-164373	
R1-166061	Reply LS on questions on NB-IOT	CT1, Nokia	Rel-13	NB_IOT-Core, CIoT-CT	R3-161032	RAN3, RAN2, SA2	RAN1, CT4	C1-162926	
R1-166062	LS to RAN1 on SPS	RAN2, LGE	Rel-14	LTE_SL_V2V-Core		RAN1		R2-164359	
R1-166063	LS on V2V transmission path selection	RAN2, Huawei	Rel-14	LTE_SL_V2V-Core		SA2, RAN1, RAN3		R2-164356	
R1-166064	INCREASING LEVELS OF RF NOISE IN THE ENVIRONMENT AND CONSEQUENT INTERFERENCE TO RADIOCOMMUNICATION SERVICES	ITU-R WP 1A	-	-		RAN1, RAN4		ITU-R WP 1A/TEMP/26 (14 June 2016)	
R1-166065	LS on 5G millimeter wave channel simulator	NYU WIRELESS	Rel-14	-		RAN1	RAN	LS_from_NYU_Wireless on NYUSIM (3)	
R1-166066	Long Term Evolution in Operation in Unlicensed Spectrum Must Not Interfere with Wi-Fi	City of Madison (Office of the Mayor of)	Rel-13	LTE_LAA-Core		RAN, RAN1	FCC Office of Engineering & Technologies, FCC Wireless Telecommunications Bureau, WiFi Alliance, IEEE 802, Council of the Mayor of NYC	NYC LTE-U Letter	
R1-166067	LS on RAN2 aspects on MC enhancements	RAN2, Huawei	Rel-14	FS_UTRA_MCe		RAN1	RAN3	R2-164352	
R1-166068	Reply LS on EPC procedures for providing eNB with V2X authorization information	RAN2, LGE	Rel-14	FS_LTE_V2X	S2-162248	SA2	RAN1, RAN3, SA1	R2-164498	
R1-166069	LS on HARQ process selection for UL asynchronous HARQ	RAN2, Huawei	Rel-13	LTE_MTCe2_L1-Core, LTE_eLAA-Core		RAN1		R2-164538	

