

Source: MCC Support

Title: Final Report of 3GPP TSG RAN WG1 #85 v1.0.0
(Nanjing, China, 23rd – 27th May 2016)

Document for: Approval



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Main facts summary

3GPP TSG WG RAN1 #85 meeting, hosted by the Chinese Friends of 3GPP, was held at Shangri-La Hotel Nanjing, China. The meeting started at 9:00 on Monday 23rd May and finished at 17:10 on Friday 27th May 2016. The number of attending delegates, having signed the participants' paper list, was **458**.

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 2026, and those documents were categorized as followed.

Agenda Item	Input Document	Treated Document
All	2026	955

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 85 meeting and opened the meeting at 09:00. Mr Tong Hui from CMCC welcomed the delegates on behalf of the Chinese Friends of 3GPP, CATT, CATR, China Mobile, China Unicom, Coolpad, Huawei, Lenovo, Nokia, Oppo, Qualcomm, Samsung, ZTE 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

[R1-163960](#) Draft Agenda of RAN1#85 meeting RAN1 Chair

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

Discussion: Vodafone asked clarifying the overlap between NR session and NB-IoT maintenance on Tuesday's afternoon Chair → it will highly depend on the progress achieved during Monday's afternoon maintenance session.

Decision: The agenda is approved.

3 Approval of Minutes from previous meeting

[R1-165448](#) Final Report of 3GPP TSG RAN WG1 #84 bis v2.0.0 ETSI ([R1-163961](#))

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

Discussion: MCC→ report is revised as one agreement of the email thread [84b-06] was overlooked in [R1-163961](#).

Few typos/editorials also corrected.

Decision: The document is approved.

4 Incoming Liaison Statements

Dual connectivity related

[R1-163969](#) LS on RLM for PSCell in dual connectivity RAN2, Intel

The document was presented by Hong He from Intel and informs RAN1 and RAN4 about discussion that took place related to RLM for PSCell in dual connectivity. RAN2 has the understanding that if eNB does not configure the timers/constants for RLM then the consequence is that RLF due to physical layer failure will never be triggered for the PSCell.

Decision: The document is noted.

[R1-164121](#) Discussion on RLM for PSCell in dual connectivity Intel Corporation

The document was presented by Hong He from Intel and deals with the potential spec changes on the UE behavior of RLM on PSCell in dual connectivity (DC) in order to reduce power consumption.

Discussion: Corresponding draft CR in [R1-164122](#).

Decision: The document is noted.

[R1-164122](#) Draft CR on correction on RLM for PSCell in dual connectivity Intel Corporation

Clarify that the downlink radio link quality of the PSCell of the SCG shall be monitored by the UE for the purpose of indicating out-of-sync/in-sync status to higher layers, only if the UE is configured with a SCG and the parameter *rlf-TimersAndConstantsSCG* provided by the higher layers is not set to release.

Discussion: Qualcomm→ case where UE is not configured should be considered.

Decision: The document is noted. Continue offline discussion.

Friday

[R1-165724](#) Correction on RLM for PSCell in dual connectivity Intel Corporation, Panasonic Rel-13
36.213 13.1.1 LTE_SC_enh_dualC-Core, TEI13 CR0684 F

Decision: The document is agreed.

LAA related

[R1-163973](#) LS to RAN on new RAN4 TR for documenting multi-node tests for LAA RAN4, Ericsson

The document states that a new RAN4 TR can be defined to document the multi-node tests for Rel-13 LAA operation. The same TR can be used to introduce new multi-node tests in future releases also, if needed.

Discussion: No comment.

Decision: The document is noted.

[R1-164114](#) LS regarding 3GPP LTE based technologies operating in the unlicensed bands City of New York
(Counsel to the Mayor of)

The document was presented by RAN1 Chair on behalf of NYC. The letter lists a number of WiFi-based applications and use cases the City of New York has committed to deliver to their residents and raises concerns on the potential impact of 3GPP standardized LTE-Unlicensed regarding lower level WiFi signals.

The letter also refers to the review of the incoming LS from WiFi Alliance ([R1-163388](#)) and IEEE 802 ([R1-163375](#)).

Discussion: Qualcomm suggested focusing on the replies to WFA and IEEE and, when ready copy NYC.

Decision: The document is noted.

[R1-164393](#) Draft response LS to 802dot11 regarding LAA Qualcomm Incorporated

The document was presented by Peter Gaal from Qualcomm. Reply to [R1-163375](#).

Discussion: Broadcom → let's review the content of the reply LS offline.

Decision: The document is noted. Continue offline discussion.

Friday

[R1-165998](#) Draft Response LS to IEEE 802.11 regarding LAA Qualcomm

Decision: The document is noted and final LS is agreed in [R1-166040](#).

[R1-164394](#) Draft response LS to WFA regarding LAA Qualcomm Incorporated

The document was presented by Peter Gaal from Qualcomm. Reply to [R1-163388](#).

Discussion: Broadcom → let's review the content of the reply LS offline.

Decision: The document is noted. Continue offline discussion.

Friday

[R1-165999](#)

Draft response LS to WFA regarding LAA

Qualcomm Incorporated

Decision: The document is noted and **final LS is agreed in [R1-166041](#)**

[R1-165449](#)

Review of 3GPP LAA Specification Rel. 13

IEEE 802 LAN/MAN SC

The document was presented by RAN1 Chair on behalf of IEEE. IEEE 802 would appreciate an acknowledgment from 3GPP RAN that the LAA Rel. 13 specification will not be complete until all outstanding issues raised by all stakeholders, including 3GPP RAN1, IEEE 802 and the Wi-Fi Alliance, have been resolved.

Discussion: Qualcomm → RAN's reply is more appropriate.

Decision: The document is noted. RAN1 understanding is that RAN should reply to IEEE.

eMTC related

[R1-163974](#)

LS on continuous uplink transmission in eMTC

RAN4, Intel

The document was presented by Debdeep Chatterjee from Intel and asks RAN1 to clarify the expected eMTC UE behaviour:

- Is RAN1 considering the introduction of any mechanism for maintaining frequency and timing accuracy in eMTC, for example similar to the mechanism used in NB-IoT?

Decision: The document is noted.

[R1-165224](#)

Discussion on continuous uplink transmissions in eMTC

Intel Corporation

The document was presented by Debdeep Chatterjee from Intel.

- Observation 1: Maintaining 0.1ppm of frequency accuracy during prolonged UL transmission bursts spanning multiple seconds can be extremely challenging and expensive, if not impossible, for HD-FDD eMTC UEs.
- Observation 2: Introduction of UL compensation gaps is not expected to impact eMTC UEs in CE mode A or those UEs that only support CE mode A.
- Proposal 1: UL compensation gaps are introduced for eMTC UEs long uplink (i.e. PUSCH/PRACH) transmissions.
 - During the UL gaps, the UE may switch to the DL and performs time/frequency synchronization
 - The UL gap is defined by a gap period (X ms) and gap length (Y ms)
 - The values of X and Y are to be determined by RAN4 and are fixed in the specifications.
- Proposal 2: Send an LS response to RAN4 indicating RAN1 support for the introduction of UL gaps for HD-FDD eMTC UEs with long UL transmissions (of PUSCH and PRACH) and asking them to determine the values of the maximum duration of continuous UL transmission and the UL gap length for eMTC UEs.

Decision: The document is noted.

[R1-165225](#)

Draft reply LS on continuous uplink transmissions in eMTC

Intel Corporation

Discussion: ZTE's proposal in [R1-165133](#).

Intel → let's get feedback from RAN4.

Qualcomm, Huawei requested more time for review during the week.

Decision: The document is noted.

[R1-165133](#)

Discussion on UL gap for eMTC

ZTE

Proposal 1: Mechanism of uplink compensation gaps in NB-IoT can be reused for Rel-13 eMTC.

- *For any PUSCH transmission with duration greater than X ms, a final UL gap of duration Y ms is inserted at the end of the PUSCH transmission.*
- *It is preferable that the value of X and Y equals to the multiples of maximum of Y_{ch} .*

Decision: The document is noted.

Continue offline discussion under AI 6.1.5– (Intel)

NB-IoT related

[R1-163963](#)

LS on NB-IoT RRM requirements

RAN2, Huawei

The document was presented by Matthew Webb from Huawei.

- RAN2 assumes that RSRQ is only used for cell selection. RAN2 would like to RAN4 to further provide the value range of q-Qual for NB-IoT.
- RAN2 agrees RSRP is used for both cell selection and cell reselection and would like to ask RAN4 to provide range of q-RxLev.
- RAN2 assumes that Pcompensation is used in the cell selection criteria $S: S_{rxlev} = Q_{rxlevmeas} - Q_{rxlevmin} - P_{compensation} - Q_{offsettemp}$ and would like to ask RAN4 whether this in line with RAN4's understanding and if so to provide parameters and the associated value ranges to calculate the Pcompensation.
- RAN2 assumes that NB-IoT supports additionalSpectrumEmission and additionalPmax per band (8 bands), and this is mandatory for the UE. RAN2 would like to ask RAN4 whether this assumption is correct and to provide value ranges for relevant parameters.
- RAN2 would also like to ask RAN4 to provide feedback on whether a NB-IoT carrier is identified by <EARFCN, offset>

Discussion: No action to RAN1.
Decision: The document is noted.

R1-163964 Reply LS on per-UE configuration to allow exception reporting RAN2, Qualcomm

The document was presented by Peter Gaal from Qualcomm and states that at least one use case for per-UE configuration to allow exception reporting is to prevent abuse of the RRC establishment cause mo-ExceptionData because exception data is handled with priority in the network. RAN2 requests CT1 and SA2 to consider how to prevent applications in the UE from abusing the RRC access cause in the upper layers.

Discussion: No action to RAN1.
Decision: The document is noted.

R1-163965 Reply LS on direct SI update indication for NB-IoT RAN2, Ericsson

The document was presented by Asbjorn Grovlen from Ericsson and confirms that

- The system information change indication (1bit for SystemInfoModification and 1bit for systemInfoModification-eDRX) carried in DCI is supported.
- RAN2 will capture this direct indication bit field for NB-IoT in TS 36.331.

Discussion: Already captured in RAN1 spec.
Decision: The document is noted.

R1-164120 LS on direct indication DCI bits for NB-IoT RAN2, Huawei

The document was presented by Matthew Webb from Huawei and RAN2 agreed to assume that 6 “spare” bits are included in DCI for future use, as shown in the following table:

Table : Direct Indication information

Bit	Field
1	<i>systemInfoModification</i>
2	<i>systemInfoModification-eDRX</i>
3, 4, 5, 6, 7, 8	Not used, and shall be ignored by category NB UE if received.

Discussion: Already captured in RAN1 spec.
Decision: The document is noted.

R1-163966 Response to LS on questions on CIoT RAN2, Vodafone

The document was presented by RAN1 chair on behalf of Vodafone.

Discussion: No action to RAN1.
Decision: The document is noted.

R1-163967 Reply LS on NB-IoT RAN2, Huawei

The document was presented by Matthew Webb from Huawei and confirms that:

- 2 bits in NB-MIB will be used to indicate the two LSB of HyperSFN,
- Regarding paging and system information, RAN2 is under discussion and would like to inform RAN1 later the decision,
- The NB-SIB1 modification period is 40.96s.

Discussion: Already captured in RAN1 spec.
Decision: The document is noted.

R1-163971 Response LS on Reply LS on questions on NB-IOT RAN3, Nokia

The document was presented by Michel Robert from Nokia and states that RAN3 has agreed the new *NAS PDU Transmission Delay Indicator* IE in the S1AP Initial UE Message message of the attached CR against TS36.413 which is one of the draft RAN3 CRs for CIOT optimization. This IE represents an expected delay for the transmission of the NAS PDU as a factor relative to the delay assumed at the MME without this indication. RAN3 is still considering whether this IE could additionally be introduced for the UP CIOT optimization.

Discussion: No action to RAN1.
Decision: The document is noted.

R1-164119 Reply LS on questions on NB-IOT RAN2, Nokia

The document states that RAN2 agreed not to adjust NAS timers based on the coverage level in NB-IoT. RAN2 agreed that NAS timers should be long enough i.e. taking into account the worst transmission delay in NB-IoT. RAN2 may provide further feedback about transmission delay of the NAS PDU in non-NB-IoT later.

Discussion: No action to RAN1.
Decision: The document is noted.

R1-165417 LS on TB sizes for SI-messages for NB-IoT RAN2, Ericsson

The document was presented by Asbjorn Grovlen from Ericsson and asks RAN1 to feedback early at RAN1#85 meeting whether adding two new TB sizes of 56 bits and 120 bits for SI messages is possible, and if so, to inform RAN2 which values of ITBS/ISF from TS 36.213 should be used.

Discussion: Contributions available on the topic, for review during the week.

Decision: The document is noted.

UTRA related

R1-163962 Reply LS on Cell FACH DTx/DRx Enhancements signalling RAN2, Qualcomm

The document was presented by Vasanthan Raghavan from Qualcomm and provides the following feedback:

- RAN2 specification does not allow configuring the UE to only listen to one HS-SCCH every FACH DRX cycle.
- RAN2 specification allows configuring the UE to listen to two HS-SCCH sub-frames every FACH DRX cycle in the 2-level FACH DRX mechanism.

Decision: The document is noted.

Mobility enhancement related

R1-163968 LS on the feasibility of mobility enhancement solutions RAN2, ZTE

The document was presented by Zhisong Zuo from ZTE and raises:

- Q1: Would the accuracy of the TA value calculated according to the schemes in the attachment be sufficient for transmitting PUSCH/PUCCH/SRS at the target cell in either synchronous or asynchronous network? (RAN1/RAN4)
- Q2: Assuming the TA value can be calculated accurately, would starting PUCCH/PUSCH/SRS transmission directly (i.e. without power ramping step) be feasible? (RAN1/RAN4)
- Q5: Is it feasible that the UE performs simultaneous transmission to two intra-frequency cells in either synchronous or asynchronous network in the following two cases? (RAN1/RAN4)
 - Case 1: PUSCH/PUCCH/SRS to one intra-frequency cell and PUSCH/PUCCH/SRS/PRACH preamble to another intra-frequency cell
 - Case 2: PUSCH/PUCCH/SRS to one intra-frequency cell and PRACH preamble in the other intra-frequency cell

Decision: The document is noted.

R1-164644 Draft reply LS on the feasibility of mobility enhancement solutions ZTE

The document was presented by Zhisong Zuo from ZTE.

Decision: The document is noted.

R1-165226 Discussion on feasibility of mobility enhancement solutions Intel Corporation

The document was presented by Seunghye Han from Intel.

Discussion: Intel → RAN1 should discuss further based on the discussion in Section 3.

Decision: The document is noted.

R1-165227 DRAFT Reply LS on the feasibility of mobility enhancement solutions Intel Corporation

Decision: The document is withdrawn.

R1-165370 Discussion on the mobility enhancements solutions Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by Jari Lindholm from Nokia and provides views to the questions in [R1-163968](#). Some changes to the physical layer specifications may need to be done. Changes related to RACH-less handover are more straightforward (e.g. modification to SSTD measurement) but further studies are needed for make-before-break type of operation. It should be noted that currently RAN2, RAN3 and RAN4 have TU allocation for this work item but RAN1 does not have, so RAN1 cannot do detailed studies on these issues.

Discussion: Ericsson, Huawei → no TU allocated, further studies needed → that's should be the answer.

Decision: The document is noted. RAN1 will liaise to RAN2 and tell RAN2 that further study is needed in RAN1. Prepare a draft reply LS to RAN2 – (ZTE)

Friday

R1-165986 [Draft]Reply LS on the feasibility of mobility enhancement solutions ZTE

Decision: The document is noted and **final LS is agreed in [R1-165996](#).**

eLAA related

R1-163970 LS on RAN2 agreements on eLAA RAN2, Huawei

The document was presented by Xiayuan from Huawei.

Decision: The document is noted. For information to RAN1.

V2X related

R1-163975 LS on EPC procedures for providing eNB with V2X authorization information SA2, LGE

The document was presented by Hanbyul Seo from LGE and discusses EPC procedures for providing the eNB with V2X authorization information. Following two questions were raised:

- Whether it is required to have an indication to differentiate between a UE and an RSU implemented as a UE (i.e. UE-type RSU) from the PC5 radio resource allocation perspective?
- Whether it is required to have separate indications for different UE types/roles (i.e. Vehicle UE and Pedestrian UE) from the PC5 radio resource allocation perspective?

Discussion: No action to RAN1.

NEC has prepared a reply LS in [R1-165452](#).

Decision: The document is noted.

[R1-165414](#) Reply LS on EPC procedures for providing eNB with V2X authorization information SA1, LGE

The document was presented by Hanbyul Seo from LGE and feedbacks SA1's view whether it is acceptable to distinguish between the UE-type RSU, Vehicle UEs (UE in vehicle or installed in a vehicle) and Pedestrian UEs.

- From service requirements' perspective, there is no need to differentiate UEs.

Discussion: No action to RAN1.

Decision: The document is noted.

[R1-165415](#) Reply LS on V2X message characteristics SA3, TNO

The document was presented by RAN1 chair on behalf of TNO and informs RAN2 that SA3 is studying the security of V2X and will provide the requested size of a possible security overhead in due course.

Discussion: No action to RAN1.

Decision: The document is noted.

NR related

[R1-163972](#) LS on Parameters for WP5D Sharing and compatibility studies RAN4, Ericsson

The document was presented by Stefan Parkvall from Ericsson and asks RAN1 to take note of the intentions of RAN4 to prepare a response to parameters 3 to 7.4 in [R1-163390](#) and to any additional RF parameter of relevance. RAN4 also asks RAN1 to keep RAN4 informed about any progress on NR access scheme parameters, in particular for aspects that are believed to have any direct or indirect impact on RF characteristics such as unwanted emission levels, sensitivity, etc. This includes, but may not be limited to, the following parameters:

- Access technique (No. 1 in the LS)
- Modulation parameters (No. 2 in the LS)
- Channel spacing (No. 3 in the LS)
- Channel bandwidth (No. 4 in the LS)
- Signal bandwidth (No. 5 in the LS)
- Beam forming parameters
- Power dynamic range (No. 6.1 in the LS)
- SINR performance

RAN4 will keep RAN1 updated in its progress on the relevant sharing parameters and plans to send a more detailed LS to RAN1 at the May WG meetings. A first response from RAN1 would be very helpful during the May meetings, followed by a second response in August.

Decision: The document is noted. To be handled under AI 7.1.

[R1-164260](#) Formation of IEEE 1914 Next Generation Fronthaul Interface Working Group IEEE 1914 Next Generation Fronthaul Interface (NGFI) Working Group

The document was presented by RAN1 Chair and informs about the creation of IEEE 1914 Next Generation Fronthaul Interface (NGFI) Working Group to develop IEEE 1914.1 Standard for Packet-based Fronthaul Transport Networks. The scope of this project includes:

- Transport network architecture for the transport of mobile fronthaul traffic (e.g., Ethernet-based), including user data, management and control plane traffic.
- Requirements and definitions for the fronthaul networks, including data rates, timing and synchronization, quality of service etc.

Decision: The document is noted. RAN3 in charge of replying.

[R1-164286](#) LS on Remaining Issues on Path Loss Scenarios New York University Wireless

The document was presented by RAN1 Chair and provides NYU WIRELESS observations regarding the recent RAN1 84Bis channel modeling activity.

Discussion: Further discussion can be handled during the channel model session.

Decision: The document is noted.

The following LS have been received in the course of the week:

[R1-165655](#) LS to RAN1 on RAN2 agreements related to V2X RAN2, LGE

[R1-165722](#) Reply LS on questions on NB-IOT CT1, Nokia
[R1-165723](#) LS to RAN1 on SPS RAN2, LGE
[R1-165727](#) LS on V2V transmission path selection RAN2, Huawei
[R1-165753](#) **Reply LS on NB-IoT RRM requirements RAN4, Huawei**
Decision: The document is noted. See AI 6.1.6
[R1-165754](#) **LS on RRM measurement for NB-IOT RAN4, Ericsson**
Decision: The document is noted. See AI 6.1.6
[R1-165817](#) **Response LS on PUSCH transmission for eLAA RAN4, Nokia**
Decision: The document is noted. See AI 6.2.1.1
[R1-165838](#) **LS to RAN1 on RAN2 agreement on eLAA RAN4, Nokia**
Decision: The document is noted. See AI 6.2.1.5
[R1-165894](#) **Response to LS on uplink transmission gap in NB-IoT RAN4, Sony**
Decision: The document is noted. See AI 6.1.6
[R1-165895](#) **LS on Tx Gaps for Frequency Error Correction RAN4, Qualcomm**
Decision: The document is noted. See AI 6.1.6
[R1-166004](#) **Response LS on realistic power amplifier model for NR waveform evaluation RAN4, Nokia**
Decision: The document is noted. See AI 7.1.2

5 UTRA

[R1-165865](#) **Chairpersons' summary of the UMTS sessions UMTS Session Chairpersons (Huawei, Ericsson)**
The document was presented by Carmela Cozzo from Huawei and Florent Munier from Ericsson.
Decision: The document is endorsed and content is incorporated as below.