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TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-166070	LS to RAN1 on WLAN RSSI	RAN2, Nokia	Rel-13	LTE_WLAN_radio-Core		RAN1	RAN4	R2-164548	
R1-166071	LS to RAN1 on RAN2 agreements on skipping Uplink transmission	RAN2, Nokia	Rel-14	LTE_LATRED_L2-Core		RAN1		R2-164554	
R1-166072	LS to RAN1 on agreed TPs	RAN2, LGE	Rel-14	FS_LTE_V2X		RAN1		R2-164558	
R1-166073	LS to RAN1 on clarification on MIMO capability	RAN2, Huawei	Rel-10	TEI10		RAN1		R2-164559	R1-167906
R1-166074	LS on the evaluation of simultaneous transmission and reception	RAN2, ZTE	Rel-14	LTE_eMob-Core		RAN1, RAN4		R2-164565	
R1-166075	LS on VoLTE and video quality related enhancements	RAN2, Ericsson	Rel-14	FS_LTE_eVoLTE		RAN1		R2-164566	
R1-166076	LS on Multi-carrier enhancements	RAN3, Huawei	Rel-14	FS_UTRA_MCe		RAN1	RAN2	R3-161516	
R1-166077	Reply LS on Formation of IEEE 1914 Next Generation Fronthaul Interface Working Group	RAN3, Intel	Rel-14	FS_NR_newRAT	201604 LS IEEE1914 to 3GPP	IEEE 1914	RAN1, RAN2, RAN	R3-161538	
R1-166078	Response LS on the feasibility of mobility enhancement solutions	RAN3, ZTE	Rel-14	LTE_eMob-Core	R2-163135	RAN2	RAN1, RAN4	R3-161542	
R1-166079	LS on Characteristics of terrestrial IMT systems for frequency sharing/interference analysis in the frequency range between 24.25 GHz and 86 GHz	RAN4, Nokia	Rel-14	FS_NR_newRAT		RAN	RAN1	R4-164527	
R1-166080	Reply LS on the feasibility of mobility enhancement solutions	RAN4, ZTE	Rel-14	LTE_eMob-Core	R2-163135	RAN2	RAN1, RAN3	R4-164906	
R1-166081	LS on continuous uplink transmission in eMTC	RAN4, Intel	Rel-13	LTE_MTCe2_LI-Core		RAN1, RAN2		R4-164928	
R1-166082	Reply LS on V2V multicarrier configuration	RAN4, LGE, Ericsson	Rel-14	LTE_SL_V2V-Core	R1-163746	RAN1, RAN2		R4-164930	
R1-166083	Response to Wi-Fi Alliance comments on “Way forward on coexistence tests for LAA”	RAN4, Qualcomm, Ericsson	Rel-13	LTE_LAA-Core		Wi-Fi Alliance	RAN, RAN1	R4-164972	
R1-166084	Reply LS on SRS carrier switching interruption time	RAN4, Huawei	Rel-14	LTE_SRS_switch-Core	R1-163453	RAN1		R4-164974	
R1-166085	LS on Network Assistance for Network Synchronization in LTE	RAN, Huawei	Rel-14	FS_LTE_NW_SYNC		RAN4, RAN1	RAN3	RP-161262	
R1-166086	LS on 256QAM support for UE Category 9/10 from Rel-12	RAN, Intel	Rel-12	LTE_SC_enh_LI-Core		RAN1, RAN2		RP-161327	
R1-166087	LS on 5G NR study – mMTC use case	RAN, MediaTek	Rel-14	FS_NR_newRAT		RAN1		RP-161333	
R1-167878	LS on V2V Authorization	RAN3, Huawei	Rel-14	LTE_SL_V2V-Core		SA2, CT4	RAN2, RAN1, SA1	R3-161540	
R1-167879	Reply LS to ITU-R WP5D/TEMP/39(Rev.2) = RP-	RAN, Nokia	Rel-14	FS_NR_newRAT	R1-163390	ITU-R WP5D	RAN1, RAN4	RP-161056	

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	160508 on Characteristics of terrestrial IMT systems for frequency sharing/interference analysis in the frequency range between 24.25 GHz and 86 GHz								
R1-167880	Reply LS on Rel-13 LAA specifications	RAN, Qualcomm, NTT DOCOMO	Rel-13	LTE_LAA-Core	R1-165449	IEEE 802 LMSC	RAN1, RAN4, IEEE 802 19 Coexistence WG	RP-161228	
R1-167881	Response to Liaison Statement on coexistence simulation results for DL only LAA	Wi-Fi Alliance	Rel-13	LTE_LAA-Core	R1-161396	RAN1		20160811 Response to 3GPP LS on coexistence simulation results for DL only	
R1-167882	Proposal for Improved RMa model and upgraded open source channel simulator	NYU Wireless	Rel-14	FS_NR_newRAT		RAN1	RAN	LS_from_NYU_Wireless on Proposed Improved Rma model	
R1-167908	Review of 3GPP LAA Specification Rel. 13	IEEE 802 LMSC	Rel-13	LTE_LAA-Core		RAN1	RAN	802 to 3GPP 01AUG2016 liaison	
R1-167928	LS on CSI measurement ambiguity in LAA	RAN4, LGE	Rel-13	LTE_LAA-Perf		RAN1		R4-165659	
R1-168089	LS on Multi-Carrier enhancements	RAN2, Huawei	Rel-14	UTRA_MCe		RAN1		R2-165744	
R1-168126	Response LS to Priority for V2V	RAN2, LGE	Rel-14	LTE_SL_V2V-Core	R1-165814	RAN1	SA2	R2-165765	
R1-168340	LS on applicability of NRSRQ measurement	RAN4, Huawei	Rel-13	NB_IOT-Perf		RAN1	RAN2	R4-166696	
R1-168520	LS on Support of CAT 9/10 and CAT 13	RAN2, Intel	Rel-12	TEI12		RAN1			

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Annex D: **List of Approved updated WIDs**

None

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Annex E: List of draft TSs/TRs agreed at RAN1 #86

Tdoc Number	Title	Source	Conclusion/Decision
R1-168526	TR 38.802 V0.1.0 Study on New Radio (NR) Access Technology - Physical Layer Aspects	NTT DOCOMO, INC.	Endorsed

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Annex F: List of actions

- Outgoing LS.

[86-21] Asbjorn (Ericsson)

LS to RAN2 about NE initial access and mobility

Email approval until 1st September to tell the current RAN1 agreements and WA to RAN2

Done: Final LS is agreed in R1-168214 as per Mr Chair's decision posted on Sept 2nd.

- CR approval

[86-01] Bob (Motorola Mobility)

R1-167507 Addition of LTE_LATRED_L2-Core Ericsson LM

CR0709 of 36.213 is for email approval until Sept 12th.

Done: CR0709r2 to 36.213 is in R1-168228 as per Mr Chair's decision posted on Sept 13th.

[86-02] Suzuki (Panasonic)

R1-167434 Clarification of valid subframe in eMTC Panasonic Corporation

Email discussion/approval until Sep. 1st

Done: CR0725r1 to 36.213 is agreed in R1-168213 as per Mr Chair's decision posted on Sept 2nd.

[86-03] Johan (Ericsson)

R1-168549 PUCCH retuning with puncturing for BL/CE UE Ericsson, Qualcomm, NEC, NTT DoCoMo

Email approval until Sept 2nd

Done: CR0286 to 36.211 is agreed per Mr Chair's decision posted on Sept 3rd.

[86-04] Editors

Editors will provide updated eLAA CRs including the agreements and WA until Sept 6th, for email approval until Sept 12th

Rapporteur will provide agreement lists until August 29th.

Done: Agreements list was provided as R1-168210 by rapporteur (Ericsson). The set of agreed CRs are listed below:

<u>R1-168220</u>	Introduction of eLAA (PHY layer aspects) in 36.213	Motorola Mobility	Rel-14	36.213	13.2.0	LTE_eLAA-Core		
	CR0742 B							
<u>R1-168221</u>	Introduction of eLAA (UL Channel Access Procedure) in 36.213	Motorola Mobility	Rel-14	36.213	13.2.0	LTE_eLAA-Core		
	CR0743 B							
<u>R1-168222</u>	Introduction of eLAA Ericsson	Rel-14	36.211	13.2.0	LTE_eLAA-Core	CR0266r2	B	
<u>R1-168225</u>	Introduction of eLAA into 36.212 HuaWei Technologies Co., Ltd	Rel-14	36.212	13.2.0	LTE_eLAA-Core	CR0218 B		RP-161571
<u>R1-168457</u>	Introduction of eLAA into 36.201 Nokia	Rel-14	36.201	13.2.0	LTE_eLAA-Core	CR0015 B		RP-161571

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R1-168560 Introduction of eLAA (UL Channel Access Procedure) in 36.213 Motorola Mobility Rel-14 36.213 13.2.0 LTE_eLAA-Core
CR0743r1 B

[86-05] Editors

Editors will provide updated V2V CRs including the agreements and WA until Sept 6th, for email approval until Sept 12th

Rapporteur will provide agreement lists until August 29th.

Done: Agreements list was provided as R1-168217 by rapporteur (LGE). The set of agreed CRs are listed below:

R1-168201	Introduction of V2V	Nokia	Rel-14	36.201	13.2.0	LTE_SL_V2V-Core	CR0016r1	B
R1-168223	Introduction of V2V support	Ericsson	Rel-14	36.211	13.2.0	LTE_SL_V2V-Core	CR0267r2	B
R1-168224	Introduction of V2V into TS36.212	HuaWei Technologies Co., Ltd	Rel-14	36.212	13.2.0	LTE_SL_V2V-Core	CR0217	B
R1-168226	Introduction of V2V into TS36.213	Motorola Mobility	Rel-14	36.213	13.2.0	LTE_SL_V2V-Core	CR0744	B
R1-168227	Introduction of V2V support	Ericsson	Rel-14	36.214	13.2.0	LTE_SL_V2V-Core	CR0038r1	B