5.1 Maintenance of UTRA Releases 4 – 13

5.1.1 FDD

[R1-164364](#) **Clarifications to DCH enhancements feature Qualcomm Europe Inc.(France)**
Decision: The document is noted.

Proposal 1: Disallow multiple “maximum TTI” channels each with a transport format with zero transport blocks.
Proposal 2: Transmit UL TPC on DL when there is UL SRB transmission in the case of single transport channel configurations with 40 ms TTI.

Conclusion: Proposal 2 is agreed. Whether it impacts the specifications is FFS.

Proposal 3: Specify DL synchronization behavior in the context of DCH enhancements.

Proposal 4: When TFCI 0 is indicated UL DPCH is transmitted on both frames.

Proposal 5: NodeB should transmit TPC command on the first slot after gap.

Proposal 6: Disallow the concurrency of PCA2 and DCH enhancements.

Proposal 7: NodeB shall transmit in 20 ms mode when it doesn't detect UL reliably.

Conclusion: Proposal 7 is agreed. Whether it impacts the specifications is FFS.

Proposal 8: Disallow DCH enhancements with PS mapped to HS or EUL in the absence of CPC for 20 ms only mode.

Email discussion on proposals 2/4/7/8 from [R1-164364](#) until June 8, 2016 – (Qualcomm)

[R1-164365](#) **Clarifications on DCH enhancements feature Qualcomm Europe Inc.(France)**
Decision: The document is noted. Further revised in [R1-165862](#).

[R1-165862](#) **Rel-12 25.214 CR0747 F**

Decision: The document is agreed.

[R1-164366](#) **Clarifications on DCH enhancements feature (Mirror Rel-13) Qualcomm Europe Inc.(France)**

Decision: The document is noted. Further revised in [R1-165863](#).

[R1-165863](#) **Rel-13 25.214 CR0748 A**

Decision: The document is agreed.

[R1-164367](#) **Clarifications on DCH enhancements feature Qualcomm Europe Inc.(France)**

Decision: The document is noted. Further revised in [R1-165515](#).

[R1-165515](#) **Rel-12 25.212 CR0339 F**

Decision: The document is agreed.

[R1-164368](#) **Clarifications on DCH enhancements feature (Mirror Rel-13) Qualcomm Europe Inc.(France)**

Decision: The document is noted. Further revised in [R1-165516](#).

[R1-165516](#) **Rel-13 25.212 CR0340 A**

Decision: The document is agreed.

[R1-165336](#) **Clarification on UL DPCH 10ms Mode Ericsson**

Decision: The document is noted. (25.212 12.1.0 UTRA_DCHenh-Core CR0337 F)

For email approval until June 8, 2016 - (Ericsson)

[R1-165337](#) Clarification on UL DPCCH 10ms Mode Ericsson
Decision: The document is noted. (25.212 13.0.0 UTRA_DCHenh-Core 0338 A)

Not pursued.

[R1-165338](#) Clarification on measuring the transmitted code power for the downlink DPCCH slot formats #17 and #18
Ericsson Rel-12 25.215 12.1.0 UTRA_DCHenh-Core 0207 F

[R1-165339](#) Clarification on measuring the transmitted code power for the downlink DPCCH slot formats #17 and #18
Ericsson 25.215 13.0.0 UTRA_DCHenh-Core 0208 A

5.1.2 TDD

None

5.2 Multi-Carrier enhancements for UMTS - WID in RP-152290.

5.2.1 Performance evaluation

[R1-165084](#) Further evaluation results for [2+10]ms TTI in DB-DC-HSUPA Huawei, HiSilicon

Decision: The document is noted.

[R1-165085](#) Further evaluation results for [10+10]ms TTI in DB-DC-HSUPA and DC-HSUPA Huawei, HiSilicon

Decision: The document is noted.

[R1-165325](#) Further Evaluation of Multicarrier Enhancements for DC HSUPA Ericsson

Decision: The document is noted.

[R1-165326](#) Further Evaluation of Multicarrier Enhancements for DB-DC HSUPA Ericsson

Decision: The document is noted.

TP of evaluation in [R1-165084/5](#) revised in [R1-165509](#)

[R1-165509](#) TP on Evaluation results Huawei, HiSilicon

Decision: The document is noted and TP is agreed.

5.2.2 Other

[R1-165086](#) Impact on legacy terminals Huawei, HiSilicon

Decision: The document is noted.

[R1-165087](#) TP on impact on legacy terminals Huawei, HiSilicon

Decision: The document is noted.

[R1-165088](#) Impact on specifications Huawei, HiSilicon

Decision: The document is noted.

[R1-165089](#) TP on impact on specifications Huawei, HiSilicon

Decision: The document is noted.

[R1-165090](#) Conclusion on MultiCarrier enhancements Huawei, HiSilicon

Decision: The document is noted.

[R1-165327](#) Impact of Multicarrier Enhancements on L1 Mechanisms and standards Ericsson

Decision: The document is noted.

[R1-165328](#) View on the conclusions for the SI on Multicarrier Enhancements for UMTS Ericsson

Decision: The document is noted.

[R1-165329](#) Text proposal: Evaluation of Multicarrier Enhancements Ericsson

Decision: The document is noted. Revised in [R1-165508](#)

[R1-165508](#) Text proposal: Evaluation of Multicarrier Enhancements Ericsson

Decision: The document is noted and TP is agreed

[R1-165513](#) Text proposal: Evaluation of Multicarrier Enhancements Qualcomm

Decision: The document is noted and TP is agreed

[R1-165330](#) Text proposal: Impact of Multicarrier Enhancements on L1 Mechanisms and standards Ericsson

Decision: The document is noted.

[R1-165331](#) Text proposal: View on the conclusions for the SI on Multicarrier Enhancements for UMTS Ericsson

Decision: The document is noted.

[R1-165088](#) and [R1-165330](#) captured in [R1-165507](#)

[R1-165507](#) Text proposal on impact on specifications and UE implementation Ericsson

Decision: The document is noted and TP is agreed

[R1-165510](#) TP on conclusions for the Multicarrier Enhancements for UMTS Huawei

Decision: The document is noted and TP is agreed

Agreements

In summary, among the new proposed dual carrier solutions (including the DB-DC-HSUPA) 2ms+10ms or 10ms+10ms overall provide benefits depending on how much path loss is present and how much power is allocated to the primary carrier, and may

outperform 2ms+2ms DC- and DB-DC HSUPA. However the performance of single carrier is larger than the proposed dual carrier configurations when grant limitation does not occur.

- **Simulations and scenarios:** Scenarios discussions spanned multiple DC-HSUPA and DB-DC-HSUPA scenarios, and also single carrier HSUPA. The scenarios vary in terms of TTI lengths in each subcarrier, power setting per subcarrier and maximum transmitted UE power. Control channel overhead was not taken into consideration in the evaluation (see Section x.x.x). Several companies presented link simulations
- **In good coverage** i.e. when the UE is near the base station, legacy dual carrier 2ms+2ms TTI outperforms both for DB-DC-HSUPA and DC-HSUPA. It is also observed that 10ms+10ms in DC-HSUPA and 2ms+10ms in DB-DC-HSUPA outperform single carrier HSUPA.
- **In medium coverage** dual carrier configurations (i.e., 2ms+2ms and 10ms+10ms DC-HSUPA, as well as 2ms+2ms, 2ms+10ms and 10ms+10ms DB DC-HSUPA) are outperformed by single carrier 2 or 10 ms TTI only when it is possible to allocate the power of the single carrier with a value exceeding the power allocated to the primary uplink frequency of the DC or DB-DC cases. Among the new proposed dual carrier solutions (including the DB-DC-HSUPA) 2ms+10ms or 10ms+10ms overall provide similar benefits depending on how much path loss is present and how much power is allocated to the primary carrier, and outperforms 2ms+2ms DC- and DB-DC HSUPA. The UE-NodeB distance where the legacy 2ms DC-HSUPA (DB-DC-HSUPA) is outperformed by either the single carrier or the proposed dual carrier (i.e. DC or DB-DC HSUPA) configurations depends on the power configuration.
- **In poor coverage** (e.g. near the cell boundary), single carrier configuration with 10ms TTI dominates the overall performance.

R1-165511 LS on RAN1 multi-carrier enhancements for UMTS agreements RAN1

Decision: The document is agreed.

Updated TR in [R1-165514](#).

Email discussion on updated TR25.707 until Monday June 6, 2016 (Huawei)

5.3 DTX/DRX enhancements in CELL_FACH - WID in RP-160185.

5.3.1 DRX improvements

R1-164362 HS-SCCH DRX lite design with enhanced servicing ability Qualcomm Europe Inc.(France)

Decision: The document is noted.

R1-164363 Open Issues on HS-SCCH DRx lite proposal Qualcomm Europe Inc.(France)

Decision: The document is noted.

R1-165332 A view on DRX enhancements in CELL_FACH Ericsson

Decision: The document is noted.

QC proposal for HS-SCCH DRX Lite Design was noted. The following considerations for DRX Improvements are listed:

- Enable the network to schedule the UE in more than one subframe (Rx Burst of e.g. 0.4, 0.8 frames)
- Investigate the possibility of using HS-SCCH control information rather than HS-SCCH orders
- For example Mechanism and reliability
- Enable 640 ms mode in HS-SCCH /HS-DSCH DRX in CELL FACH mode in addition to existing values present in IE *HS-DSCH DRX cycle_{FACH}*

R1-165512 LS on HS-SCCH DRx Design in Cell FachRAN1, Qualcomm

Decision: The document is agreed.

Conclusion

Based on the analysis performed, the following observations have been made:

- Observation 1: The proposals made on the “DRX enhancements area” may certainly bring benefits in terms of battery savings based on creating more opportunities for the UE to stay in a sleep period.
- Observation 2: The analysis made in this contribution aims at keeping the impact on the specifications as low as possible, encouraging at the same time the use of the solutions that are already available in the standard.
- Proposal 1: Take observations 1 and 2 on “DRX enhancements” into account, and discuss the technical details within the TSG RAN WG2 since most of it design (i.e., a part from the assessment on the potential gains and the design of the HS-SCCH orders) is connected to the RAN2 specifications.

5.3.2 DTX improvements

R1-165091 Evaluation results for DTX in CELL_FACH Huawei, HiSilicon

Decision: The document is noted.

R1-165092 Further considerations on the design of DTX in CELL_FACH Huawei, HiSilicon

Decision: The document is noted.

Huawei will come back with revised results with an updated model according to the following:

- Back off timer starts as soon as the buffer of the UE is empty (TEBS)
- Account for blocking rate and noise rise (cell capacity issues).

R1-165333 **An assessment on the potential gains associated to the introduction of DTX in CELL_FACH** Ericsson
Decision: The document is noted.

R1-165334 **On applying DTX on the UL DPCCH prior to an E-DCH retransmission in CELL_FACH** Ericsson
Decision: The document is noted.

R1-165335 **Summary of the potential gains and technical implications of introducing DTX in CELL_FACH**
Ericsson
Decision: The document is noted.

Agreement: It may be possible to configure, the “Back-off” timer and the number of “Common E-DCH resources” available in the cell as a function of the CELL_FACH traffic, in order to achieve a trade-off between:

- amount of uplink interference,
- E-DCH resource blocking rate,
- Cell capacity

6 E-UTRA

6.1 Maintenance of E-UTRA Releases 8 – 13

6.1.1 Maintenance of E-UTRA Release 8 – 12

None.

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

R1-164196 **Draft 36.213 CR Clarification on PUCCH format 4/5 resource derivation** CATT

The document (draft CR to 36.213) was presented by Fang Chen Cheng from CATT.

Discussion: Huawei → UE behavior is not correctly captured. Doesn't work.

Decision: The document is noted.

- UE behaviour of TPC mapping is different for PUCCH formats 3, 4, and 5 in Rel-13 compared to that of PUCCH format 3 in Rel-12
 - No spec change is needed

R1-164733 **HARQ-ACK Codebook on PUSCH for TDD** Samsung

The document was presented by Aris Papasakellariou from Samsung.

- Proposal: For TDD and a UE configured with more than 5 cells, the HARQ-ACK codebook in the PUSCH is determined as for FDD.

Discussion: Late change according to Huawei – would like to understand spec impact, may need more time.

Decision: The document is noted. Continue offline discussion – (Samsung)

Friday: Email discussion until June 30th – (Samsung)

R1-164926 **Correction on citations to a DAI bits table** ITRI

The document from ITRI clarifies that the DAI bits should be expressed in Table 5.3.3.1.2-2 but not in Table 5.3.3.1.1-2 which is not existed in the specification.

Decision: The document is noted and CR0205 to 36.212 is agreed.

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

R1-164395 **Draft CR on CWp adjustment** Qualcomm Incorporated

The document (draft CR to 36.213) was presented by Srinivas Yerramalli from Qualcomm and clarifies that when the contention window size is increased, it is done so for every access priority class.

Discussion: Indication of rev in CR coversheet not needed.

Nokia, Huawei believe the change is not needed.

Decision: The document is noted.

LGE: following document addresses the same topic:

R1-164491 **Correction on CWS update for multiple channel access priority classes** LG Electronics

The document specifies the eNB behavior to adjust CWS for all channel access priority classes at the same time.

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

Friday:

R1-166039 CR on CWp adjustment Qualcomm Incorporated

Decision: The document is noted and CR0687 to 36.213 is agreed.

R1-164396 DCI Format 1C signaling and expected UE behavior Qualcomm Incorporated

The document was presented by Srinivas Yerramalli from Qualcomm and suggests adding the following statement to section 13A of 36.213.

The UE is not expected to monitor PDCCH with CRC scrambled by CC-RNTI outside of the Active Time defined in [8] in order to determine the configuration of occupied OFDM symbols in any subframe within the Active Time.

Discussion: Panasonic → second part of the sentence may be removed.

Decision: The document is noted.

R1-164397 Draft CR on DCI Format 1C signaling and expected UE behavior Qualcomm Incorporated

Discussion: Indication of rev in CR coversheet not needed.

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

Friday:

R1-165766 [DRAFT] LS on DRX and Reception of PDCCH scrambled by CC-RNTI Panasonic

Decision: The document is noted and **final LS is agreed in R1-166038.**

R1-164405 Draft CR on clarification for channel sensing Qualcomm Incorporated

The document was presented by Srinivas Yerramalli from Qualcomm and clarifies that the time quanta of re-attempting sensing the medium is a slot of duration 9 μs instead of Td.

Discussion: Indication of rev in CR coversheet not needed.

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

Friday:

R1-166022 CR on clarification for channel sensing Qualcomm Incorporated

Decision: The document is noted and CR0686 to 36.213 is agreed.

R1-164490 Discussion on CWS update for multiple channel access priority classes LG Electronics

The document was presented by ... from LGE.

Suggestion: Option 1 is supported for Rel-13 LAA.

- Option 1: eNB can change the channel access priority every DL transmission burst.
- Option 2: eNB can change the channel access priority class only when the adjusted CWS is the minimum value.
- Note that additional specification work is not necessary to support Option 1.

Discussion: Seems that all are fine with option 1 – no need to capture anything.

Decision: The document is noted.

R1-164492 Clarification on DL ending partial subframe LG Electronics

The document was presented by ... from LGE and proposes a TP for section 13A of 36.213 to clarify the UE behaviour for the reception of DL ending partial subframe and discusses the duration of PDCCH in DL ending partial subframe.

Discussion: Panasonic → doesn't see the need for Rel-13, may be addressed in Rel-14.

Decision: The document is noted.

R1-165324 Draft CR on LAA DL Multichannel access BROADCOM LIMITED

The document (draft CR to 36.213) was presented by Sindhu Verma from Broadcom and suggests extending to all the channels in the same sub-band across multiple groups the restriction of 4 slots pause before resuming countdown of the backoff counter on a CAT4 LBT channel.

Decision: The document is noted. Continue offline discussion – (Broadcom)

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

R1-164123 Evaluation of MU-MIMO performance with Rel-13 DM-RS Intel Corporation

The document was presented by Yuan Zhu from Intel and provides views on the two alternatives for the DM-RS sets of possibly multiplexed DM-RS antenna ports.

Decision: The document is noted.

R1-165105 Clarification of OCC=2 and OCC=4 MU-MIMO Transmission Ericsson

The document was presented by Mark Harrison from Ericsson.

- Clarify the specification of OCC=2 codepoints to either support OCC=2 only coscheduling or mixed OCC=2 and OCC=4 coscheduling.
 - Support mixed OCC=2 and OCC=4 transmission on ports 7, 8, 11, and 13 unless there is consensus among UE vendors that performance is a significant concern given UE implementation, considering that the Rel-12 table is also available.

- Specify UE behaviour as proposed in the first correction shown in section **Error! Reference source not found.**, and in the corresponding CR [R1-165105].
- Otherwise, specify UE behavior to support OCC=2 only coscheduling on ports 7 and 8, as proposed in [R1-163688].

Decision: The document is noted.

[R1-165106](#) MU-MIMO with Mixed Orthogonal Cover Code Length Ericsson

The document (CR0655 to 36.213) was presented by Mark Harrison from Ericsson.

- When a UE is scheduled with OCC=2 and a single layer on port 7, UE assumptions support PDSCH transmission on port 8 and 13 to other UEs.
- When a UE is scheduled with OCC=2 and a single layer on port 8, UE assumptions support PDSCH transmission on port 7 and 11 to other UEs.

Decision: The document is noted.

[R1-164317](#) Correction on UE assumption on DMRS ports ZTE

The document (draft CR to 36.213) clarifies the UE assumption in case of the new DMRS table in DCI formats 2C and 2D is configured for single-antenna port transmission scheme.

Discussion: Aligned with Intel.

Decision: The document is noted and agreed as CR0672 to 36.213 in [R1-165538](#).

[R1-164734](#) Draft CR on FD-MIMO codebooks (36.213) Samsung

Corrections to ensure alignment with the FD-MIMO codebook agreements made in RAN1#82b and RAN1#83.

Decision: The document is noted and agreed as CR0666 to 36.213 in [R1-165528](#).

[R1-164735](#) Draft CR on CSI-Reporting-Type in TS 36.213 Samsung

The document suggests changing the field name 'CSI-reporting-Type' to 'eMIMO-Type'.

Decision: The document is noted and agreed as CR0667 to 36.213 in [R1-165529](#).

[R1-164736](#) Clarification on non-PMI based CSI reporting in TS 36.213 Samsung

Observation: Two options for UE assumption on precoding matrix for PUSCH mode 3-0/PUCCH mode 2-0 are available.

- *Alternative 1: Remove all assumptions on precoding matrix in non-PMI based CSI reporting mode descriptions.*
- *Alternative 2: Release the assumption that 'a single precoding matrix is selected from the CBR' and clarify that 'for each subband a preferred precoding matrix is selected from the codebook subset assuming transmission only in the subband' in non-PMI based CSI reporting mode descriptions.*

Proposal: Support both options in observation and revise the corresponding descriptions in the current specification.

Discussion: No consensus.

Decision: The document is noted.

[R1-164737](#) Draft CR on non-PMI based CSI reporting in TS 36.213 Samsung

Decision: The document is not treated.

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

[R1-165932](#) Chairman's Notes of Agenda Item 6.1.5 on eMTC CRs Ad-hoc chair (Qualcomm)

The document was presented by Wanshi Chen from Qualcomm and provides the outcomes of eMTC maintenance session.

Decision: The document is endorsed. Contents incorporated below.

Terminology

[R1-164833](#) Correction on the usage of CEModeA and CEModeB for eMTC in TS 36.211 Huawei, HiSilicon

Decision: The document is withdrawn.

[R1-165450](#) Correction on the usage of CEModeA and CEModeB for eMTC in TS 36.213 Huawei, HiSilicon

([R1-164834](#))

Decision: The document is noted and agreed as CR0669 to 36.213 in [R1-165531](#).

PBCH

[R1-164402](#) Remaining issues for eMTC Qualcomm Incorporated

Decision: The document is noted.

[R1-165082](#) Draft CR for clarification of MPDCCH over empty CRS tones in PBCH repetition Qualcomm

Incorporated

Decision: The document is noted and agreed as CR0247 to 36.211 in [R1-165532](#).

DCI definition

[R1-164835](#) Correction on the DCI payload size for eMTC in TS 36.212 Huawei, HiSilicon

Decision: The document is noted and agreed as CR0207 to 36.212 in [R1-165533](#).
[R1-165386](#) Frequency hopping flag definition in DCI formats for BL/CE UE Ericsson

Decision: The document is noted, revised in and agreed as revision 1 of CR0206 to 36.212 in [R1-165540](#).
[R1-165392](#) Definition of number of MPDCCH repetitions for BL/CE UE Ericsson

Decision: The document is noted and CR0662 to 36.213 is agreed.

MPDCCH

[R1-164402](#) Remaining issues for eMTC Qualcomm Incorporated

Decision: The document is noted.

[R1-165671](#) Scrambling sequence initialization for PDSCH Qualcomm Incorporated, NTT DOCOMO

Decision: The document is noted and the CR is endorsed. Final CR0252 to 36.211 is agreed in [R1-165703](#).

[R1-164401](#) Draft CR for scrambling sequence initialization Qualcomm Incorporated

Decision: The document is noted and agreed as CR0248 to 36.211 in [R1-165534](#).

[R1-165081](#) Draft CR for clarification on starting subframe for MPDCCH Qualcomm Incorporated

Decision: The document is noted and the CR is endorsed. Final CR0681 to 36.213 is agreed in [R1-165672](#).

[R1-164602](#) eMTC MPDCCH corrections for 36.213 Sequans Communications

Decision: The document is noted and revision 1 of CR0653 to 36.213 is agreed in [R1-165746](#).

[R1-164843](#) On MPDCCH AL and search space for 8 EREGs per ECCE in TS 36.213. Huawei, HiSilicon

Decision: The document is noted and agreed as CR0670 to 36.213 in [R1-165536](#).

[R1-164844](#) On MPDCCH AL for 8 EREGs per ECCE in TS 36.211. Huawei, HiSilicon

Decision: The document is noted and the CR is endorsed. Final CR0249 to 36.211 is agreed [R1-165623](#).

[R1-164916](#) draft CR on MPDCCH quasi co-location Panasonic Corporation

Decision: The document is noted and agreed as CR0671 to 36.213 in [R1-165537](#).

[R1-165382](#) Draft LS on MPDCCH configuration for BL/CE UE Ericsson

Decision: The document is noted. Final LS is approved in [R1-165748](#) with the following update:

For case #3 above, from RAN1 specification point of view it is necessary to know the PRB indices of the 2 PRBs and the 4 PRBs, respectively. RAN1 notes that if the resourceBlockAssignment-r11 can be used to point out the PRB indices of the 2 PRBs then it is trivial to deduce the PRB indicates of the other 4 PRBs in a 6-PRB narrowband for BL/CE UEs. The second EPDCCH-SetConfig entity specified in TS 36.331 V13.1.0 would then not be used by BL/CE UEs in Rel-13.

[R1-165385](#) Enable cross-subframe channel estimation for BL/CE UE Ericsson

Decision: The document (CR0246 to 36.211) is noted and revised in:

[R1-165802](#) Enable cross-subframe channel estimation for BL/CE UE Ericsson

Decision: The document is noted and CR0246 is postponed. Revisit in RAN1#86.

[R1-165389](#) Overlapping MPDCCH search spaces for BL/CE UE Ericsson

Decision: The document (CR0659 to 36.213) is noted and revised in:

[R1-165867](#) Overlapping MPDCCH search spaces for BL/CE UE Ericsson

Decision: The document is noted and CR0659 is postponed. Revisit in RAN1#86.

[R1-165390](#) MPDCCH search space for random access in connected mode for BL/CE UE Ericsson

Decision: The document (CR0660 to 36.213) is noted and revised in:

[R1-165868](#) MPDCCH search space for random access in connected mode for BL/CE UE Ericsson

Decision: The document (CR0660rev1 to 36.213) is noted and revised in:

[R1-165958](#) MPDCCH search space for random access in connected mode for BL/CE UE Ericsson

Decision: The document is noted and revision 2 of CR0660 to 36.213 is for email approval until June 3rd – (Ericsson).

[R1-165393](#) PRB locations for Type0 MPDCCH search space for BL/CE UE Ericsson

Decision: The document is noted and CR0663 to 36.213 is agreed.

PDSCH

[R1-164124](#) Draft CR on PDSCH scrambling for eMTC Intel Corporation

Decision: The document is noted.

[R1-165312](#) Scrambling Sequence for paging MPDCCH and PDSCH Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document (draftCR to 36.211) is noted and revised in:

[R1-165578](#) Scrambling Sequence for paging MPDCCH and PDSCH Nokia, Alcatel-Lucent Shanghai Bell, Intel, Ericsson

Decision: The document is noted and the CR is endorsed. Final CR0251 to 36.211 is agreed in [R1-165686](#).

[R1-164927](#) Some corrections for eMTC ITRI

Decision: The document is noted and CR0245 to 36.211 is agreed.

[R1-165279](#) Correction on PDSCH reception timing for eMTC Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted and the CR is endorsed. Final CR0679 to 36.213 is agreed in [R1-165636](#).

[R1-165387](#) Starting OFDM symbol for SIB1-BR for BL/CE UE Ericsson

Decision: The document is noted and CR0657 to 36.213 is agreed.

[R1-165388](#) Collision between SIB1-BR and SI message for BL/CE UE Ericsson

Decision: The document is noted and CR0658 to 36.213 is agreed.

PUSCH

[R1-164124](#) Draft CR on PDSCH scrambling for eMTC Intel Corporation

Decision: The document is noted.

[R1-164488](#) Correction of cyclic hopping term for PUSCH DMRS NEC

Decision: The document is noted.

Conclusion: Regarding the issues discussed in [R1-164125](#) and [R1-164488](#), no CR is necessary.

[R1-164402](#) Remaining issues for eMTC Qualcomm Incorporated

Proposal 1: Capture the agreement that for $R=1$ the invalid subframes are overridden for the transmission of PUSCH/PUCCH.

Decision: The document is noted.

[R1-165080](#) Draft CR for overriding of valid-invalid subframes for $R=1$ Qualcomm Incorporated

Decision: The document is noted and the CR is endorsed. Final CR0250 to 36.211 is agreed in [R1-165673](#).

[R1-164842](#) Correction on RV determination for PUSCH in TS 36.213. Huawei, HiSilicon

Decision: The document is noted and the CR is endorsed. Final CR0675 to 36.213 is agreed in [R1-165624](#).

[R1-165395](#) Correction on collision of dynamically scheduled data and semi-statically scheduled data for Rel-13 eMTC Ericsson

Conclusion: CR in [R1-165395](#) is agreed in principle. As this CR is intended to replace 36.213 CR0637r1 (agreed in [R1-163787](#) – Ran1#84bis), final CR0637r2 to 36.213 is agreed in [R1-165568](#)

Continuous UL transmission

[R1-163974](#) LS on continuous uplink transmission in eMTC RAN4, Intel

Decision: The document is noted.

Not treated

[R1-165413](#) Continuous Uplink Transmission in eMTC Sony

[R1-165133](#) Discussion on UL gap for eMTC ZTE

[R1-165134](#) Draft reply LS on continuous uplink transmission in eMTC ZTE

[R1-165562](#) WF on UL gaps for eMTC Intel Corporation, Sony, Sequans, Sierra Wireless, ZTE

Decision: The document is noted. Revised in:

[R1-165681](#) WF on UL gaps for eMTC Intel Corporation, Sony, Sequans, Sierra Wireless, ZTE, Qualcomm, Ericsson

Decision: The document is noted. Further revised in:

[R1-165874](#) WF on UL gaps for eMTC Intel Corporation, Sony, Sequans, Sierra Wireless, ZTE, Qualcomm, Ericsson, Nokia, Alcatel-Lucent Shanghai Bell, Samsung, Nordic Semiconductor, Spreadtrum, KT Corporation, Nubia Technology, NEC, InterDigital, CATT

Decision: The document is noted.

Proposal:

- UL compensation gaps are introduced for HD-FDD eMTC UEs long transmissions PUSCH/PRACH.
 - During the UL gaps, the UE may switch to the DL and performs time/frequency synchronization.
 - Note that the UE is not required to process DL channels during the UL gaps.
 - The UL gap is defined by a gap period (X ms) and gap length (Y ms).
 - The values of X and Y are to be determined by RAN4 and are fixed in the specifications.

- Note: From RAN1 perspective, it may be beneficial to align the values of X and Y with the maximum frequency hopping granularity
- 1 bit capability signaling is introduced to enable more capable HD-FDD UEs to indicate that they do not need UL gaps during long UL transmissions to maintain the required frequency accuracy.
 - This bit is included in msg3, and also in the capability report of the UE.
- UL compensation gaps are applicable for PRACH and Msg3 transmissions during initial access regardless of the UE capability
 - For PRACH transmission, gaps do not apply if between two PRACH transmissions there is at least Z ms.
 - RAN4 to decide the value of Z
 - Note that for PDCCH ordered PRACH, the UE applies gaps following the capability signaling.
- During the UL gap durations, the corresponding PUSCH/PRACH transmissions are dropped
- Send an LS response to RAN4 and RAN2 informing them of the above and requesting:
 - RAN4 to determine the values of X, Y, and Z for eMTC UEs considering worst case coverage;
 - RAN2 to provide signaling support for the above capability signalling

Objected by: Huawei, HiSilicon

- Reason from Huawei, HiSilicon: it's a new feature, not essential, and there are other ways to approach this situation. Since it impacts multiple work groups, it should be handled at the RAN plenary.

Continue discussion offline, aim for concluding in RAN1 this week.

R1-165953 **WF on UL gaps for eMTC** **Intel Corporation, Sony, Sequans Communications, Verizon, Sierra Wireless, ZTE, Qualcomm, Ericsson, AT&T, Nokia, Alcatel-Lucent Shanghai Bell, Samsung, NTT DoCoMo, SoftBank Mobile, CATT, Panasonic, NEC, KT Corporation, MediaTek, LG Electronics, Nordic Semiconductor, Spreadtrum, Nubia Technology, InterDigital, Virtuosys, Sharp, WILUS Inc.**
Decision: The document is noted.

Proposal:

- UL compensation gaps are introduced for HD-FDD eMTC UEs long transmissions PUSCH/PRACH.
 - During the UL gaps, the UE may switch to the DL and perform time/frequency synchronization.
 - Note that the UE is not required to process DL channels during the UL gaps.
 - The UL gap is defined by a gap period (X ms) and gap length (Y ms).
 - The values of X and Y are to be determined by RAN4 and are fixed in the specifications.
 - Note: From RAN1 perspective, it may be beneficial to align the values of X and Y with the maximum frequency hopping granularity
- 1 bit capability signaling is introduced to enable more capable HD-FDD UEs to indicate that they do not need UL gaps during long UL transmissions to maintain the required frequency accuracy.
 - This bit is included in msg3, and also in the capability report of the UE.
- UL compensation gaps are applicable for PRACH and Msg3 transmissions during initial access regardless of the UE capability.
 - For PRACH transmission, gaps do not apply if between two PRACH transmissions there is at least Z ms.
 - RAN4 to decide the value of Z
 - Note that for PDCCH ordered PRACH, the UE applies gaps following the capability signaling.
- During the UL gap durations, the corresponding PUSCH/PRACH transmissions are dropped.
- Send an LS response to RAN4 and RAN2 informing them of the above and requesting:
 - RAN4 to determine the values of X, Y, and Z for eMTC UEs considering worst case coverage;
 - RAN2 to provide signaling support for the above capability signalling

Objected by: Huawei, HiSilicon

- Reason from Huawei, HiSilicon: it's a new feature, not essential, and there are other ways to approach this situation. Since it impacts multiple work groups, it should be handled at the RAN plenary. In addition, RAN4 wishes to study this, and RAN1 should take no action.

Intel: it is NOT a valid concern that the WF would impact multiple working groups
Further discussion till Friday.

Friday

R1-166015 **WF on UL gaps for eMTC** **Intel Corporation, Sony, Sequans Communications, Verizon, Sierra Wireless, ZTE, Ericsson, AT&T, Nokia, Alcatel-Lucent Shanghai Bell, Samsung, NTT DoCoMo, SoftBank Mobile, CATT, Panasonic, NEC, KT Corporation, MediaTek, LG Electronics, Nordic Semiconductor, Spreadtrum, Nubia Technology, InterDigital, Virtuosys, Sharp, WILUS Inc.**
Decision: The document is noted.

R1-166035 **WF on UL gaps for eMTC** **Intel Corporation, Sony, Sequans Communications, Verizon, Sierra Wireless, ZTE, Ericsson, Qualcomm, AT&T, Nokia, Alcatel-Lucent Shanghai Bell, Samsung, NTT DoCoMo, SoftBank**

Mobile, CATT, Panasonic, NEC, KT Corporation, MediaTek, LG Electronics, Nordic Semiconductor, Spreadtrum, Nubia Technology, InterDigital, Virtuosys, Sharp, WILUS Inc.

Decision: The document is agreed.

[R1-165784](#) [DRAFT] Reply LS on continuous uplink transmission in eMTC Intel

Decision: The document is noted and [final LS is agreed in R1-166042](#).

Collision between PUCCH and PUSCH

[R1-164597](#) Collision between PUCCH and PUSCH Sequans Communications

Decision: The document is noted.

[R1-164599](#) Correction for collision between PUCCH and PUSCH Sequans Communications

Decision: The document is noted.

[R1-165280](#) Correction on UCI multiplexing on PUSCH Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted.

[R1-165394](#) Multiplexing of UCI and PUSCH for BL/CE UE Ericsson

Decision: The document is noted.

[R1-164840](#) Correction on collision between PUCCH and PUSCH in TS 36.213 Huawei, HiSilicon

Decision: The document is noted.

[R1-165708](#) Correction on UCI multiplexing on PUSCH Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted and the CR0683 to 36.213 is [endorsed](#), with the following update:

- For a BL/CE UE, and remove BL/CE in the sub-bullets
- Double-check whether FDD/TDD or FS1/FS2 is used, and align the terminology if necessary
- The CR in [R1-165625](#) is withdrawn.

Final CR agreed in [R1-165767](#) (CR0683r1), which is further revised and [revision 2 is agreed in R1-165791](#)

Decision: The document is noted.

PUCCH

[R1-164837](#) Correction on the supported PUCCH format for CEModeA in TS 36.213 Huawei, HiSilicon

Decision: The document is noted and draft CR is endorsed. Final CR in [R1-165625](#) – withdrawn according to the conclusion to [R1-165767](#)).

[R1-164838](#) Clarification on collision between SR and PDSCH with repetitions in TS 36.213 Huawei, HiSilicon

Decision: The document is noted. Draft CR is postponed till next meeting. Revisit in RAN1#86.

[R1-165383](#) PUCCH frequency retuning for BL/CE UE Ericsson

Decision: The document is revised in:

[R1-165869](#) PUCCH frequency retuning for BL/CE UE Ericsson

Decision: The document is noted.

[R1-165903](#) WF on PUCCH frequency retuning for BL/CE UE Ericsson, Qualcomm, NEC, Sequans, Virtuosys, Softbank, NTT DoCoMo, Sierra Wireless, CATT, Sony, Altair, LG Electronics, InterDigital, Huawei, HiSilicon, Verizon, AT&T, ZTE

Decision: The document is noted.

Proposal:

- Revoke the following RAN1#84 agreement:
 - Shortening of PUCCH 1/1a/1b in the first slot of a subframe is realized by using in the first slot with PUCCH 1/1a/1b resource mapping from symbols 1 through 6 in the first slot while maintaining the existing PUCCH 1/1a/1b DM-RS locations.
- Agree the following proposal:
 - For PUCCH 1/1a/1b, UL retuning gaps are generated by puncturing of the affected SC-FDMA symbols: last symbol and first symbol of the prior and the latter subframe respectively
 - However, if the prior subframe is an SRS subframe, shortened format of legacy behaviour is applied, i.e., shortened format is applied in the prior subframe, and first symbol of the latter subframe is punctured.

Objected by Samsung:

- Reasons: orthogonality is broken for multiplexing different UEs, difficult to achieve the target of 10^{-3} performance

Further discussion till Friday.

Friday

Samsung still maintained their opinion – performances will be broken – suggested having an email discussion and revisit at next meeting.

Chair: can we have it as working assumption? Samsung: no
Ericsson→ what will the outcomes of an email discussion be?
NO consensus.

CSI definition

[R1-164399](#) Clarification on CSI measurements Qualcomm Incorporated

Decision: The document is noted.

[R1-165542](#) Clarification of CSI measurements Qualcomm Incorporated ([R1-164400](#))

Decision: The document is noted. Email discussion on the issue raised in [R1-164399](#) and [R1-165542](#) until June 10th

[R1-164738](#) Draft CR on CSI Reporting Samsung

Decision: The document is noted. The first change in [R1-164738](#) is endorsed. Final CR0674 to 36.213 is agreed in [R1-165622](#)

[R1-164839](#) Correction on PDSCH transmission scheme assumed for TM9 CSI reference resource in TS 36.213
Huawei, HiSilicon

Decision: The document is noted. The change in [R1-164839](#) is endorsed. Final CR0685 to 36.213 is agreed in [R1-165737](#)

[R1-164739](#) Draft CR on A-CSI reporting for TM6 Samsung

Decision: The document is noted and the draft CR endorsed. Final CR0673 to 36.213 is agreed in [R1-165621](#)

SRS handling

[R1-164841](#) Correction on SRS frequency location in TS 36.213 Huawei, HiSilicon

Decision: The document is noted. The change in [R1-164841](#) is agreed in principle, further discussion offline especially regarding the wording. Final CR0678 to 36.213 is agreed in [R1-165627](#)

[R1-165278](#) Channel interleaver correction for eMTC Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted and the CR is endorsed. Final CR0208 to 36.212 is agreed in [R1-165635](#)

Random access

[R1-164836](#) Clarification on Msg3 PUSCH repetition level in TS 36.213 Huawei, HiSilicon

Decision: The document is noted and the CR is endorsed. Final CR0208 to 36.212 is agreed in [R1-165626](#)

[R1-164865](#) Correction on the determining PRACH starting subframe in TS 36.211 Huawei, HiSilicon

Decision: The document is noted and the draft CR is postponed. Revisit in RAN1#86.

[R1-165314](#) MCS for Random Access Response Grant Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is revised in:

[R1-165579](#) MCS for Random Access Response Grant Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted and the draft CR is endorsed. Final CR0682 to 36.213 is agreed in [R1-165687](#).

Paging occasion overlap

[R1-164398](#) Discussion on paging occasion overlap for eMTC Qualcomm Incorporated

Decision: The document is noted and the topic is postponed. Revisit in RAN1#86.

[R1-165543](#) Correction on DCI payload size Qualcomm

Decision: The document is noted.

[R1-165646](#) Correcting configuration parameter for number of PRB-pairs Sequans Communications

Decision: The document is noted and the draft CR is endorsed. Final CR0680 to 36.213 is agreed in [R1-165682](#)

Not treated.

[R1-165785](#) Draft 36.211 eMTC CR capturing RAN1 #84bis and #85 agreements Ericsson

[R1-165786](#) Draft 36.212 eMTC CR capturing RAN1 #84bis and #85 agreements Ericsson

[R1-165787](#) Draft 36.213 eMTC CR capturing RAN1 #84bis and #85 agreements Ericsson

[R1-165993](#) CAT-M1 Coverage Enhancement Analysis Sierra Wireless, Ericsson, Sequans

6.1.6 Maintenance of Release 13 NB-IoT

[R1-165933](#) Chairman's Notes of Agenda Item 6.1.6 on NB-IoT CRs Ad-hoc chair (Qualcomm)

The document was presented by Wanshi Chen from Qualcomm and provides the outcomes of NB-IoT maintenance session.

Decision: The document is endorsed. Contents incorporated below.

[R1-165111](#) Introduction of NB-IoT Motorola Mobility 36.213 13.1.1 CR0656 B

Decision: The document is already agreed (decision taken during email thread [84b-02]).

[R1-165396](#) 36.201CR0014r1 Introduction of NB-IoT Nokia, Alcatel-Lucent Shanghai Bell 36.201 13.1.0
CR0014r1 B

Decision: The document is already agreed (decision taken during email thread [84b-02]).

[R1-165754](#) **LS on RRM measurement for NB-IOT** RAN4

RAN4 LS providing the definitions of NRSRP and NRSRQ.