[86-40] Harish (Qualcomm)

R1-167814 Introduction of HS-SCCH Order for HS-SCCH DRx feature in enhanced Cell Fach Qualcomm Europe Inc.(France)

R1-167815 UE Procedures for HS-SCCH DRx feature in enhanced Cell Fach Qualcomm Europe Inc.(France)

Email discussion until Sept 9th. on Qualcomm CRs.

Done: Clean versions of both CRs (revision of CR0343 to 25.212 and revision of CR0756 to 25.214) were agreed, according to Mr Chair's email posted on Sept 12th. It was also agreed by all companies that these CRs could wait until the end of the WI - December 2016 acc. to the draft SR to RAN#73. Therefore the approval of these CRs is postponed to RAN#74.

- Text proposal for TS and TR

None

- Miscellaneous

[86-06] Philippe (Huawei)

Following the agreements on step 2 of resource (re)-selection, the threshold values in brackets (-128 dBm, 0 dBm and 2 dB) need to be finalized for V2V.

Email discussion until Sept. 2nd on the numbers in the brackets

Done: As per Mr Chair's decision posted on Sept 3rd, the following is agreed

- The threshold per subcarrier is in a range (-136...-38) dBm/15kHz with 2dB steps
- The threshold configuration is 6bits coded

[86-07] Hanbyul (LGE)

Energy measurement in each sub-channel for V2V

Email discussion until 2nd September

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Done: As per Mr Chair's decision posted on Sept 3rd, the following is agreed for S-RSSI definition:

- **Sidelink RSSI (S-RSSI) is defined as the linear average of the total received power (in [W]) per SC-FDMA symbol observed only in the configured sub-channel in the SC-FDMA symbols #1, #2, ..., #12 by the UE.**
- **The reference point for the S-RSSI shall be the antenna connector of the UE.**
- **If receiver diversity is in use by the UE, the reported value shall not be lower than the corresponding S-RSSI of any of the individual diversity branches.**

[86-08] Stefano (Ericsson)

R1-168348 WF on CBR measurement – Ericsson

Email discussion until Sept 2nd

Done: As per Mr Chair's decision posted on Sept 3rd, there is no consensus to define a CBR measurement. Revisit at next meeting.

[86-09] Stefano (Ericsson)

R1-168080 WF on V2V congestion control - Ericsson

Email discussion until Sept 2nd

Done: As per Mr Chair's decision posted on Sept 3rd, there is no consensus to define details of the congestion control framework of V2V. Revisit at next meeting, if needed.

[86-10] Hanbyul (LGE)

Candidate size for V2V for email discussion until Sept 2nd

Done: As per Mr Chair's decision posted on Sept 3rd, the following is agreed:

- **The candidate size of a sub-channel is {4,5,6,8,9,10,12,15,16,18,20,30,48,72,96} for SA-data non-adjacent case.**

[86-11] Shailesh (Qualcomm)

DCI for V2V for email discussion to finalize the square-bracketed figure and FFS until Sept 2nd

Done: As per Mr Chair's decision posted on Sept 3rd, the following is agreed:

DCI X for all BW

Let k be the number of sub-channels configured on the resource pool of a sub-carrier

- **CIF : 3 bits**
- **Lowest index of sub-channel allocation $\text{ceil}(\log_2(k)) = 0$ to 5 bits**
- **Time gap between tx and retx 4 bits**
- **Frequency resource of initial and last tx $\text{ceil}(\log_2(k*(k+1)/2)) = 0$ to 8 bits**

If the number of information bits in V2V DCI format mapped onto a given search space is less than the payload size of format 0 mapped onto the same search space, zeros shall be appended to V2V DCI format until the payload size equals that of format 0 including any padding bits appended to format 0.