Decision: The document is noted.

[R1-165753](#) **Reply LS on NB-IoT RRM requirements** RAN4

Decision: The document is noted.

[R1-165894](#) **Response to LS on uplink transmission gap in NB-IoT** RAN4

Decision: The document is noted.

[R1-165895](#) **LS on Tx Gaps for Frequency Error Correction** RAN4

Decision: The document is noted.

[R1-164026](#) Updated Draft NB-IoT CR to 36.213 post Busan Motorola Mobility Germany GmbH

[R1-164305](#) Introduction of LTE Physical Layer Enhancements for NB-IoT Motorola Mobility Germany GmbH

[R1-164562](#) **Introduction of NB-IoT** Ericsson

Decision: The document is noted and CR0033 to 36.214 is agreed.

PSS/SSS

[R1-164403](#) **Potential issues of NB-SSS in asynchronous deployment** Qualcomm Incorporated

Decision: The document is noted.

Conclusion:

- There is no consensus to standardize a solution to address the issue identified in [R1-164403](#) and there is no consensus to send an LS to RAN4.

SI Handling

[R1-164863](#) **On TBS values for NB-SI transmission** Huawei, HiSilicon

Decision: The document is noted.

[R1-165127](#) **Remaining issue on SI messages for NB-IoT** ZTE

Decision: The document is noted.

[R1-165231](#) **TBS values and resource mapping for SI messages** Intel Corporation

Decision: The document is noted.

[R1-165602](#) **WF on TBS for NB-IoT SI-messages** Huawei, HiSilicon, CATT, Ericsson, Intel, Nokia, ASB, QC,

Sony, Vodafone

Decision: The document is noted. Also supported by MediaTek.

Agreement:

- It is feasible to support additional TBS of 56, and 120 bits for SI-messages (not including SIB1-NB)
- Recommend RAN2 to select:
 - $I_{SF} = 1, I_{TBS} = 1$ (for 56 bits); and
 - $I_{SF} = 1, I_{TBS} = 4$ (for 120 bits)
- Send an LS to RAN2 based on the above bullets, draft LS in [R1-165694](#), agreed in [R1-165710](#)

[R1-165663](#) **WF on SI messages for NB-IoT** ZTE, Nubia Technology

Decision: The document is noted.

NPDCCH

[R1-164291](#) **Monitoring of NPDCCH after NPDSCH/NPUSCH transmission** Sony

Decision: The document is noted.

Agreement:

- An NB-IoT UE is required to monitor for NB-PDCCH for UL and DL grant 3 ms after the end of the NB-PUSCH transmission.
 - Up to the editor how to capture the bullet

[R1-164404](#) **On NPDCCH search space** Qualcomm Incorporated

Decision: The document is noted.

[R1-165629](#) **WF on collision with SI transmission and overlapping NPDCCH search space** Qualcomm, Ericsson,

MediaTek, Huawei, HiSilicon, ZTE

Decision: The document is noted.

Agreement:

- A UE is not required to monitor an NPDCCH search space that ends later than 4ms before the beginning of the next NPDCCH search space.
 - The above rule also applies to partial NPDCCH search space period.
- Subframes of NPDSCH/NPDCCH for unicast, paging, and RAR that overlap with SI transmission are postponed to the next valid DL subframes

[R1-164847](#) Clarification on NPDCCH monitoring in 36.213 Huawei, HiSilicon

Decision: The document is noted.

Agreement:

- Clarify that “the corresponding NB-PDSCH or NB-PUSCH transmission” includes the ACK/NACK transmission on NPUSCH format 2 scheduled in DCI Format N1.
- An NB-IoT UE that has received a NPDCCH order is not required to monitor NPDCCH for any further DL or UL grant during the time period between the end of the NPDCCH order and the start of the ordered NPRACH transmission.

[R1-164877](#) Discussion on Scheduling Delay with Transmission Gaps CMCC

Decision: The document is noted.

[R1-165139](#) Discussion on starting subframe of NPDCCH search space MediaTek Inc.

Decision: The document is noted.

[R1-165670](#) WF on NPDCCH starting subframe MediaTek, LGE, Huawei, HiSilicon

Decision: The document is noted. Also supported by Samsung.

Agreement:

- The formula for starting subframe of NPDCCH is updated as $(10n_f + \lfloor n_s/2 \rfloor) \bmod T = \lfloor \alpha_{\text{Offset}} T \rfloor$ where
 - α_{Offset} is signaled via RRC $\{0, 1/8, 1/4, 3/8\}$, i.e., α_{Offset} is an UE-specific parameter configured by RRC for USS and cell-specific and PRACH resource specific parameter for CSS for RAR/Msg 3 re-tx/Msg 4

Send an LS to RAN2, draft LS in [R1-165695](#) (to update “two additional parameters”, potentially include other possible new parameters) – (Huawei)

[R1-165695](#) [DRAFT]LS on RRC parameter list for NB-IoT Huawei

Decision: The document is noted, revised in [R1-165709](#), which is endorsed. **Final LS is agreed in [R1-165906](#).**

[R1-165730](#) L1 parameters list for NB-IoT Huawei

Decision: The document is noted and included in [R1-165906](#).

[R1-165229](#) Some remaining issues on NPDCCH related to TS 36.213 Intel Corporation

Decision: The document is noted.

Agreements:

- Adopt the recommended changes to Section 16.4.1 and Section 16.6 of TS 36.213 as indicated in Section 2 of [R1-165229](#)
- If the higher layer parameter NB-IoT-Operation-mode (or operationMode) indicates in-band mode of operation (i.e., set to ‘00’ or ‘01’), the starting OFDM symbol for NPDCCH ($L_{\text{NPDCCHStart}}$) is given by the higher layer parameter lteControlRegionSize.

PDSCH

[R1-165228](#) On resource allocation for SIB1-NB in TS 3.213 Intel Corporation

Decision: The document is noted.

Agreement: The proposed text change in [R1-165228](#) is endorsed

[R1-165230](#) On scrambling initialization for NPDSCH Intel Corporation

Decision: The document is noted.

Agreements:

- For NPDSCH carrying SIB1-NB, the scrambling is reinitialized at the first subframe carrying a repetition of the codeword.
- For NPDSCH carrying SI messages other than SIB1-NB, the scrambling is reinitialized at the first subframe carrying a repetition of the codeword.

[R1-164100](#) Time reference for A/N transmission Huawei, HiSilicon

Decision: The document is noted.

[R1-164126](#) Time domain resource allocation for NPUSCH with 1-bit A/N feedback Intel Corporation

Decision: The document is noted.

[R1-165000](#) Time Reference for Ack/Nack Transmission Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted.

[R1-165124](#) Remaining issues on UL Transmission reference for NB-IoT ZTE

Decision: The document is noted.

[R1-165539](#) WF on time reference of ACK/NACK of NPDSCH Huawei, HiSilicon, CATT, Intel, Panasonic, u-blox, ZTE

Decision: The document is noted.

[R1-165664](#) WF on time reference of ACK/NACK of NPDSCH Huawei, HiSilicon, CATT, Intel, Panasonic, u-blox, ZTE, Samsung, China Unicom, Astri, NEUL, CATR

Decision: The document is noted. Also supported by China Telecom, Potevio.

[R1-165651](#) WF on Time Reference for Ack/Nack Transmission Ericsson, Nokia, Alcatel-Lucent Shanghai Bell, Sony, Verizon, AT&T, LG, Sierra Wireless

Decision: The document is noted.

[R1-165884](#) WF on Time Reference for Ack/Nack Transmission Ericsson

Decision: The document is noted.

Agreements:

- A/N transmission delay is relative to the end of the corresponding NPDSCH transmission plus 12ms.
- Introduce both odd and even numbers for the time offset for 15 kHz ACK/NACK.
- It is proposed to use the following timing offsets in the DCI instead of {0, 2, 4, 6} ms for 15kHz ACK/NACK transmission.
 - {0 2 4 5}

DL & UL Gap

Decision: The document is noted.

[R1-164290](#) UL Transmission Gap Duration Sony

Decision: The document is noted.

[R1-164376](#) On UL transmission gaps and related RAN4 analysis Huawei, HiSilicon

Decision: The document is noted.

[R1-165126](#) Potential issue on value of DL Gap configuration for NB-IoT ZTE

Decision: The document is noted.

[R1-165131](#) Issues on NPRACH UL Gap configuration ZTE

Decision: The document is noted.

[R1-165644](#) WF on clarification for timing of DL transmission ZTE, MTK, HW, HiSilicon, Sony

Decision: The document is noted.

Agreement: If NPUSCH UL Gap is inserted at the end of NPUSCH transmission, the UE resumes monitoring of N-PDCCH from the end of the UL gap.

[R1-165645](#) WF on NPRACH UL gap ZTE, MTK, Sony

Decision: The document is noted.

Agreement: If a NPRACH UL Gap is inserted at the end of NPRACH opportunity, the start of RAR detecting window is from the end of the UL gap.

RACH

[R1-164862](#) Clarification on UL grant in NB-RAR in 36.213 Huawei, HiSilicon

Decision: The document is noted.

Agreement: When $I_{\text{delay}} = 0$ for UL grant in NB-RAR, $k_0 = 13$.

[R1-164939](#) Clarification on repetition and Pseudo-random hopping of NPRACH NEC Corporation

Decision: The document is noted.

[R1-165355](#) NB-IoT-NPDCCH ordered PRACH Ericsson

Decision: The document is noted.

[R1-165652](#) WF on NPDCCH ordered PRACH Ericsson

Decision: The document is noted. Also supported by ZTE.

Agreement:

- Introduce the tone index in DCI format N1 for the NPDCCH ordered PRACH.
- A field of 6 bits in DCI format N1 should be used to indicate the tone index as
 - Indicate the absolute tone index.
 - The tone index in DCI format N1 has to indicate a tone in a PRACH resource matching the PRACH repetitions.
 - A tone outside this PRACH resource is not allowed.

PUSCH

[R1-164998](#) **Handling of cyclic shift in UL DMRS sequence selection** **Nokia, Alcatel-Lucent Shanghai Bell**

Decision: The document is noted.

[R1-165130](#) **Comments on NPUSCH format 1 and TP for 36.213** **ZTE**

Decision: The document is noted.

Conclusion: The TP in [R1-165130](#) is endorsed

[R1-165128](#) **Remaining issues on DMRS for NPUSCH format 2** **ZTE**

Decision: The document is noted.

[R1-165630](#) **WF on NB-IoT UL DMRS Hopping** **Qualcomm**

Decision: The document is noted. Also supported by Panasonic.

Agreements:

- To adopt the legacy LTE group hopping, as defined in Sec. 5.5.1.3, TS36.211, for NB-IoT UL DMRS for N-PUSCH format 1:
 - The group hopping pattern is revised from legacy LTE with 30 replaced by M in the following equations
 - $u = (f_{gh}(n_s) + f_{ss}) \bmod M$
 - $f_{gh}(n_s) = \begin{cases} 0 & \text{if group hopping is disabled} \\ \left(\sum_{i=0}^7 c(8n_s + i) \cdot 2^i \right) \bmod M & \text{if group hopping is enabled} \end{cases}$
 - $c_{init} = \left\lfloor \frac{n_{ID}^{RS}}{M} \right\rfloor$
 - $f_{ss}^{PUSCH} = (N_{ID}^{cell} + \Delta_{ss}) \bmod M$
 - $f_{ss}^{PUSCH} = n_{ID}^{RS} \bmod M$
 - In the above, M=30, 14, 12, and 16 for, respectively, 12-tones, 6-tone, 3-tone and single-tone cases.
 - The group-hopping pattern is reset:
 - Every subframe for multi-tone transmission
 - Every RU for single-tone transmission
 - The group-hopping for single-tone transmission only applies to the Hadamard sequence index
 - n_{ID}^{PUSCH} is not defined, and $n_{ID}^{RS} = N_{ID}^{Ncell}$.
- Send an LS to RAN2 (cc-RAN4) to inform the above including the need to have
 - a new cell-specific RRC parameter, Group-hopping-enabled, to enable and disable the group hopping,
 - a new UE-specific RRC parameter, Disable-group-hopping to disable the function despite it is enabled by the cell-specific parameter unless the PUSCH transmission corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure,
 - a new RRC parameter for the offset, Δ_{ss} (the same range of the one in LTE)

Post meeting: It is noticed that LS sent to RAN2 did not include RAN4 – see email thread [85-26].

Collision Handling

[R1-164846](#) **Clarifications on collision handling in 36.211 and 36.213** **Huawei, HiSilicon**

Decision: The document is noted.

[R1-164991](#) **NB-IoT - Collision handling** **Ericsson**

Decision: The document is noted.

[R1-165125](#) **Collision handling for NB-IoT** **ZTE**

Decision: The document is noted.

[R1-165132](#) **On collision between NPRACH and NPUSCH** **ZTE**

Decision: The document is noted.

General/Multiple

[R1-164493](#) **Discussion on remaining issues on NB-IoT/LG Electronics**

Decision: The document is noted.

Agreement:

- When a UE is configured with additional PRB in inband where anchor PRB is in guard band
 - If same-PCI indicator is true, the behaviour is defined the same in all cases
 - If same-PCI indicator is not true, the behaviour is defined the same in all cases

R1-164494 Discussion and comments on NB-IoT CRs LG Electronics

Decision: The document is noted.

Agreement:

- Introduce the following definition in 36.211:
 - N: A constant equal to 2048 for $\Delta f=15\text{kHz}$, 4096 for $\Delta f=7.5\text{kHz}$ and 8192 for $\Delta f=3.75\text{kHz}$

R1-164577 Clarifications for NB-IoT CRs Spreadtrum Communications

Decision: The document is noted. The first change in [R1-164577](#) is to be handled by the editor.

R1-165002 Non-anchor PRB location for NB-IoT multi-carrier operation Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted.

R1-165129 Comments on UE procedures for NB-IoT and TP for 36.213 ZTE

Decision: The document is noted.

Agreement: The TP in [R1-165129](#) is endorsed

Others

R1-164848 Draft 36.300 section 5 CR for NB-IoT Huawei

Decision: The document is noted.

Agreement:

- The draft CR in [R1-164848](#) is endorsed (removing the changes on changes), send an LS to RAN2 – (Huawei)
- [R1-165600](#) (the updated CR)
- The draft LS is in [R1-165601](#), with the final LS agreed in [R1-165711](#)

R1-164917 Clarification of antenna port usage of NB-IoT Panasonic Corporation

Decision: The document is noted.

Agreement:

- When the same-PCI indicator is set to true, to use antenna port 0 and 1 for the transmission of NRS, NPDCCH, NPDSCH and NBPCH. When the same-PCI indicator is set to false, to use new antenna port (for example port 1000 and 1001) for the transmission of NRS, NPDCCH, NPDSCH and NBPCH.
 - How to capture the bullet is up to the editor
- A UE may assume the antenna ports 1000 – 1001 of a serving cell are quasi co-located (as currently defined in 36.213 that is introduced in 36.211) with respect to delay spread, Doppler spread, Doppler shift, average gain, and average delay.
 - How to capture the bullet is up to the editor

R1-165879 WF on NPDCCH search space monitoring MediaTek, Nokia, Huawei, Hisilicon, Qualcomm, Sony, ZTE

Decision: The document is noted.

Agreement:

- UE is not required to simultaneously monitor CSS for paging and CSS for RAR/Msg 3 re-tx/Msg 4.

R1-165949 WF on NPUSCH format 2 Phase Rotation ZTE

Decision: The document is noted.

- ZTE: it is noted for single-tone modulation, the waveform phase transition requirement agreed in previous meeting does not apply for NPUSCH format 2.

Not treated:

[R1-165683](#) On NSSS design and SFN index detection ambiguity Intel Corporation
[R1-165747](#) WF on NB-IoT Multi-PRB operation LG Electronics, Nokia, ASB
[R1-165788](#) WF on NB-IoT UL DMRS Hopping Qualcomm

Friday

[R1-165985](#) WF on UL gaps for NB-IoT Huawei, HiSilicon, Sony, Ericsson, MediaTek, Vodafone, ZTE, Nubia Technology, Spreadtrum, u-blox

Decision: The document is noted. Revised in:

[R1-166023](#) WF on UL gaps for NB-IoT Huawei, HiSilicon, CATT, Ericsson, Intel, MediaTek, Nokia, Samsung, Sony, u-blox, Vodafone, ZTE, Nubia Technologies

Decision: The document is agreed.

[R1-166009](#) [DRAFT]LS on NB-IoT Performance Huawei, HiSilicon, Vodafone, Deutsche Telekom, CMCC, China Telecom, China Unicom, NTT DOCOMO

Decision: The document is noted, revised in [R1-166024](#). Further revised in:

[R1-166036](#) [DRAFT]LS on NB-IoT Performance Huawei, HiSilicon, Vodafone, Deutsche Telekom, CMCC, China Telecom, China Unicom, NTT DOCOMO

Decision: The document is noted and [final LS is agreed in R1-166037](#).

Rapporteur shall submit the list of all agreements by May 30th.

Editors will provide updated NB-IoT CRs to 36.211, 36.212, 36.213 and 36.214 by June 3rd, for email approval by June 7th.

6.1.7 Other

[R1-165093](#) Correction on search space to decode the PDCCH configured by the SC-N-RNTI TD Tech Ltd
36.213 13.1.1 LTE_SC_PTM-Core CR0654 F

If a UE is configured by higher layers to decode PDCCH with CRC scrambled by the SC-N-RNTI, the UE shall monitor common search space to decode the PDCCH with CRC scrambled by the SC-N-RNTI.

Decision: The document is noted and [CR0654 to 36.213 is agreed](#).

[R1-165168](#) Introduction of 60ms periodicity for wideband CQI/PMI reporting Nokia, Alcatel-Lucent Shanghai Bell, Apple, Broadcom, Ericsson, Intel, Mediatek 36.213 13.1.1 TEI13 draftCR B

Tables 7.2.2-1A and 7.2.2-1C are modified so that some of the currently reserved $I_{CQI/PMI}$ values are used to define 60ms CQI/PMI reporting periodicity and associated offsets.

Decision: The document is noted and [agreed as CR0668 to 36.213 in R1-165530](#).

6.2 LTE Release 14

6.2.1 Enhanced Licensed-Assisted Access to Unlicensed Spectrum - WID in [RP-160407](#).

[R1-165934](#) Chairman's Notes of Agenda Item 6.2.1 on eLAA Ad-hoc chair (Nokia, Ericsson)

The document was presented by Matthew Baker from Nokia and provides the outcomes of the eLAA session.

Decision: The document is endorsed. Contents incorporated below.

Friday

Email approval regarding the remaining yellow colour parts as highlighted below until June 6th – (Ericsson)

Editors will submit draft CRs (36.201, 36.211, 36.212, 36.213, 36.214 (if needed)) until August 18th.

Rapporteur shall submit agreement and WA lists until June 30th

6.2.1.1 PUSCH design

TPC and PHR

[R1-165557](#) WF on Uplink Power Control in eLAA LG Electronics, ZTE Microelectronics, Nubia, Intel

Decision: The document is noted.

Agreement:

- UE's path-loss calculation for the open loop power control for uplink is based on the CRS in DRS within DMTC
 - Note: There may be no specification impact

Agreement:

- PHR for a subframe shall be calculated based on the scheduled uplink transmissions in LAA SCells regardless of whether the actual transmission is performed or not performed

Resource Allocation for eLAA

[R1-165817](#) Response LS on PUSCH transmission for eLAA RAN4, Nokia

Decision: The document is noted.

[R1-165800](#) WF on PUSCH resource allocation for eLAA Huawei, HiSilicon, Intel, Qualcomm, NTT DOCOMO, LGE

Decision: The document is noted.