[86-12] Philippe (Huawei)

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SCI contents for V2V

Email discussion until Sept 2nd to confirm the working assumption and square-bracketed figures, and the details of joint encoding of frequency location of the other transmission and number of subchannels

Done: As per Mr Chair's decision posted on Sept 7th, the following is agreed:

- Fixed size of 48 for the SCI
- For frequency RA, copy the frequency RA field from DCI and pad it to 8 bits.
- All other aspects (e.g., DMRS randomization) FFS to be addressed at next meeting including how to set the padding bits in frequency RA.

[86-13] Hanbyul (LGE)

PSD offset for V2V for email approval until Sept.1st

Done: According to Mr Chair's email dated on Sept 2nd, the PSD offset is fixed to [3] dB in specifications.

Note that exact fixed value can be discussed in the next meeting by seeing more evaluation results and analysis.

[86-14] Mark (Ericsson)

Antenna Port Layouts for FD-MIMO for email discussion until the next meeting

Done: Status to be checked at RAN1#86bis.

[86-15] Yi (Huawei)

SLS baseline for NR MA for email discussion on any other potential parameters until Sept.2nd

Done: According to Mr Chair's email dated on Sept 3rd, the following clarifications are agreed:

Attributes	Agreed values or assumptions	Further clarifications
Waveform	CP-OFDM as the UL waveform • UL DMRS overhead, 1 OFDM symbol out of 7 OFDM symbols	Summary: no change to the existing agreements.
Resource allocation	A UE selects a MA physical resource randomly from a pool of orthogonal MA physical resources • There is no partial overlapping between the MA physical resources selected by more than one UE • All orthogonal MA physical resources are of same size	Total allocated bandwidth: 6RB, 4RB (optional) for calibration purpose only, • Companies are encouraged to provide calibration results for both values, • Either value can be used for later evaluation of the proposed MA scheme Bandwidth per user per transmission: 1 RB
Receiver	MMSE, assuming realistic channel estimation • No blind decoding assumed	MMSE-IRC, assuming ideal channel estimation for calibration purpose only • 2Rx • No blind decoding assumed
MCS	Same for all UEs • MCS is reported by each company	Same for all UEs, • Derived by the bandwidth per user of 1 RB and TB size of 160 bits per transmission • QPSK is assumed
Power control	Open loop power control • Alpha=1, P0= -90 dBm	Summary: no change to the existing agreements. A few companies share different views. This power control setting for evaluation can be discussed later.
Packet size	Fixed by 20 bytes	TB size with CRC included

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HARQ retransmission		No. of transmission is 1 (i.e., no repetition or retransmission)
Traffic model		FTP 3 with fixed TB size
Average no. of users per sector		20 assuming 3 sectors/cell, total 57 sectors
Channel code		LTE Turbo
Any other potential parameters		Summary: how to present the results for calibration/comparison can be discussed later.

[86-16] Yi (Huawei)

Templates for NR MA

Huawei will provide the initial template for preliminary simulation results summary by 9th Sept, and email discussion about this template by 16th Sep

Done: According to Mr Chair's email dated on Sept 20th, clean versions of the proposed templates (for UL & DL NR MA preliminary LLS results – for UL & DL NR MA preliminary SLS results) are agreed.

[86-17] Yi (Huawei)

SLS calibration for NR MA for email discussion until Sept 16th.

Done: Status to be checked at RAN1#86bis.

[86-18] Yifei (ZTE)

Categorization for NR MA schemes for email discussion until the next meeting

Done: Status to be checked at RAN1#86bis.

[86-19] Joseph (Qualcomm)

Use cases discussion for time domain structure for NR for email discussion Sept 15th.

Done: Summary to be submitted at RAN1#86bis.

[86-20] Ruyue (ZTE)

MIMO calibration for NR for email discussion until Sept 8th.

Done: Summary to be submitted at RAN1#86bis.

[86-22] Kazuaki (NTT DOCOMO)

Target packet drop rate for NR

Email discussion on the two options of the packet size and clarification on Target packet drop rate

as listed in [R1-168510](#) until Sept. 1st

Done: According to Mr Chair's email dated on Sept 3rd, the following clarifications are agreed:

- **Packet size**
 - **Observation :** There is no consensus on which option to use. Each company would need to report the option used,, but are encouraged to evaluate both options. Decide on which option(s) is used to draw the conclusion of MA at RAN1#86bis meeting

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- **Proposal 1**
 - **Option 1: Follow TR45.820**
 - **Option 2: Fix 40 Bytes**
- **Target packet drop rate**
 - **Proposal 2: Packet drop rate = (Number of packet in outage) / (number of generated packets), where a packet is in outage if this packet failed to be successfully received by destination receiver beyond “Packet dropping timer”**
 - **Proposal 3: Companies report HARQ/retransmission assumption.**
 - **Proposal 4: Companies are encouraged to provide CDF of packet drop rate per UE.**

[86-23] Martin (Sony)

Battery lifetime model for NR for email discussion on battery lifetime model in [R1-168485](#) until the next meeting

Not Done: According to Mr Chair’s email dated on Sept 28th, further to RAN#73 last plenary decision, mMTC related discussion is postponed until next March 2017, and therefore this email discussion is suspended.

[86-24] Wu Yong (Huawei)

Traffic model for NR for email discussion on traffic model for urban coverage for massive connection (UL) (until Sept 15th)

Done: According to Mr Chair’s email dated on Sept 29th, the following traffic model assumption is agreed for connection density evaluation, and not for coverage nor battery life evaluation.

- **Packet size**
 - **Follow proposal1 of [86-22] (proposal on packet size). Companies report which option(s) is used.**
- **Packet arrival rate**
 - **Poisson packet arrival for each device, with arrival rate λ .**
 - **Proponents are encouraged to report**
 - **What packet arrival rate (λ) could be supported to achieve the connection density target, when packet arrival rate is assumed to be larger than what is assumed in TR45.820.**
 - **What connection density can be supported, when packet arrival rate is assumed the same as in TR45.820.**

[86-25] Haitong (Qualcomm)

Path loss calibration for NR

Email discussion for path loss calibration for 3D UMa at carrier frequency of 700 MHz until Sept 9th.

Done: According to Mr Chair’s email dated on Sept 12th, the pathloss calibration results will be compiled and presented as input to next meeting.

[86-26] Young-Han (Samsung)

R1-168537 **WF on Dense Urban scenarios** **Samsung, Ericsson, Intel, Nokia, ASB, AT&T, CMCC, Softbank, Verizon, KT, Vodafone, Deutsche Telecom**

- **Include the 30GHz band in the macro layer for the carrier frequency of dense urban scenario in Table A.2.1-1 in TR38.802**

Email approval until Sept 8th

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Done: According to Mr Chair's email dated on Sept 12th, [R1-168537](#) is agreed.

[86-27] Na (NTT DOCOMO)

[R1-168421](#) WF on Indoor TRP Configuration NTT DOCOMO, CATT, Ericsson, Intel

Email discussion until Sept 2nd

Done: According to Mr Chair's email dated on Sept 13th, the following is agreed:

- Adopt deployment ceiling mounted TRP:
 - Option 1 (baseline at least for calibration): Boresight direction is perpendicular to the ceiling. Antenna model is taken from alternative 3 in [R1-165850](#) (90 degree HPBW in Azimuth and zenith).
 - The number of sites is 3 and 12. Placement of 12 sites is the same as TR 38.900. Placement of 3 sites is according to Figure 1.
 - Antenna array baseline configuration:
 - (M,N,P,Mg,Ng) = (4, 4, 2, 1, 1) , $d_H = d_V = 0.5 \lambda$ for 4GHz
 - (M,N,P,Mg,Ng) = (4, 8, 2, 1, 1) , $d_H = d_V = 0.5 \lambda$ for 30GHz
 - (M,N,P,Mg,Ng) = (8, 16, 2, 1, 1), $d_H = d_V = 0.5 \lambda$ for 70 GHz