Agreement

- Confirm the previous working assumption
 - the 10RBs are spaced equally in frequency domain for 20MHz
 - Example for 20MHz eLAA SCell: interlace 0 is composed of RBs 0,10,20,...,90
 - Scheduling 70 UL RBs is not supported

Agreement: One interlace is composed of 10RB/interlace for 10MHz

- Companies are encouraged to provide their preference on the RA alternatives
 - Alt 1: UL resource allocation type 0
 - Supported by: Intel, LGE, Samsung, Huawei, HiSilicon, ZTE, Lenovo, Sharp, Panasonic, WILUS
 - Alt 2: bitmap based resource allocation
 - Qualcomm, NTT DOCOMO, Nokia, ASB, Ericsson, Kyocera, CATT, Mediatek, Fujitsu
 - 2nd preference: ZTE, Sharp, WILUS
 - Alt 3: predefined resource allocation patterns with the number of bits being same or less than Alt. 1
 - Define all contiguous patterns + the patterns in the set [0+5, 1+6, ...]
 - Define all contiguous patterns + other patterns
 - Examples provided in [R1-164055](#)
 - Define some number of patterns based on the number of interlaces allocated
 - More patterns for fewer interlaces
 - 2nd preference: Huawei, HiSilicon
 - Alt 4: RRC configure between Alt 1 and Alt 2
 - 2nd preference: Intel

Alt 1: Objected by: Qualcomm, Nokia, Mediatek

Alt 2: Objected by: Huawei, HiSilicon, Intel

Alt 3: Objected by: LGE, Intel, Nokia, Mediatek

Alt 4: Objected by: Qualcomm, Mediatek, Panasonic

Scheduling, HARQ, Signaling

Agreement:

- For LAA uplink, DCI 0B and DCI 4B can schedule PUSCH transmission in maximum N_{sf} subframes, where N_{sf} is configurable by UE-specific RRC
 - DCI 0B: DCI format supporting PUSCH multi-subframe scheduling with TM1 for LAA SCell
 - DCI 4B: DCI format supporting PUSCH multi-subframe scheduling with TM2 for LAA SCell
 - N_{sf} value range is N_{min} to N_{max}
 - Value of N_{min} : 2
 - Value of N_{max} is 4
 - DCI payload sizes of DCI 0B and DCI 4B are decided by configured N_{sf} value
 - RRC signalling can enable or disable DCI 0B and DCI 4B independently

Agreement:

- UE may be configured to detect multiple uplink grants which may be chosen without restriction from DCI 0A/4A/0B/4B
 - Maximum number of uplink grants to be transmitted for a single UE in a subframe is 4
 - DCI 0A: DCI format supporting PUSCH single-subframe scheduling with TM1 for LAA SCell
 - DCI 4A: DCI format supporting PUSCH single-subframe scheduling with TM2 for LAA SCell

Working assumption:

- The new DCI formats along with all the applicable legacy DCI formats are subject to the blind decoding reduction mechanisms defined in Rel-13.
 - FFS: Whether any further enhancements to the reduction mechanisms on a per DCI format basis is necessary

R1-166003 **Way Forward on managing UE blind decoding for LAA SCells in Rel-14 eLAA** **Qualcomm**

Decision: The document is noted.

Agreement:

- A single UL grant scheduling multiple subframes can only schedule consecutive subframes for PUSCH transmission

Agreement:

- The following scheduling information in the existing DCI format 0/4 are not included in DCI 0A/4A/0B/4B for LAA when an interlace structure is used
 - frequency hopping, resource allocation type

Possible agreement:

- RRC signalling can configure whether resource allocation is based on an interlace structure or on legacy structures
- RAN1 recommends that the support of resource allocation based on an interlace resource allocation structure for DCI 0A/4A/0B/4B is mandatory.
- RAN1 recommends that the support of resource allocation based on the legacy resource allocation structure for DCI 0A/4A/0B/4B is optional

Agreement:

- There is only one SRS transmission request per DCI 0A/4A/0B/4B

R1-165822 **Second WF on Multi-subframe scheduling in LAA,** **LGE, ZTE**

Decision: The document is noted.

Agreements:

- DCI format 0B/4B indicates number of scheduled subframes
- DCI format 0B/4B indicates HARQ process IDs for the scheduled subframes by indicating HARQ process ID for a single subframe, and HARQp_ids for other subframes are derived by a given rule
 - the HARQp_ids for other subframes are consecutive with the indicated HARQ process IDs, modulo max number of HARQ processes
- DCI format 0B/4B indicates RVs for the scheduled subframes by indicating a 1-bit RV value per scheduled subframe (regardless of the number of scheduled transport blocks)
 - Can indicate RV 0 or 2

Agreements:

- For MSF DCI format 4B, utilise the current 2-bit SRS triggering field; include SRS subframe indication in the SRS parameter set configuration
- For MSF DCI format 0B, existing SRS triggering bit and 1 additional bit are used for SRS triggering and subframe indication
 - The 4 states are defined in specs as no triggering, first, second or last subframe
- Ending PUSCH DFT-S-OFDM symbol in a DCI format 0B/4B applies only to the last scheduled subframe
- CSI request in DCI format 0B/4B applies to 2nd scheduled subframe if Nmax=2, and otherwise to the penultimate scheduled subframe
- CSI reference subframe is defined according to the existing rules in 36.213 s.7.2.3.
- In case the subframe in which CSI would be transmitted is not transmitted because LBT does not succeed, CSI shall not be transmitted
- MCS for each codeword in DCI format 4B is indicated separately
- Timing offset is counted from subframe N+4+k, and k is signalled with (working assumption) 3 bits ([0...7] SFs) (FFS in case of 2-step scheduling)
- Working assumption (automatically confirmed if no problem identified by the end of the meeting): Common MCS value in DCI format 0B/4B applies to the PUSCH containing UCI and/or SRS and/or blanked symbol(s) without special handling

Discuss separately:

- RRC configures the max number of HARQ processes, up to 16

Agreement:

- eNB signals LBT type at least including 25us single slot LBT and Cat4 LBT to the UE at least for PUSCH

[R1-165647](#) WF on eLAA UL/DL scheduling combinations Nokia, Alcatel-Lucent Shanghai Bell, CATT, LG Electronics, NTT DOCOMO, Qualcomm, Intel, Ericsson, ZTE, Fujitsu, ETRI, IITL, Huawei, HiSilicon, Samsung, Kyocera, Panasonic

Decision: The document is noted.

Agreements:

- Support UL/DL Scheduling Combination 2: Self-scheduling on DL and cross-carrier scheduling on UL
 - The UE to monitor for DCI formats scheduling PUSCH of a single eLAA Scell on one UL licensed-band scheduling cell
 - i.e. DCI formats 0A/0B, Formats 4A/4B if configured for TM2
 - The UE to monitor for DCI formats scheduling LAA PDSCH on the LAA SCell
 - i.e. DCI formats 1A/1B/1D/1/2A/2/2B/2C/2D
 - Configuration details of enabling self-scheduling on DL and cross-carrier scheduling on UL are up to RAN2
 - FFS: If UCI cell groups concept is agreed, then whether scheduling is allowed from outside the UCI cell group
 - FFS: Whether cross-carrier transmissions of DCI scheduling on the UL is only applicable to PUSCH scheduling or whether it may be applicable to all the UL DCIs for the UL (e.g. if agreed, DCI for SRS triggering etc).
 - FFS: How to manage the number of blind decodes at the UE side in general (equally applicable for other scheduling combinations)?

PUSCH structure

[R1-165963](#) CR to 36.211 on Introduction of NB-IoT

Decision: The document is for further discussion.

[R1-165883](#) WF on initial signal transmission in LAA, LGE Huawei, HiSilicon, ZTE

Decision: The document is noted.

[R1-165717](#) WF on PUSCH transmissions on an LAA Scell and PUCCH transmissions Ericsson

Decision: The document is noted.

Agreement: Timing of 25 us gap immediately before transmission of PUSCH and SRS for 25 us LBT is decided by the eNB and is indicated to the UE

Agreement:

- Transmission time for PUSCH and SRS after a Cat. 4 LBT at the UE is decided by the eNB and is indicated to the UE.
 - Note: There is no restriction on when the UE starts cat. 4 LBT
 - Note: If the UE fails to complete Cat. 4 LBT for the first subframe in a multi-subframe UL grant, it can continue the Cat. 4 LBT procedure and attempt transmission for subsequent subframes.

Possible offline agreement:

Transmission on UL is allowed to start at the following times in a UL subframe

- Start of DFTS-OFDM symbol 0
- Start of DFTS-OFDM symbol 1
- 25 us + TA value after start of DFTS-OFDM symbol 0
- 25 us after start of last DFTS-OFDM symbol of previous subframe
- FFS: 16 us + TA after start of DFTS-OFDM symbol 0
- Note: Gaps may be created by UE subframe timing adjustment instead of using a partial OFDM symbol if a TA offset is dynamically signaled

Other

[R1-165145](#) On Power Spectral Density Regulations for Enhanced LAA Transmissions Ericsson

Decision: The document is noted.

Not treated

R1-164055	Resource allocation for RB interleaved PUSCH for eLAA	Huawei, HiSilicon
R1-164075	Multi-subframe scheduling design for eLAA	Huawei, HiSilicon
R1-164127	On the DCI design for multi-subframe scheduling	Intel Corporation
R1-164128	Remaining details on resource allocation for eLAA PUSCH transmission	Intel Corporation
R1-164197	PUSCH scheduling for Rel-14 eLAA	CATT
R1-164287	Power headroom report enhancement for eLAA	Sony
R1-164319	eLAA PUSCH transmission	Fujitsu

R1-164406	PUSCH design details	Qualcomm Incorporated
R1-164407	PUSCH and SRS multiplexing	Qualcomm Incorporated
R1-164408	PUSCH resource allocation granularity	Qualcomm Incorporated
R1-164409	Control details for UL scheduling	Qualcomm Incorporated
R1-164410	DCI design for PUSCH scheduling in eLAA	Qualcomm Incorporated
R1-164479	Remaining issues on PUSCH resource allocation	NEC
R1-164480	Remaining details on multiple-subframe scheduling for LAA	NEC
R1-164495	PUSCH resource allocation in LAALG	Electronics
R1-164496	Multi-subframe scheduling in LAA	LG Electronics
R1-164497	Summary of email discussion on multi-subframe scheduling	LG Electronics
R1-164572	HARQ for UL LAA	ZTE
R1-164573	Consideration of LBT failure in LAA UL HARQ operation	ZTE
R1-164574	On UL Resource Allocation for PUSCH	ZTE
R1-164575	Discussion on UL scheduling for LAA	ZTE
R1-164576	TPC and PHR for UL LAA	ZTE
R1-164578	Discussion on UL Grant Transmission for eLAA	Spreadtrum Communications
R1-164595	WF on UL scheduling and transmission for LAA	ZTE
R1-164717	Multi-subframe scheduling for eLAA	Kyocera Corporation
R1-164740	UL Waveform for PUSCH	Samsung
R1-164741	Multi-subframe scheduling for PUSCH	Samsung
R1-164742	Discussion on UL power issues for eLAA	Samsung
R1-164743	Discussion on scheduling options for eLAA	Samsung
R1-164744	Remaining issues on PUSCH design for eLAA	Samsung
R1-164745	Further Discussion on PUSCH DTX Handling for eLAA	Samsung
R1-164828	Discussion on PUSCH transmission starting within symbol #0	Huawei, HiSilicon
R1-164829	PHY signaling design for eLAA	Huawei, HiSilicon
R1-164831	Discussion on equal and non-equal multi-interlace based PUSCH structure	Huawei, HiSilicon
R1-164918	On PUSCH Transmit Power on LAA SCells	Nokia, Alcatel-Lucent Shanghai Bell
R1-164919	PUSCH Resource Allocation Details	Nokia, Alcatel-Lucent Shanghai Bell
R1-164928	Discussion on scheduling combinations for eLAA	ITRI
R1-164940	On LAA UL/DL Scheduling Combinations	Nokia, Alcatel-Lucent Shanghai Bell
R1-164941	eLAA UL scheduling / UL grant details	Nokia, Alcatel-Lucent Shanghai Bell
R1-164942	On Two-Stage UL scheduling for eLAA	Nokia, Alcatel-Lucent Shanghai Bell
R1-164992	DCI design for multiple-subframe scheduling for LAA UL	Sharp
R1-164993	Resource allocation of PUSCH for eLAA	Sharp
R1-165033	Uplink Subframe Structure	Panasonic
R1-165115	Considerations on eLAA PUSCH design	Mediatek
R1-165116	Control channel design for eLAA	Mediatek
R1-165141	Uplink Resource Allocation Design for Enhanced LAA	Ericsson
R1-165142	Multi-subframe scheduling design for Enhanced LAA	Ericsson
R1-165143	Performance impact of UL short LBT periods in symbol #0	Ericsson
R1-165144	Solutions supporting UL short LBT period in Symbol #0	Ericsson
R1-165185	Discussion on PUSCH subframe structure and resource allocation for eLAA UL	NTT DOCOMO, INC.
R1-165186	Discussion on UL scheduling design for eLAA	NTT DOCOMO, INC.
R1-165247	Remaining details of multi-subframe scheduling for eLAA	ETRI
R1-165556	WF on Multi-subframe scheduling in LAA	LG Electronics, Nokia, Alcatel-Lucent Shanghai Bell, Huawei, HiSilicon, ZTE
R1-165649	WF on eLAA PUSCH retransmission with synchronous HARQ	Huawei
R1-165783	WF on handling PUSCH errors after 25us LBT in eLAA	Broadcom
R1-165893	WF on power headroom report for eLAA	Sony
R1-165900	Way-Forward on DL+UL Traffic multiplexing for eLAA	Broadcomm
R1-165901	Way-Forward on the No LBT option for UL transmissions in eLAA	Broadcomm
R1-165921	WF on UL resource allocation for eLAA	Qualcomm Incorporated
R1-165923	WF on supporting trigger based transmission for UL in eLAA	Qualcomm Incorporated

6.2.1.2 SRS design

- [R1-165565](#) WF on LBT scheme for SRS transmission on LAA SCell LGE, ITL, Sharp
- DL grant triggering aperiodic SRS that is not multiplexed with PUSCH signals LBT type for SRS transmission
 - LBT type includes at least 25 usec one-shot LBT or Cat 4 LBT.
 - FFS: If aperiodic SRS is followed by PUSCH without gap between SRS and PUSCH, UE performs LBT indicated for the following PUSCH.

- If Cat 3 or Cat 4 LBT is performed for aperiodic SRS that is not multiplexed with PUSCH and without PUSCH in following subframe, the highest LBT priority class with only the minimum contention window size [3] can be considered for LBT purposes.

R1-165572 WF on general SRS aspects Huawei, HiSilicon

Decision: The document is noted.

Agreement:

- Periodic SRS is NOT supported in Rel-14 eLAA WI
- Cell-specific and UE-specific SRS subframe configuration in RRC signaling for both periodic and aperiodic SRS is not applicable in the current scope of Rel-14 eLAA

Agreement: SRS uses the legacy comb structure

Agreement:

- Keep the existing max # SRS RBs for a given system bandwidth
 - No shifting of SRS is used on an LAA SCell

R1-165573 WF on transmission and triggering SRS without PUSCH, Huawei, HiSilicon, Qualcomm, Samsung, ZTE, Intel, ITL, Nokia, ALU, Ericsson

Decision: The document is noted.

Agreement: When SRS without PUSCH is transmitted in DL ending partial subframes, UE transmits SRS in symbol 13

Options for triggering of SRS transmissions:

- 1) SRS without PUSCH is transmitted in subframe $n+4$ if the DL grant triggering the SRS transmission is received in subframe n (default if no other options are agreed)
- 2) SRS is transmitted according to one of the two options
 - a. in a DL ending partial subframe $n+4$ if a DL grant triggering SRS transmission is received in subframe $\leq n$
 - b. in a subframe $n+4$ immediately following a DL subframe, if a DL grant triggering SRS transmission is received in subframe $\leq n$ and no DL ending partial subframe is present between the DL grant and subframe $n+4$
- 3) SRS without PUSCH is transmitted in subframe $n+k$ if the DL grant triggering the SRS transmission is received in subframe n .
 - a. The parameter k is indicated in the DL grant

Proposal:

- Common/Group DCI can be used to trigger a-SRS without PUSCH for a group of UEs on the LAA SCell
- The triggering signaling includes the following fields
 - Subframe timing k . This field will be omitted if subframe timing is predefined.
 - FFS SRS LBT type, e.g., cat.2/cat.4
 - Depends on whether or not the UE knows of the MCOT
 - CIF, if cross carrier indication from PCell is supported
 - UE-specific field: trigger or not
- The group ID/RNTI is configured to the UE via RRC signaling

Not treated:

R1-164074	SRS configurations for eLAA	Huawei, HiSilicon
R1-164129	Remaining details of SRS transmission for eLAA	Intel Corporation
R1-164288	LBT operation for SRS in eLAA	Sony
R1-164411	SRS procedures for eLAA	Qualcomm Incorporated
R1-164498	SRS transmission in LAA	LG Electronics
R1-164579	Discussion on the remaining issues for SRS transmission in eLAA	Spreadtrum Communications
R1-164596	Discussion on SRS design for eLAA UL	ZTE
R1-164719	SRS design for eLAA	Kyocera Corporation
R1-164746	Remaining issues of SRS transmission	Samsung
R1-164814	SRS waveform	Huawei, HiSilicon
R1-164986	Remaining issues on aperiodic SRS transmission without PUSCH	Nokia, Alcatel-Lucent Shanghai Bell
R1-164987	Remaining issues on LAA SRS with PUSCH allocation	Nokia, Alcatel-Lucent Shanghai Bell
R1-165117	SRS design for LAA	Mediatek
R1-165146	On SRS Design for Enhanced LAA	Ericsson
R1-165187	Discussion on SRS design for eLAA UL	NTT DOCOMO, INC.

[R1-165239](#) SRS design in Rel-14 eLAA Innovative Technology Lab Co.
[R1-165248](#) Remaining details of SRS transmission on eLAA ETRI

6.2.1.3 Uplink control information on an LAA SCell

[R1-164747](#) UCI Transmission on LAA SCell Samsung

Decision: The document is noted.

[R1-164198](#) UCI transmission for Rel-14 eLAA CATT

Decision: The document is noted.

[R1-165188](#) Discussion on UCI transmission for eLAA UL NTT DOCOMO, INC.

Decision: The document is noted.

Agreement:

- A UE may be configured with simultaneous PUSCH/PUCCH in licensed spectrum or without simultaneous PUSCH/PUCCH in licensed spectrum independently from the configuration of an LAA SCell for the UE

Agreement:

- An LAA SCell for UL is configured to the UE only if simultaneous PUCCH in licensed spectrum and LAA SCell PUSCH transmission is supported by the UE

Not treated:

[R1-164076](#) UCI transmission for eLAA Huawei, HiSilicon
[R1-164130](#) UCI transmission for eLAA Scells Intel Corporation
[R1-164412](#) UCI reporting on unlicensed carriers Qualcomm Incorporated
[R1-164499](#) UCI transmission in LAA LG Electronics
[R1-164598](#) Discussion on UCI transmission on LAA SCell ZTE
[R1-164647](#) UCI transmission on LAA SCell Lenovo (Beijing) Ltd
[R1-164920](#) UCI Transmission on LAA Scells Nokia, Alcatel-Lucent Shanghai Bell
[R1-164994](#) UCI transmission on LAA carrier Sharp
[R1-165118](#) UCI transmission in LAA Mediatek
[R1-165147](#) Summary of Email Discussion [84b-05] on UCI Transmission for Enhanced LAA Ericsson
[R1-165148](#) On the Transmission of Uplink Control Information for Enhanced LAA Ericsson
[R1-165149](#) Performance impact of large HARQ-ACK payloads multiplexed with PUSCH Ericsson
[R1-165150](#) Solutions supporting large HARQ-ACK payloads multiplexed with PUSCH Ericsson
[R1-165251](#) HARQ-ACK transmission on LAA SCell PUSCH for eLAA WILUS Inc.
[R1-165922](#) WF on UCI transmission for eLAA Scells Qualcomm Incorporated

6.2.1.4 PRACH design

[R1-165498](#) WF on PRACH Ericsson

Decision: The document is noted.