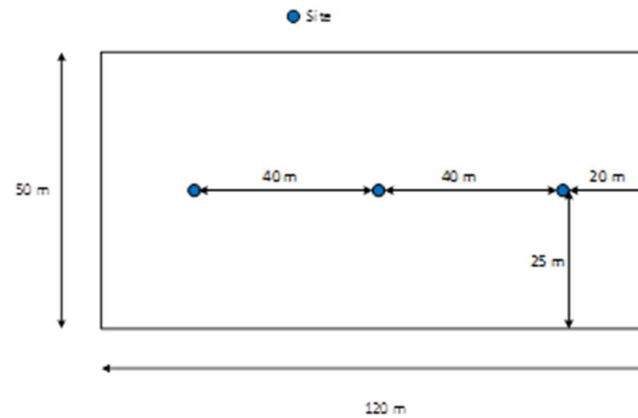


Figure 1: 3-site deployment of indoor TRPs.

- Option 2: Three sectors (example below). Antenna model is taken from alternative 2 in [R1-165850](#) (65 degree HPBW in Azimuth and zenith).



- Used antenna tilt should be reported by each company.
- The number of sites is 3 and 12. Placement of 12 sites is the same as TR 38.900. Placement of 3 sites is according to Figure 1.
- Antenna array baseline configuration:
 - Same as Option 1
- Boresight direction is according to TR 38.900
- Option 3 : Boresight direction is perpendicular to the ceiling. Omni antenna model is applied for 4 GHz.
 - The number of sites is 3 and 12. Placement of 12 sites is the same as TR 38.900. Placement of 3 sites is according to Figure 1.
 - Antenna array baseline configuration:
 - $(M, N, P, M_g, N_g) = (1, 1, 2, 1, 1)$ for 4GHz.
- Indoor TRP transmission power and various interference management schemes can be further studied when TRP density is high, e.g., 12 or 36.

[86-28] Young-Han (Samsung)

Additional feature calibration for channel model

Email discussion until 30th September to collect calibration data for additional features

Done: Summary to be submitted at RAN1#86bis.

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Annex G: List of participants at RAN1 #86

Please see excel file attached to this report

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Annex H: TSG RAN WG1 meetings in 2016 – 2017

TITLE	TYPE	DATES	LOCATION	CTRY
<u>3GPPRAN1#86bis</u>	<u>WG</u>	10 – 14 Oct 2016	Lisbon	Portugal
<u>3GPPRAN1#87</u>	<u>WG</u>	14 – 18 Nov 2016	Reno	US
<u>3GPPRAN1-NR</u>	<u>AH</u>	16 – 20 Jan 2017	TBD	US
<u>3GPPRAN1#88</u>	<u>WG</u>	13 – 17 Feb 2017	Athens	Greece
<u>3GPPRAN1#88bis</u>	<u>WG</u>	03 – 07 Apr 2017	TBD	US
<u>3GPPRAN1#89</u>	<u>WG</u>	15 – 19 May 2017	TBD	China
<u>3GPPRAN1-NR</u>	<u>AH</u>	27 – 30 Jun 2017	TBD	TBD
<u>3GPPRAN1#90</u>	<u>WG</u>	21 – 25 Aug 2017	Prague (TBC)	Rep Czech
<u>3GPPRAN1#90bis</u>	<u>WG</u>	09 – 13 Oct 2017	Prague (TBC)	Rep Czech
<u>3GPPRAN1#91</u>	<u>WG</u>	27 Nov – 01 Dec 2017	TBD	US

MEETING TYPES

AH = Ad Hoc

JM = Joint

PM = Preparatory Meeting

RM = Resolution Meeting

ST = Startup Meeting

WG = Working Group

CM = Chairmen's meeting

OR = Ordinary

RG = Rapporteurs Group

SG = Steering Group

TG = Task Group

XO = Extraordinary

End of document