Conclusion:

- Several possible approaches have been identified for the PRACH
- PRACH is useful in some use cases
- Enhanced LAA can operate without PRACH at least in scenarios with limited separation between base stations on licensed and unlicensed carriers, if the initial values of timing advance and power control are defined, e.g. if the licensed and unlicensed carriers are in the same TAG

Not treated:

[R1-164077](#) PRACH waveform for eLAA Huawei, HiSilicon
[R1-164078](#) PRACH configurations for eLAA Huawei, HiSilicon
[R1-164131](#) PRACH transmission for eLAA Intel Corporation
[R1-164199](#) PRACH design for Rel-14 eLAA CATT
[R1-164413](#) PRACH waveforms for eLAA Qualcomm Incorporated
[R1-164414](#) PRACH procedures for eLAA Qualcomm Incorporated
[R1-164500](#) Random access preamble in LAA LG Electronics
[R1-164501](#) Random access procedure in LAA LG Electronics
[R1-164600](#) PRACH Design for LAA ZTE
[R1-164748](#) PRACH Transmission for UL LAA Samsung
[R1-164749](#) Discussion on random access procedure for eLAA Samsung
[R1-164830](#) Evaluation for PRACH waveform for eLAA Huawei, HiSilicon
[R1-164904](#) Discussion on PRACH design for LAA HTC
[R1-164988](#) Discussion on PRACH design for eLAA Nokia, Alcatel-Lucent Shanghai Bell
[R1-164989](#) Performance Evaluation of PRACH for eLAA Nokia, Alcatel-Lucent Shanghai Bell

R1-165034	PRACH Bandwidth on Unlicensed Carriers	Panasonic
R1-165070	Performance Evaluation for PRACH for eLAA	Intel Corporation
R1-165119	Considerations on PRACH design in eLAA	Mediatek
R1-165151	PRACH Design for Enhanced LAA	Ericsson
R1-165152	On Performance of PRACH for Enhanced LAA	Ericsson
R1-165169	Discussion on PRACH for eLAA	Shenzhen Coolpad Technologies
R1-165189	Discussion on PRACH for eLAA UL	NTT DOCOMO, INC.
R1-165558	WF on PRACH procedure in LAA	LG Electronics, Intel

6.2.1.5 Channel access framework

[R1-164990](#) Channel Access for LAA UL Nokia, Alcatel-Lucent Shanghai Bell
Decision: The document is noted.

[R1-164073](#) Contention window size adjustment for UL category 4 LBT for eLAA Huawei, HiSilicon
Decision: The document is noted.

Possible agreement:

Contention window maintenance for UL Category 4 LBT is done per UE

Options for LBT priority class handling when UE performs Category 4 LBT:

Option 1: Signalling of LBT priority class from eNB to UE determines for its Cat. 4 LBT

- Buffer status report from UE allows eNB to determine what LBT priority class the UE intends to use for its category 4 LBT
- eNB schedules subframes and gaps according to its determination and signals priority class or contention window size (FFS between the two) to the UE
- UE follows the signalled LBT parameters for UL LBT for Category 4 LBT
- UE is allowed to use LCP for the allocated subframes regardless of LBT priority class that was used for UL LBT

Don't like this approach: Mediatek, Broadcom, Intel, Marvell, Cablelabs

Option 2: No signalling of LBT parameters for category 4 LBT at the UE from eNB and UE determines all Cat. 4 LBT parameters

- Buffer status report from UE allows eNB to determine what LBT priority class the UE intends to use for its category 4 LBT
- eNB schedules subframes and gaps according to its determination
- UE determines all category 4 LBT parameters for UL LBT for the allocated UL subframes based on traffic type of the data sent in the allocated subframes and the number of subframes it has been allocated

Don't like this approach: Qualcomm, LG, ZTE, Samsung, ETRI, Sharp

[R1-165812](#) WF on ED threshold Ericsson

- Align the requirement on the energy detection threshold for UL transmission with the corresponding Rel-13 LAA requirements for PDSCH transmission.
- The maximum transmit power per carrier configured to the UE is used to set the ED threshold

Decision: The document is noted.

[R1-165890](#) Way Forward on determining UL LBT priority class Mediatek
Decision: The document is noted.

WF on DL+UL Traffic Multiplexing for eLAA

Broadcom, BlackBerry, CableLabs, Orange, Marvell

- For a ~~DL~~ transmission burst with PDSCH(s) and/or PUSCH(s) scheduled by the eNB for which channel access has been obtained using Channel Access Priority Class P (1...4), E-UTRAN shall ensure the following where ~~a DL~~ transmission burst refers to ~~the continuous~~ DL transmissions from the eNB and all scheduled UL transmissions from the UEs starting after a successful LBT:
 - o the transmission duration of the ~~DL~~ transmission burst shall not exceed the minimum duration needed to transmit all available buffered traffic corresponding to Channel Access Priority Class(es) $\leq P$;
NOTE: the buffered traffic includes all ~~the~~ available traffic in DL at the eNB and all traffic available for transmission at all scheduled UEs as per the latest buffer status information from each UE (see [ref 13 in 36.300])
 - o the transmission duration of the ~~DL~~ transmission burst shall not exceed the Maximum Channel Occupancy Time (as defined in Table 15.1.1-1 of [ref 6 in 36.300]) for Channel Access Priority Class P;

- additional traffic corresponding to Channel Access Priority Class(es) > P may only be included in the ~~DL~~ transmission burst once no more ~~data~~-buffered traffic corresponding to Channel Access Priority Class(es) ≤ P is available for transmission and the transmission duration of the transmission burst as defined above has not yet expired. In such cases, E-UTRAN should maximise occupancy of the remaining transmission resources in the ~~DL~~ transmission burst with this additional traffic.

Note: Additions to the agreements made in Rel 13 LAA are marked in Green while deletions are marked in Red with strikethrough.

[R1-165838](#) LS to RAN1 on RAN2 agreement on eLAA RAN2
Decision: The document is noted.

[R1-165897](#) WF on the determination of LBT priority class at the UE Nokia, Alcatel-Lucent Shanghai Bell
Decision: The document is noted.

Agreement:

- When the UE performs Cat. 4 LBT, it uses the priority class signaled by the eNB
 - There is no additional restriction at the UE (other than the multiplexing rules defined in RAN2) on the type of the traffic that can be carried in the scheduled subframes.
 - eNB shall not schedule the UE more subframes than what is needed to transmit all the traffic corresponding to the same LBT priority class or lower (i.e., with a lower number in the LBT priority class table) than the signaled LBT priority class based on the latest BSR and received UL traffic from the UE.
 - The eNB is responsible for making sure that the mapping between QCI and LBT priority class is consistent with section 5.7.1 in TS 36.300.
 - The eNB is expected to take the QCI with the lowest priority in the logical channel group into account when defining the LBT priority class for a logical channel group

[R1-165948](#) WF on the CWS adjustment at the UE for Cat-4 LBT Nokia, Alcatel-Lucent Shanghai Bell, Ericsson, Broadcom
Decision: The document is noted.

[R1-165752](#) WF on CWS adjustment for category 4 UL LBT in eLAA LG Electronics, Sharp
Decision: The document is noted.

Possible offline agreement:

- For category 4 LBT for PUSCH transmission on LAA SCell,
 - CWS is managed by eNB and indicated by UL grant.
 - CWS is adjusted per UE based on whether or not reference subframe is successfully decoded.
 - Reference subframe is the starting subframe of the most recent UL transmission burst for which a Cat. 4 LBT was expected to be used, for which DM-RS or SRS transmission from the UE is detected and PUSCH decoding is completed.
 - If at least one of the TBs in the reference subframe is successfully decoded, the CWS is reset for all priority classes; otherwise, it is increased to the next higher value for all priority classes.
 - 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 eNB implementation from the set of values from (1, ..., 8).

Possible offline agreement:

- For category 4 LBT for PUSCH transmission on LAA SCell
 - **The reference scheduled burst** is the most recent set of **contiguous** (i.e. without any gap in between) scheduled UL subframe(s) for the UE that is expected to start after a category 4 LBT and is expected to end at least 4 subframes earlier than the subframe in which the following contention window size adjustment is transmitted
 - **The reference subframe** is the first subframe in the reference scheduled burst where the eNB successfully **decodes** at least one transport block from the UE.
 - The position of the reference subframe within the reference scheduled burst is signaled to the UE in the UL grant in which Cat. 4 LBT is signaled as the LBT type to the UE
 - The eNB can also signal that no reference subframe was detected
 - If the UE first transmitted in the reference scheduled burst earlier than the signaled reference subframe, the CWSs for all the priority classes are increased.
 - If the UE first transmitted in the reference scheduled burst later than the signaled reference subframe, the CWSs for all the priority classes are left unchanged.
 - If the UE first transmitted in the reference scheduled burst in the signaled reference subframe, the CWSs for all the priority classes are reset.

- The CWS is reset to the minimum value if the maximum CWS is used for K consecutive LBT attempts only for the priority class for which maximum CWS is used for K consecutive LBT attempts.
 - K is selected by eNB and RRC configured to the UE from the set of values from (1, ...,8).

Not treated.

R1-164071	Discussion on the applications of LBT options in eLAA	Huawei, HiSilicon
R1-164072	UL category 4 LBT with eNB assistance	Huawei, HiSilicon
R1-164132	Remaining details for UL LBT	Intel Corporation
R1-164133	UL grant transmission	Intel Corporation
R1-164200	UL channel access for Rel-14 eLAA	CATT
R1-164318	Considerations for UL LBT	Sequans Communications
R1-164415	UL channel access for eLAA	Qualcomm Incorporated
R1-164416	Discussion on ED threshold for UEs in eLAA	Qualcomm Incorporated
R1-164502	LBT schemes in LAA UL	LG Electronics
R1-164503	Further details on channel access in LAA UL	LG Electronics
R1-164504	Impact of UE-to-UE interference on LAA performance	LG Electronics
R1-164505	Initial signal in LAA uplink	LG Electronics
R1-164601	Frame design and signalling for LAA UL based on FS3	ZTE
R1-164603	Discussion on the UL LBT for LAA	ZTE
R1-164604	LBT for Frequency and reuse and Multiplexing in Uplink	ZTE
R1-164605	WF on UE initiated TxOP/MCOT shared by the eNB	ZTE
R1-164648	LBT mechanism for LAA uplink	Lenovo (Beijing) Ltd
R1-164720	Channel Access Scheme for UE multiplexing	Kyocera Corporation
R1-164750	Discussion of LAA-LAA coexistence	Samsung
R1-164751	Discussion on UL LBT alignment	Samsung
R1-164752	Discussion on shared MCOT and LBT procedure	Samsung
R1-164753	Remaining issues on Cat 4 LBT for eLAA	Samsung
R1-164815	On the need of reservation signal	Huawei, HiSilicon
R1-164827	Other issues related to LBT for eLAA	Huawei, HiSilicon
R1-164905	Dynamic carrier selection for LAA	HTC
R1-164995	Methods of UL LAA channel access	Sharp
R1-165032	Error Cases due to Failed Clear Channel Assessment for UL Transmissions	Panasonic
R1-165071	Defer period for UL LBT	Intel Corporation
R1-165120	eLAA Uplink channel access	Mediatek
R1-165121	On priority classes for uplink LBT	Mediatek
R1-165140	PUSCH DTX Detection for LAA UL	Nokia, Alcatel-Lucent Shanghai Bell
R1-165154	On Channel Access Procedures for PRACH and SRS	Ericsson
R1-165155	On Channel Access Procedures for Transmissions with Only UL Grants	Ericsson
R1-165156	On Support of Conditional UL Transmissions without LBT	Ericsson
R1-165157	On UL Channel Access Procedures	Ericsson
R1-165158	On Performance of UL Channel Access Procedures	Ericsson
R1-165159	On Signaling of UL Channel Access Parameters	Ericsson
R1-165190	Discussion on channel access framework for eLAA UL	NTT DOCOMO, INC.
R1-165235	Uplink Channel Access Mechanisms in eLAA	ETRI
R1-165250	On channel access mechanism for eLAA	ETRI
R1-165252	Consideration on UL LBT Type Switching for eLAA	WILUS Inc.
R1-165253	CWS adjustment for UL PUSCH in eLAA	WILUS Inc.
R1-165318	Discussion on LAA paused COT and UL traffic multiplexing	BROADCOM LIMITED
R1-165323	Discussion on LAA UL no LBT	BROADCOM LIMITED
R1-165713	WF on CW adjustment for UL LBT based on Cat. 4	Ericsson
R1-165714	WF on Selection of LBT Priority Class for UL Transmission	Ericsson
R1-165715	WF on LBT Priority Class for UL Transmission	Ericsson
R1-165716	WF on MCOT limit Signaling and Modifying LBT type	Ericsson
R1-165924	WF on determining maximum UE TX power on a LAA SCell for ED threshold computation	Qualcomm Incorporated
R1-165927	WF on CCA Detection Threshold for eLAA	CableLabs, Broadcom, Orange, Marvell, Microsoft
R1-165962	WF on ED Threshold for UL LBT	Ericsson, Huawei, HiSilicon
R1-166014	Way-Forward on UL PSD limit in eLAA	Broadcom, Marvell, CableLabs
R1-166021	[Draft]LS on Mapping of QCI to LBT Priority Classes in UL	CableLabs

6.2.1.6 Others

Not treated.

R1-164106	Discussion on synchronous and asynchronous HARQ method for eLAA	Huawei, HiSilicon
R1-164506	Power control in LAA uplink	LG Electronics
R1-164921	On the Support for UL Operation in FS3 and C-PDCCH	Nokia, Alcatel-Lucent Shanghai Bell
R1-165566	WF on ending partial TTI with duration of 3 symbols for eLAA	LG Electronics, ITL, Sharp
R1-165567	WF on PDCCH reception in ending partial subframe for eLAA	LG Electronics, Intel, Ericsson, Nokia, Alcatel-Lucent Shanghai Bell, Sharp, Huawei, HiSilicon, ITL

6.2.2 Support for V2V services based on LTE sidelink - *WID in RP-160649*

[R1-165935](#) Chairman's Notes of Agenda Item 6.2.2 on V2V Ad-hoc chair (Nokia, LGE)

The document was presented by Matthew Baker from Nokia and provides the outcomes of the eLAA session.

Decision: The document is endorsed. Contents incorporated below.

Friday

LS to RAN2/4 for email approval regarding the agreements and WAs until June 2nd – (LGE)

Editors will submit draft CRs (36.201, 36.211, 36.212, 36.213, 36.214 (if needed)) until August 18th.

Rapporteur shall submit agreement and WA lists until June 30th

[R1-165608](#) Summary of Tuesday offline discussions on V2V LG Electronics

Decision: The document is noted.

Agreement:

- For PSSCH resource (re)selection when all the PSCCH/PSSCH transmissions have the same priority (FFS whether the initial resource selection needs to be designed differently from the procedure below)
 - Step 1: All the resources are considered available.
 - Step 2: UE excludes resources at least based on SA decoding and additional conditions. Down select one between the following options.
 - Option 2-1: A resource is excluded if it is indicated or reserved by a decoded SA and the received DM RS power in the associated data resource is above a threshold.
 - Option 2-2: A resource is excluded if it is indicated or reserved by a decoded SA and the energy in the associated data resource estimated from the measurement in the SA resource is above a threshold. Additional estimation of energy caused by in-band emission is not precluded.
 - FFS the estimation of the energy in the associated data resource.
 - Measuring energy of SA transmitted from a particular UE may not be accurate enough.
 - The precise definition of “if it is indicated or reserved by a decoded SA” to be discussed later.
 - FFS the details of the thresholds above
 - Step 3: UE selects its transmission resource from the resources not excluded by (Down select one among the following options)
 - Option 3-1:
 - Step 3-1: UE measures and ranks the remaining PSSCH resources based on total received energy and selects a subset
 - Step 3-2: UE compares the energy on the currently selected resource with the energy of the resources the subset. If the energy of the current resource is a threshold above the energy of all the resources in the subset, then UE selects one among the subset of resources.
 - A semi-persistent period before reselection is triggered, UE transmits PSSCH on another resource in the subset identified in step 3-1 and measures the energy of the currently selected resource for step 3-2.
 - Step 3-3: UE randomly selects one resource from the subset
 - Option 3-2:
 - Step 3-1: UE measures and ranks the remaining PSSCH resources based on total received energy and selects a subset
 - Step 3-2: UE randomly selects one resource from the subset
 - Option 3-3:
 - Step 3-1: UE measures and ranks the remaining PSSCH resources based on total received energy and selects a subset
 - Step 3-2: UE selects the resource that minimizes the frequency resource fragmentation from the subset.
 - Option 3-4:
 - Step 3-1: UE measures RX power of PSSCH resource indicated in the decoded SA, sum them as the total RX power of a subframe, and sorts the subframes according to the total RX power.

- Step 3-2: A set of available subframes consists of X subframes with the highest total RX power and Y subframes of the lowest total RX power. UE randomly selects transmission subframe(s) from this set.
- Step 3-3: UE randomly selects frequency from transmission subframe(s).
- FFS how to select resources for a wideband transmission based on the energy/power measurement above.

Proposed agreement:

After resolving the FFS points relevant to RAN1, send LS to RAN2 to ask them to define the following UE behavior for resource reselection triggering.

Agreements:

- Reselection is triggered if any of the following conditions are met
 - A counter meets an expiration condition
 - The counter decrements
 - **Working assumption:** every TB transmission (can be revisited if a problem is identified with TBs other than every 100 ms)
 - The counter is reset to a value when reselection is triggered for all the semi-persistently selected resources.
 - The value is uniformly randomly selected within a range (which is independent of the TB arrivals) between 5 and 15
 - UE identifies that the TB does not fit within the current resource allocation using the maximum allowed MCS,
 - FFS other triggers that may be defined by RAN2,

For further discussion:

- Working assumption: UE detects resource allocation (including the indication of the intention of reusing the frequency resource as per the existing agreement) of another UE which potentially overlaps with its current resource allocation (including the indication of the intention of reusing the frequency resource as per the existing agreement) and the detected situation meets an FFS condition
 - different conditions for different priorities are not precluded (if any relevant case happens in priority handling from RAN1 point of view).
- eNB implicitly triggers reselection whenever the resource pool configuration is changed
 - Dedicated signalling is used for RRC_Connected UEs and broadcast signalling is used for RRC_Idle UEs
 - FFS whether some information needs to be reported from UE to eNB
- FFS additional condition(s), e.g.,
 - If it is supported that a UE can notify later that it no longer intends to use the resource at a future TTI, reselection triggering condition related to this notification.
 - Reselection triggered by notification on resource collision from another UE
 - Reselection triggered by sensing of resources utilization above a threshold
 - Reselection triggered by higher layer
 - Other conditions are not precluded

Continue discussion during this week

R1-165898 Summary of Thursday offline discussions on V2V LGE

Decision: The document is noted.

Agreement:

- For all the PSCCH/PSSCH/SLSS/PSBCH transmissions for V2V in all the resource allocation modes, $N_{TA,SL} = 0$
- FFS in RAN1 on the receiver UE assumption on the reception timing, e.g., whether it can assume that all the transmissions in a single subframe use the same synchronization reference.

R1-165991 Summary of Friday offline discussions on V2V LGE

Decision: The document is noted.

6.2.2.1 Enhancement to sidelink physical layer structure

Not treated

R1-165072 Enhancements of sidelink physical layer structure for PC5 V2V communication Intel Corporation
R1-165277 L1 Format for V2V Transmissions using Sidelink Ericsson

6.2.2.1.1 DM-RS for PSCCH and PSSCH

Agreement: Confirm the working assumption that legacy PUSCH RS is used for PSCCH and PSSCH in the four RS symbols.

Agreement:

- Alt 1 + Adapt MCS, the number of RBs, and number of transmission subframes depending on the UE absolute speed and UE synchronization source (e.g. GNSS or eNB)
 - Options for details of PSCCH
 - **Working assumption** which will be automatically confirmed if no problem is identified during this week
 - DMRS within a TTI for a transmission by a UE are not identical
 - No blind detection of DMRS is introduced
 - Details FFS
 - **Working assumption:** 2 consecutive PRB pairs in a subframe are used for each PSCCH if the number of SA bits is less than 64 including CRC. The exact size of SA is FFS including the CRC size and could be larger than 64 bits.
 - Options for details of PSSCH
 - Network configuration or preconfiguration can be used to associate the ranges of MCS, RB number for PSSCH, number of retransmission with the condition of the UE absolute speed. Different (pre)configuration and threshold is given for the different type (e.g., eNB, GNSS, UE) of the transmission synchronization reference.
 - RAN1 will study the proper range of these parameters.

R1-165676 **WF on PSSCH DMRS and SA IDLG Electronics, ZTE, Qualcomm, Nokia, ASB, Samsung, CATT**

Decision: The document is noted.

Proposed agreements:

- Source ID is used for PSSCH DM RS sequence generation.
- 8-bit destination ID in SA is replaced by 8-bit source ID.
 - Send LS to RAN2 to inform this agreement.
 - FFS whether source ID is changed in time (up to RAN2).

Continue discussion during this week.

R1-165604 **WF on Multi-Cluster PSSCH Transmissions** **Qualcomm, Samsung**

Decision: The document is noted.

Proposed agreements:

- Multi-cluster PSSCH transmissions by a UE are supported
 - Details FFS

Continue discussion until Thursday (Qualcomm).

Not treated

R1-164094	DMRS for PSCCH and PSSCH	Huawei, HiSilicon
R1-164134	On DMRS physical structure enhancements for PSCCH and PSSCH	Intel Corporation
R1-164417	DM-RS Enhancements for V2V PSCCH and PSSCH	Qualcomm Incorporated
R1-164507	Discussion on DMRS for PSCCH and PSSCH	LG Electronics
R1-164754	DMRS configuration for PSSCH and PSCCH	Samsung
R1-164902	Link performance of DMRS Enhancement for PSCCH and PSSCH	Beijing Xinwei Telecom Techn.
R1-164932	Enhancement to sidelink physical layer structure in super high Doppler case for V2V	ITRI
R1-164949	DMRS Enhancements for PSSCH and PSCCH	ZTE
R1-165041	Evaluations of DMRS Enhancement for PSCCH and PSSCH	Nokia, Alcatel-Lucent Shanghai Bell
R1-165255	Construction of DMRS sequences	Ericsson
R1-165412	Link level performance of DM RS for V2V	CATR
R1-165535	DMRS enhancement in PC5-based V2V	CATT
R1-165592	WF on Supporting 500kmph for SA	Qualcomm, LGE
R1-165658	WF on L1 Format for V2V Communication	Intel, ITRI

6.2.2.1.2 DM-RS for PSBCH

R1-165677 **WF on PSBCH DMRS** **LG Electronics, ZTE, Qualcomm, ITL, KRRI**

Decision: The document is noted.

Proposed agreements:

- For PSBCH DM RS symbol location, Option 3 (i.e., symbol #4, #6, #9 for normal CP) is supported. Continue discussion until Thursday (Hyukjin – LGE).

Agreements:

- For PSBCH DM RS symbol location, Option 3 (i.e., symbol #4, #6, #9 for normal CP) is supported.
- **Working assumption:** PSBCH content size is the same as Rel-12.
- **Working assumption:** V2V SLSS/PSBCH periodicity is 200 ms.
- If it is agreed that SLSS/PSBCH is used for the purpose of detecting LTE ITS transmissions, this working assumption needs to be revisited.
- Rel-13 D2D synchronization resource configuration principle is reused.

Not treated:

R1-164095	DMRS for PSBCH	Huawei, HiSilicon
R1-164135	On DMRS physical structure enhancements for PSBCH	Intel Corporation
R1-164320	Discussion on DM-RS for PSBCH for sidelink-based V2V communication	Fujitsu
R1-164418	DM-RS Enhancements for V2V PSBCH	Qualcomm Incorporated
R1-164958	DMRS for PSBCH	ZTE
R1-165307	DMRS design for PSBCH	Samsung
R1-165419	Discussion on DMRS for PSBCH	LG Electronics

6.2.2.1.3 Other

Including adaptation of MCS, the number of RBs, and number of transmission subframes depending on the UE absolute speed and UE synchronization source (e.g, GNSS or eNB)

Not treated:

R1-164509	Discussion on adaptation of MCS depending on UE speed	LG Electronics
R1-164756	Supporting 500 km/h relative speed requirement for V2V	Samsung
R1-164864	Discussion on inband emission suppression for V2V communications	Huawei, HiSilicon
R1-165268	Radio measurements for congestion control for V2X	Ericsson
R1-165678	WF on transmission parameter adaptation	LG Electronics, Ericsson, ITL, KRRI, NTT DOCOMO

6.2.2.2 Sensing with semi-persistent transmission in UE autonomous resource selection mode

Not treated.

R1-165073	Discussion on sensing aspects to support V2V communication with different traffic periodicity	Intel Corporation
R1-165555	Sensing and autonomous resource selection	Ericsson
R1-165957	WF on semi-persistent transmission for mode 2	Ericsson, Qualcomm

6.2.2.2.1 Details of using SA decoding and energy measurement for sensing

[R1-165679](#) **WF on sub-channelization** LG Electronics, Ericsson, CATT, Intel

Decision: The document is noted. Also supported by Lenovo.

Proposed agreements:

- Sub-channelization is supported for PSSCH.
 - A sub-channel consists of a group of RBs in a same subframe.
 - The sub-channel size in a resource pool can be configured by eNB or preconfigured.
 - Candidate sub-channel sizes are FFS.
 - Sub-channel size is the same in a resource pool.
 - Different sub-channels have disjoint group of adjacent RBs.
 - FFS whether different formation of sub-channels is needed if multi-cluster transmission is supported.
- Energy sensing granularity of PSSCH is based on the size of sub-channel.
- The UE always (re)selects an integer number of subchannels for transmission.
- The UE always transmits on an integer number of subchannels.

Continue discussion.

Not treated:

R1-164136	Utilization of PSCCH decoding and energy measurements for sensing based V2V communication	Intel Corporation
R1-164203	Discussion on sensing mechanism in PC5-based V2V	CATT
R1-164467	UE sensing based congestion control for mode-2	Guangdong OPPO Mobile Telecom.
R1-164510	Discussion on details of sensing operation for PC5 based V2V	LG Electronics

R1-164757	Sensing procedure for UE autonomous resource selection	Samsung
R1-164758	RSRP measurement on decoded SA for sensing	Samsung
R1-164959	SA decoding and energy measurement	ZTE
R1-164984	Discussion on SA Decoding and Energy Measurement	Beijing Xinwei Telecom Techn.
R1-165039	On sensing with SA decoding and energy measurement for V2V	INTERDIGITAL
COMMUNICATIONS		
R1-165042	On sensing with semi-persistent transmission	Nokia, Alcatel-Lucent Shanghai Bell
R1-165191	Discussion on SA decoding and energy measurement for sensing	NTT DOCOMO, INC.
R1-165306	Discussion on SA decoding and energy measurement for sensing	Sony
R1-165499	Updated WF on sub-channelisation LGE	

6.2.2.2.2 Details of the transmitter UE behaviour in resource selection/reselection

Including the time duration in which UE performs sensing, the transmission timing of SA and the associated data, and the indication of the intention to reuse the frequency resource for another TB

R1-165698 Way forward on timeline for sensing based UE autonomous resource selection NTT DOCOMO, NEC, Samsung

Decision: The document is noted. Also supported by Huawei, HiSilicon, Intel

Agreement:

- The values of a and b are fixed
 - $b > 0$
 - Confirm the working assumption “The values a and b are common for V2V UEs”
 - $a = 1000 + b$
 - All the decoded SA transmissions in TTI [n-a, n-b) are taken into account.
 - A decoded SA which is associated with data transmissions in data resource(s) at any TTI [n-a, n-b) and transmitted earlier than TTI n-a is taken into account.
- FFS: If UE skips sensing on sub-frame m, for e.g.: due to its own transmission in sub-frame m, it excludes resources in subframes at $m+100*k$ in the resource (re)selection (if triggered), until it is able to perform sensing in those sub-frames.
- FFS on the following:
 - $c > 0$
 - $c, d \leq 100$
 - FFS how to further restrict the selection of c and d, e.g., to fulfill the latency requirement
- FFS during this week on the details of c, e.g., the receiver UE assumption on the transmitter UE behavior in reusing the same resource.

Friday: Email approval regarding above FFSs until June 9th – (LGE)

Not treated

R1-164102	Discussion on sensing details for measurement and reservation	Huawei, HiSilicon
R1-164137	Transmitter behavior for sidelink resource re-selection	Intel Corporation
R1-164204	Discussion on resource selection mechanism in PC5-based V2V	CATT
R1-164205	Discussion on time duration of sensing in PC5-based V2V	CATT
R1-164206	Further consideration on UE autonomous resource allocation in PC5-based V2V	CATT
R1-164468	Discussion on the SPS configuration for mode-2	Guangdong OPPO Mobile Telecom.
R1-164473	Schedule Assignment for SPS	NEC
R1-164511	Discussion on details of resource selection for PC5 based V2V	LG Electronics
R1-164645	UE autonomous resource selection for semi-persistent transmission	Lenovo (Beijing) Ltd
R1-164670	Discussion on the transmitter UE behavior in resource selection/reselection	Sony
R1-164759	UE operation after sensing in UE autonomous resource selection	Samsung
R1-164855	Power control for V2V	Huawei, HiSilicon
R1-164933	Discussion on explicit and implicit approaches for enhanced random resource selection	ITRI
R1-164960	Transmitter UE behavior in V2V	ZTE
R1-164961	Geo Based Resource Allocation for V2V	ZTE
R1-165043	On resource selection with sensing	Nokia, Alcatel-Lucent Shanghai Bell
R1-165192	Transmitter UE behaviour for sensing-based resource allocation	NTT DOCOMO, INC.
R1-165240	Considerations on UE autonomous resource selection for V2V	Innovative Technology Lab Co.
R1-165244	Adaptation of MCS, RB allocation, and number of retransmissions	Ericsson
R1-165271	How Should PC5 Autonomous Resource Allocation be Specified?	Ericsson
R1-165276	Discussion on V2X PC5 Scheduling, Resource Pools and Resource Patterns	Ericsson
R1-165315	Sensing and SPS for UE Autonomous Mode	PANASONIC
R1-165904	WF on resource usage indication	LGE

[R1-165909](#) WF on Timing Relationship for V2V Sensing and Resource Selection Intel
[R1-165910](#) Details of sensing for V2V Qualcomm Incorporated

6.2.2.2.3 Details of triggering resource reselection

Agreement:

Send LS to RAN2 to ask them to define the following UE behavior for resource reselection triggering with the following additional agreements:

- eNB implicitly triggers reselection whenever the resource pool configuration is changed
 - Dedicated signalling is used for RRC_Connected UEs and broadcast signalling is used for RRC_Idle UEs
 - FFS whether some information needs to be reported from UE to eNB

Not treated:

[R1-164096](#) Resource (re)selection triggering mechanisms Huawei, HiSilicon
[R1-164138](#) Discussion on resource reselection triggers for V2V communication Intel Corporation
[R1-164474](#) Triggering resource reselection based on collision detection NEC
[R1-164512](#) Discussion on details of resource reselection for PC5 based V2V LG Electronics
[R1-164760](#) Triggering conditions for resource reselection Samsung
[R1-164962](#) Discussion on V2V resource reselection ZTE
[R1-165263](#) Resource reselection Ericsson
[R1-165692](#) WF on UE measurement and reporting Huawei, HiSilicon, NEC

6.2.2.2.4 Priority handling

[R1-165561](#) **Way Forward on priority information in SCI** Huawei, HiSilicon, Intel, Ericsson, Sharp, LG Electronics, NTT DoCoMo, OPPO, ITRI, Kyocera, Nokia, ASB, Potevio
Decision: The document is noted. Also supported by Sony, ZTE, III, CATT

Agreements:

- **Working assumption:** PPPP is used to identify which PDCP PDU has which priority level. RAN1 will not use any additional notion of priority.
- Send LS to RAN2 (CC: SA2) to confirm this working assumption. (Shailesh – Qualcomm)

[R1-165750](#) **[DRAFT] LS on Priority for V2V Qualcomm**

Decision: The document is noted and final LS is **agreed in R1-165814** with adding SA2 in “CC” and reflecting the changes in the working assumption.

Proposed agreement:

- Priority information is explicitly indicated by SA
 - The number of bits is FFS.
 - SCI decoding is used to identify associated data transmissions priority
- If UE with lower priority transmission decodes a SCI with priority information higher than itself, UE doesn't transmit on that resource and (re)select other resource.
 - FFS if additional criteria is needed

Continue discussion

Working assumption:

- SCI explicitly includes priority information.
 - FFS how this priority information is exactly transmitted in SCI.
 - Priority information in a decoded SCI is used in resource (re)selection.
 - Priority information in a decoded SCI is not used as a condition to trigger resource reselection
 - Priority information in a decoded SCI is not used as a condition to drop transmission.
- A measurement metric is specified to reflect the congestion level of a PC5 carrier, e.g., similarly to the channel busy ratio defined in ETSI.
 - This measurement is available to higher layers in the UE.
 - FFS whether the measurement can be reported to eNB.
 - FFS the details of the measurement and the UE behavior, for example:
 - The principle to drop PC5 transmissions as a function of this measurement and priority is supported.
 - The radio adjusts radio parameters (max tx power, nr of retx restriction, MCS range restriction, nr of PRBs restriction) as a function of priority and this measurement.
 - Packets with different priorities are transmitted on the same resource pool
- Revoke the existing working assumption on the resource reselection triggering condition: UE detects resource allocation (including the indication of the intention of reusing the frequency resource as per the existing agreement) of another UE which potentially overlaps with its current resource allocation (including the indication of the intention of reusing the frequency resource as per the existing agreement) and the detected situation meets an FFS condition

- different conditions for different priorities are not precluded (if any relevant case happens in priority handling from RAN1 point of view).
- Note that applies to resource reselection triggering only.

Not treated

R1-164104	Discussion on the priority handling Huawei, HiSilicon	
R1-164139	Design options to support priority for V2V communication	Intel Corporation
R1-164207	Considerations on V2V priority handling	CATT
R1-164322	Discussion on resource allocation for V2V based on LTE sidelink	Fujitsu
R1-164420	Priority handling for autonomous resource selection	Qualcomm Incorporated
R1-164513	Discussion on details of priority handling for PC5 based V2V	LG Electronics
R1-164671	Discussion on the priority handling for UE-autonomous resource (re)selection	Sony
R1-164761	Priority handling for UE autonomous resource selection	Samsung
R1-164901	Discussion on V2V Priority Handling	Beijing Xinwei Telecom Techn.
R1-165040	On priority handling for V2V	INTERDIGITAL COMMUNICATIONS
R1-165044	Priority considerations for autonomous V2V communication	Nokia, Alcatel-Lucent Shanghai Bell
R1-165260	Priority handling for V2V over PC5	Ericsson
R1-165952	WF on priority handling for V2V	Huawei, HiSilicon, Intel, Ericsson, Sharp, LG Electronics, NTT DoCoMo, OPPO, ITRI, Kyocera, Nokia, ASB, Potevio, Sony, ZTE, III, CATT, Samsung

6.2.2.2.5 Other

R1-164466	Discussion on the mode-2 resource allocation for V2V	Guangdong OPPO Mobile Telecom.
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6.2.2.3 Semi-persistent scheduling for sidelink resource in eNB scheduling mode

Agreements:

- Support cross carrier scheduling for sidelink SPS and dynamic scheduling for V2V with mode-1
 - PC5-based V2V design will support the multiple-operator scenario but not be optimized for it.
 - Details FFS, e.g.,
 - How to handle timing difference between eNB timing and PC5 timing, when it exists
 - PC5 resource partitioning among multiple operators
 - Resource coordination across operators is out of 3GPP scope.

Not treated

R1-164818	SPS enhancement for V2V	Huawei, HiSilicon
R1-165309	Details on PC5 SPS enhancement	PANASONIC

6.2.2.3.1 Details of (E)PDCCH used for SPS

Including details of resource indication and how to trigger/release different SPS configurations

R1-164421	eNodeB signaling for SPS resource allocation	Qualcomm Incorporated
R1-164514	Discussion on details of (E)PDCCH used for sidelink SPS	LG Electronics
R1-164762	Multiple SPS configuration support for SL	Samsung
R1-164878	Discussion on SPS configurations	CMCC
R1-164906	Signaling design to support SPS activation/release in V2V	Panasonic
R1-164963	Trigger and release of V2V SPS	ZTE
R1-165193	(E)PDCCH for sidelink SPS configuration switching	NTT DOCOMO, INC.
R1-165246	Contents of Downlink Control Information for V2V over PC5	Ericsson
R1-165699	WF on ePDCCH used for multiple SPS configuration	NTT DOCOMO
R1-165728	WF on DCI for SL SPS	LGE
R1-165907	WF on cross carrier scheduling in PC5-based V2V	CMCC

6.2.2.3.2 Details of UE reporting

Including details of UE indication to eNB on the transmission intention and the need of eNB acknowledgement

R1-164321	Discussion on the resource allocation enhancement for sidelink-based V2V communication	Fujitsu
R1-164422	UE reporting for eNodeB resource allocation	Qualcomm Incorporated
R1-164475	Reporting of radio-level measurements of sidelink	NEC
R1-164515	Discussion on details of UE reporting	LG Electronics
R1-164763	UE reporting procedure for SL SPS transmissions	Samsung
R1-164964	Discussion on UE reporting	ZTE
R1-165258	Geo-Info reporting to eNB	Ericsson
R1-165272	Mode-1 SPS for V2V over PC5	Ericsson

6.2.2.4 Details of resource pool design

Including how to configure SA and data resources FDMed from system perspective and how a data pool is associated with an SA pool

R1-165591 WF on Same Subframe SA and Data transmission Qualcomm, Ericsson, LGE

Decision: The document is noted.

Agreements:

- Allow resource pool definition where SA and associated Data transmitted on the same subframe are always adjacent in frequency
 - All the PRBs used for the SA and associated data transmissions should be contiguous in frequency.
 - Details FFS
- For a SA and associated data resource pool it should be (pre)configured whether the SA and associated data transmission by all the UEs using this pool either occur on the same subframe in an adjacent manner, or occur on different subframes, (FFS or occur on the same subframe in a potentially non-adjacent manner).
 - If the FFS part is not supported, this reverts the existing agreement “When SA and the associated data are transmitted in the same TTI, they can be transmitted in non-adjacent RBs.”
 - Strive for not increasing the number of SA blind decoding to enable this.

Continue discussion on the FFS part during this week (Qualcomm)

R1-165755 WF on resource pool configuration Huawei, HiSilicon, ZTE, NTT DoCoMo

Decision: The document is noted.

Proposed agreement:

- For PC5-based V2V, time domain resource pool can be (pre)configured.
- For PC5-based V2V, frequency domain resource pool can be (pre)configured.
- At least for the case of transmitting SA and the associated data in the same subframe, UE can perform resource selection when a TB arrives (mode-2) or transmit when instructed by the eNB (mode-1).

Continue discussion during this week.

Not treated:

R1-164056	Resource pool design and multiplexing of SA and its associated data	Huawei, HiSilicon
R1-164140	Details of resource pool design for sidelink V2V communication	Intel Corporation
R1-164208	Resource pool enhancement in PC5-based V2V	CATT
R1-164323	Discussion on Resource Pool for PC5 based V2V	Fujitsu
R1-164423	Resource pool design for V2V	Qualcomm Incorporated
R1-164424	MPR for same subframe control and data transmission for V2V	Qualcomm Incorporated
R1-164476	Resource pool design for collision detection and handling	NEC
R1-164516	Discussion on remaining issues on resource pool design for PC5 based V2V	LG Electronics
R1-164646	Resource pool for V2V	Lenovo (Beijing) Ltd
R1-164764	Details on resource pool design	Samsung
R1-164903	Enhancement on V2V geo-based resource pool	Beijing Xinwei Telecom Techn.
R1-164965	Discussion on resource pools and SA resource pattern	ZTE
R1-165066	Details of V2V resource pool design	Potevio
R1-165195	Discussion on resource pool for PC5 based V2V communications	NTT DOCOMO, INC.
R1-165273	Subbands and measurements for sensing for V2V over PC5	Ericsson

6.2.2.5 Scheduling assignment

Including the content of SCI

R1-164103	Discussion on SCI contents for V2V	Huawei, HiSilicon
R1-164141	Scheduling assignment for sidelink V2V communication	Intel Corporation
R1-164209	Discussion on contents of scheduling assignment	CATT
R1-164425	Scheduling Assignments for V2V	Qualcomm Incorporated
R1-164517	Discussion on details of scheduling assignment for PC5 based V2V	LG Electronics
R1-164636	SA contents for V2V	Lenovo (Beijing) Ltd
R1-164765	Discussion on SCI contents	Samsung
R1-164817	Variable number of transmissions for V2V	Huawei, HiSilicon
R1-164907	Repetition and relationship between SA and associated data	Panasonic
R1-164966	Discussion on SA content	ZTE
R1-165046	On SCI Contents	Nokia, Alcatel-Lucent Shanghai Bell
R1-165067	Contents of SCI for V2V communication	Potevio

R1-165196	Discussion on enhancement of scheduling assignment in V2V communications	NTT DOCOMO, INC.
R1-165262	Relation between SA and data for V2V over PC5	Ericsson
R1-165264	Contents of PSCCH for V2V over PC5	Ericsson

6.2.2.6 Details of coexistence of PC5-based V2V operation and legacy Uu operation

R1-164967	Coexistence of PC5-based V2V operation and legacy Uu operation	ZTE
R1-165259	On the Need for V2V Gaps	Ericsson

6.2.2.6.1 Details of prioritizing sidelink transmissions over UL transmissions

R1-164112	Coexistence of cellular and V2V services on the same carrier	Huawei, HiSilicon
R1-164518	Discussion on details of prioritizing sidelink transmissions over UL transmissions	LG Electronics
R1-164766	Prioritization of sidelink transmissions over Uplink transmissions	Samsung
R1-165197	Details of prioritizing sidelink transmissions over UL transmissions	NTT DOCOMO, INC.
R1-165733	WF on V2V TX gap	NTT DOCOMO

6.2.2.6.2 Other

Including reusing sidelink open loop power control and the need of RSRP-based resource selection

R1-164392	Discussion on intra-UE coexistence between 5.9GHz PC5 chain and 2GHz Uu chain for V-UE	CATT
R1-164519	Discussion on remaining issues on coexistence of PC5-based V2V and legacy Uu	LG Electronics

6.2.2.7 Enhancement to sidelink synchronization procedure

Low priority is given to enhancements to Rel-12/13 SLSS-based synchronization.

Agreements:

- Rel-12 DFN definition is reused.
 - When GNSS is the synchronization reference, DFN is derived from GNSS.
 - Details are up to RAN2.
 - For the other cases, DFN is derived according to Rel-12 behavior.

Working assumption:

Working assumption for the V2V PC5 SLSS:

- At least one value is reserved for SLSS ID used for SLSS transmissions from UEs having GNSS as the synchronization reference.
 - FFS whether multiple values need to be reserved.
- The reserved value(s) of the SLSS IDs is(are) pre-defined.
- If it is agreed that SLSS/PSBCH is used for the purpose of detecting LTE ITS transmissions, this working assumption needs to be revisited.

Conclusion:

- Companies are encouraged to consider whether having GNSS as the highest sync priority for OOC UEs have significant impact on in-coverage UE operations.

Working assumption:

- SSSS for V2V uses sequences of subframe-5 SSS
 - If it is agreed that SLSS/PSBCH is used for the purpose of detecting LTE ITS transmissions, this working assumption may need to be revisited.

R1-164113	Timing alignment of different synchronization sources for V2V	Huawei, HiSilicon
R1-164426	Synchronization Procedure for V2V	Qualcomm Incorporated
R1-165317	Distributed Synchronization Procedure for V2X over PC5	Ericsson
R1-165743	Way Forward on differentiate the GNSS timing and eNB timing	Huawei, HiSilicon, Qualcomm, Samsung, NTT DOCOMO, LG Electronics, Panasonic, Xinwei, ZTE, ITRI, CATT

6.2.2.7.1 Priority order of synchronization references

R1-164101	The remaining issues for V2V PC5 synchronization priority	Huawei, HiSilicon
R1-164105	Sidelink synchronization enhancement in V2V communication	Huawei, HiSilicon
R1-164210	Synchronization enhancements in PC5-based V2V	CATT
R1-164469	Discussion on the GNSS based synchronization	Guangdong OPPO Mobile Telecom.
R1-164520	Discussion on details of synchronization enhancements	LG Electronics
R1-164767	Priority order for synchronization references	Samsung

R1-164934	Discussion multiple synchronization references on sidelink synchronization procedure for PC5-based V2V communication	ITRI
R1-164968	Priority order of synchronization references	ZTE
R1-165045	Prioritization of sidelink synchronization sources	Nokia, Alcatel-Lucent Shanghai Bell
R1-165074	Priority order of synchronization references for sidelink V2V communication	Intel Corporation
R1-165198	SLSS enhancements for GNSS based synchronization	NTT DOCOMO, INC.
R1-165241	Considerations on priority order of synchronization references for V2V	Innovative Technology Lab Co.
R1-165308	V2V synchronization remaining issues	PANASONIC
R1-165744	Way Forward on Sync Priority for OOC	Huawei, HiSilicon, Samsung, Panasonic, NEC, Xinwei, ITRI, ZTE

6.2.2.7.2 Other

Including how sidelink TTI/subframe number and frame number are derived

R1-164211	Discussion on synchronization issues of physical design	CATT
R1-164212	Discussion on PSBCH issues	CATT
R1-164213	Timing alignment for V2V	CATT
R1-164477	Determining the radio frame and subframe for V2X synchronisation signals	NEC
R1-164521	Discussion on sidelink subframe timing and number determination	LG Electronics
R1-164768	Differentiation on synchronization references	Samsung
R1-164866	SLSS and PSBCH design for V2V PC5	Huawei, HiSilicon
R1-164969	Enhancement to the sidelink synchronization	ZTE
R1-164996	Remaining Issue Discussions on V2X Synchronization	Sharp
R1-165680	WF on V2V timing	LG Electronics
R1-165745	Way Forward on timing offset between eNB timing and PC5 based V2V	Huawei, HiSilicon, Qualcomm, Intel, ZTE, Xinwei
R1-165749	Way Forward on V2V PC5 SLSS/PSBCH transmission	Huawei, HiSilicon, ITRI, ZTE, OPPO
R1-165908	WF on V2V and D2D SLSS differentiation	Samsung

6.2.2.8 Other

R1-164908	MCS report in mode 1 resource allocation	Panasonic
R1-165245	Observations on CAM Message Periodicity and Payload	Ericsson

6.2.3 Enhancements on Full-Dimension (FD) MIMO for LTE - *WID in RP-160623*

[R1-165936](#) **Chairman's Notes of Agenda Item 6.2.3 on FDMIMO** Ad-hoc chair (Qualcomm, Samsung)

The document was presented by Wanchi Chen from Qualcomm and provides the outcomes of the FDMIMO session.

Decision: The document is endorsed. Contents incorporated below.

[R1-165447](#) **Proposed work plan for RAN1#85** Samsung, Nokia, CATT

Decision: The document is noted.

Conclusion:

- RAN1 to aim to conclude on the three “*evaluate and, if needed, specify*” items
- Decide for each of the three items:
 - whether to specify or not to specify
 - if RAN1 decides to specify, decide the scope of specification work
- Based on the decisions, recommend to refine scoping of the WI to RAN plenary

6.2.3.1 Reference Signals

6.2.3.1.1 Non-coded CSI-RS

For {20, 24, 28, 32} ports with mechanism for overhead reduction

R1-164142	Discussion on CSI-RS for Class A FD-MIMO with overhead reduction	Intel Corporation
R1-164214	CSI-RS enhancement for {20,24,28,32} ports	CATT
R1-164771	Discussions on CSI-RS enhancements for Class A CSI reporting	Samsung
R1-165047	On non-coded CSI-RS overhead reduction	InterDigital
R1-165199	Discussion on CSI-RS Port Extension	NTT DOCOMO, INC.

[R1-165593](#) WF on enhancements for non-coded CSI-RS LG Electronics, Samsung, NEC

[R1-165589](#) WF on NP CSI-RS Aggregation ZTE, Qualcomm, Beijing Xinwei Tech.

Agreement:

- For {20, 24, 28, 32} ports, a CSI-RS resource for class A CSI reporting is aggregated as follows (where M_k is the # of CSI-RS ports in a CSI-RS configuration)
 - For {24, 32} ports, $\sum_k M_k \in \{24, 32\}$, M_k is either 4 or 8, where the same $M_k = M$ used for all k
 - Possible down-selection till RAN1#86 regarding $M_k=4$ vs. 8
 - For {20, 28} ports, FFS till RAN1#86 (including possible down-selection)
 - Alt 1: $\sum_k M_k \in \{20, 28\}$, M_k is either 4 or 8, where the same $M_k = M$ used for all k
 - Possible down-selection till RAN1#86 regarding $M_k=4$ vs. 8.
 - If $M_k=8$ is supported, FFS the details
 - Alt 2: $\sum_k M_k \in \{20, 28\}$, $M_k \in \{4, 8\}$, where M_k may be different for different k
 - FFS port numbering
 - FFS N vs. M

R1-165613 WF on non-precoded CSI-RS Samsung, LGE, NEC

Proposal:

- For {20, 24, 28, 32} ports, CSI-RS RE density can be lower than 1RE/RB/port
 - The chosen scheme(s) will be down-selected/merged among following alternatives
 - FDM
 - Partial port

Continue discussion offline till RAN1#86

R1-165616 Way-forward on CDM-8 for Non-Precoded CSI-RS CATT, Intel, NEC

Proposal:

- At least OCC- 8 is supported for more than 16 ports non-precoded CSI-RS
 - other OCC value not precluded

Conclusion:

- Further discussion till RAN1#86, especially regarding evaluating different alternatives, e.g., using OCC 2/4/8, high reuse of CSI-RS, etc.

Not treated

R1-164215	Discussion on CSI-RS overhead reduction	CATT
R1-164216	Discussion on backward compatibility of Rel.12 and Rel.13 CSI-RS	CATT
R1-164308	Views on non-precoded CSI-RS design for eFD-MIMO	ZTE
R1-164309	Aperiodic CSI-RS for non-precoded CSI-RS	ZTE
R1-164335	CSI-RS Design Supporting up to 32 Antenna Ports	Nokia, Alcatel-Lucent Shanghai Bell
R1-164427	Non-precoded CSI-RS design for up to 32 ports	Qualcomm Incorporated
R1-164481	Design for Non-precoded CSI-RS for overhead reduction	NEC
R1-164483	Discussion on CSI-RS with CDM8	NEC
R1-164522	Discussion on CSI-RS designs for eFD-MIMO	LG Electronics
R1-164772	Evaluation results on CSI-RS RE densities	Samsung
R1-164822	CSI-RS pattern design for up to 32 ports	Huawei, HiSilicon
R1-164879	Discussion on non-precoded CSI-RS enhancement	CMCC
R1-165094	CSI-RS Design for Class A eFD-MIMO	Ericsson
R1-165397	Discussion on Non-precoded CSI-RS for eFD-MIMO	Beijing Xinwei Telecom Techn.

6.2.3.1.2 Beamformed CSI-RS

More efficient resource utilization for UE-specific BF CSI-RS, including aperiodic CSI-RS

R1-164428	Enhancements on Beamformed CSI-RS for eFD-MIMO	Qualcomm Incorporated
R1-164523	Beamformed CSI-RS enhancements including aperiodic CSI-RS	LG Electronics
R1-164773	On aperiodic CSI-RS design	Samsung
R1-164845	PDSCH rate matching enhancement for aperiodic NZP and ZP CSI-RS	Huawei, HiSilicon
R1-165406	Dynamic CSI-RS Design and Overhead Reduction	Ericsson (R1-165095)

R1-165585 WF on beamformed CSI-RS enhancements LG Electronics, Samsung, Qualcomm

Agreement:

- Scheme 1: Aperiodic NZP CSI-RS resource is supported in Rel-14 for Class B eMIMO-Type, where
 - Only PUSCH based A-CSI reporting is supported.
 - A new aperiodic CSI-RS resource allocation/configuration is defined

- Without *Subframe config*
- Aperiodic CSI-RS transmission instance is indicated by UL-related DCI transmitted on a control channel with a CSI request field:
 - Aperiodic CSI-RS transmission is in the same DL subframe as the associated UL-related DCI
 - FFS whether or not the UE may not assume more than one aperiodic NZP CSI-RS resource. If more than one resource is allowed, FFS the signaling details
 - FFS the number of bits for the CSI request field
 - The control channel can be PDCCH or EPDCCH. FFS whether or not the case of EPDCCH can be precluded or with some restrictions/relaxations
- FFS whether or not periodic CSI-RS can be additionally configured
- Scheme 2: For Class B eMIMO-Type, the following CSI-RS resource configuration mechanism is supported
 - A UE receives an activation/release trigger containing a choice from multiple higher-layer-configured NZP CSI-RS resources for a given CSI process
 - Each NZP CSI-RS resource can be either periodic or, aperiodic CSI-RS resource (if scheme 1 is supported)
 - Details of the activation/release trigger (including the set of NZP CSI-RS resource configuration parameters) are FFS
 - For an activation trigger received in subframe n, the transmission of the associated NZP CSI-RS resource will start no earlier than subframe n+X where X>0
 - For a release trigger received in subframe n, the transmission of the associated NZP CSI-RS resource will stop after subframe n+Y where Y>0
 - FFS the impact of multi-shot configuration, if supported
 - FFS whether or not there are any significant issues regarding the potential misalignment about activation and/or release between eNB and UE, and if so, how to address them
- FFS whether or not to further enhance rate matching for PDSCH, particularly whether or not aperiodic NZP CSI-RS will not have impact on PDSCH RE mapping
- FFS the QCL details
- Down-selection between scheme 1 and scheme 2 (if any) to be discussed in RAN1#86

[R1-165642](#) **WF on Beamformed CSI-RS** **Huawei, HiSilicon, CATT**

[R1-164336](#) **CSI-RS Overhead Reduction for Beamformed CSI-RS Transmission Schemes** **Nokia, Alcatel-Lucent Shanghai Bell**

[R1-164143](#) **Discussion on CSI-RS overhead reduction schemes for Class B FD-MIMO** **Intel Corporation**

Conclusion:

- Candidate schemes for CSI-RS overhead reduction for Class B eMIMO-Type (2, 4, and 8 ports):
 - Scheme 1: Configurable CSI-RS frequency-domain density
 - Scheme 2: Localized CSI-RS in frequency domain
 - Scheme 3: Configurable RPF pattern
 - Scheme 4: Frequency domain MR
- Companies are encouraged to study the following issues in the next meeting:
 - Backward compatibility
 - UE implementation restriction (for, e.g. channel estimation)
 - Impact on eNB scheduling
 - Impact on CSI reporting
 - PDSCH rate matching

Not treated

[R1-164217](#) On aperiodic CSI-RS transmission CATT

[R1-164218](#) Enhancements on beamformed CSI-RS CATT

[R1-164310](#) Enhancements on Beamformed CSI-RS ZTE

[R1-164858](#) Discussion on efficient utilization of BF CSI-RS Huawei, HiSilicon

[R1-164930](#) Discussion on beamformed CSI-RS ITRI

[R1-165200](#) Aperiodic CSI-RS with Semi-static Resource Reservation NTT DOCOMO, INC.

6.2.3.1.3 Uplink DM-RS

Evaluate and, if needed, specify more orthogonal ports with partially overlapping BW allocations

[R1-164144](#) **Discussion on UL DMRS Enhancement for FD-MIMO** **Intel Corporation**

[R1-164429](#) **Performance evaluation of uplink DMRS enhancements for MU-MIMO** **Qualcomm Incorporated**

[R1-164099](#) Discussion on more orthogonal DMRS ports with partial overlapping Huawei, HiSilicon
[R1-164311](#) Discussion on UL DMRS enhancement for eFD-MIMO ZTE

Not treated

[R1-164219](#) Discussion on UL DMRS enhancement CATT
[R1-164348](#) General views on DM-RS enhancements in uplink for FD-MIMO Fiberhome Technologies Group
[R1-164484](#) Proposals for uplink DM-RS enhancement NEC
[R1-164524](#) Uplink DMRS enhancements for eFD-MIMO LG Electronics
[R1-164774](#) Discussion on uplink DMRS for partially overlapping bandwidth allocations Samsung
[R1-165096](#) Discussion on UL DMRS Enhancements Ericsson
[R1-165432](#) UL DMRS Enhancement and Evaluations for FD-MIMO Nokia, Alcatel-Lucent Shanghai Bell

6.2.3.2 CSI Reporting

[R1-164775](#) Discussions on periodic CSI reporting for class A in eFD-MIMO Samsung

6.2.3.2.1 Non-precoded CSI-RS codebooks

For newly defined number of ports for NP CSI-RS for a subset of possible port layouts, both 1D and 2D

[R1-164857](#) Discussion on codebook design to support up to 32 ports CSI-RS Huawei, HiSilicon
[R1-164430](#) Non-precoded CSI-RS Codebooks for eFD-MIMO Qualcomm Incorporated
[R1-164145](#) Discussion on Class A codebook extension Intel Corporation
[R1-164146](#) Performance evaluation of Class A codebooks with 32 ports Intel Corporation
[R1-164312](#) Discussion on rank 1-2 codebook design for eFD-MIMO ZTE
[R1-165097](#) Class A Codebook Design for up to 32 Ports in Rel-14 Ericsson

[R1-165594](#) WF on enhancements on codebook for Rel-14 LG Electronics, ZTE, Qualcomm

Conclusion:

- Class A codebook enhancement:
 - Starting from Rel-13 Class A codebook design structure by enabling different N1 and N2 combinations
- Reduce the number of combinations of codebook parameters (N1, N2, O1, and/or O2)
 - To be concluded in RAN1#86
 - Examples:
 - Down select from 19 (N1,N2) combinations; and/or
 - Reduce the number of (O1,O2) combinations
 - Other possibilities are not excluded

Not treated

[R1-164220](#) Antenna port layouts for Rel-14 FD-MIMO CATT
[R1-164221](#) Codebook design for {20,24,28,32} ports CATT
[R1-164324](#) Discussion on non-precoded CSI-RS Fujitsu
[R1-164338](#) Codebook Design Supporting Antenna Configurations Up to 32 Ports Nokia, Alcatel-Lucent Shanghai Bell
[R1-164525](#) Discussion on codebook design for eFD-MIMO LG Electronics
[R1-164776](#) View on class A codebook extension Samsung
[R1-164929](#) Discussions of codebook enhancement for up to 32 ports ITRI
[R1-165201](#) Codebook Enhancement for Non-precoded CSI-RS NTT DOCOMO, INC.

6.2.3.2.2 CSI reporting for hybrid CSI-RS

Hybrid between NP and BF CSI-RS or different types of BF CSI-RS

[R1-164222](#) CSI reporting for hybrid CSI-RS CATT
[R1-164339](#) Hybrid CSI measurement and reporting schemes Nokia, Alcatel-Lucent Shanghai Bell
[R1-164431](#) Discussion on Hybrid CSI-RS Operation for eFD-MIMO Qualcomm Incorporated
[R1-164526](#) Discussion on CSI reporting enhancements for hybrid CSI-RS LG Electronics
[R1-165048](#) On Hybrid CSI-RS reporting scheme InterDigital

[R1-165606](#) WF on Hybrid CSI Samsung, CATT, Interdigital, LG Electronics, Nokia, ALU Shanghai Bell, Qualcomm, Huawei, HiSilicon

[R1-165617](#) Way Forward on Hybrid CSI Reporting ZTE, NTT DOCOMO, Beijing Xinwei Tech., NEC

Working assumption:

- Mechanism 1: Hybrid CSI is realized by with one CSI process, support at least CLASS A for the 1st eMIMO-Type and CLASS B with K=1 CSI-RS resource for the 2nd eMIMO-Type
 - i_1 is reported while CQI and i_2 are not reported for the 1st eMIMO-Type (CLASS A)
 - FFS: whether RI is reported for CLASS A
 - CQI/PMI/RI are reported for the 2nd eMIMO-Type (CLASS B K=1)
- At least one more mechanism is supported, to be discussed in RAN1#86

<u>R1-164860</u>	Discussion on Joint utilization of different types of CSI-RS	Huawei, HiSilicon
<u>R1-164770</u>	Port-based CSI-RS overhead reduction	Samsung
<u>R1-164777</u>	Hybrid PMI codebook based CSI reporting and simulation results	Samsung
<u>R1-165202</u>	CSI Reporting for Hybrid CSI-RS	NTT DOCOMO, INC.

[R1-165920](#) WF on additional hybrid CSI mechanism NTT DOCOMO, LG Electronics, NEC, Qualcomm, Samsung

Conclusion:

- Candidate mechanisms to consider in RAN1#86
- Mechanism 2A: for hybrid CSI with one CSI process, support CLASS B with $K \geq 1$ CSI-RS resources for the 1st eMIMO-Type and CLASS B with K=1 CSI-RS resources for the 2nd eMIMO-Type
 - For the 1st eMIMO-Type, depending on the value of K
 - K=1: CQI/RI are reported. In addition, i_1 is reported for Rel.12 dual-stage codebooks
 - K>1: two options
 - Option 1: CRI is reported
 - Option 2: PMI/RI for each CSI-RS resource are reported
 - For the 2nd eMIMO-Type
 - CQI/PMI/RI are reported
- Mechanism 2B: for hybrid CSI with one CSI process, support CLASS B with $K \geq 1$ CSI-RS resources for the 1st eMIMO-Type and CLASS B with K=1 CSI-RS resources for the 2nd eMIMO-Type
 - For the 1st eMIMO-Type, depending on the value of K
 - K=1:
 - Option 1: i_1 is reported for Rel.12 codebooks (when applicable) or i_2 for Rel.13 CLASS B codebooks
 - Option 2: CQI/RI are reported. In addition, PMI is reported for Rel.13 CLASS B codebooks
 - K>1: two options
 - Option 1: CRI is reported
 - Option 2: PMI/RI for each CSI-RS resource are reported
 - For the 2nd eMIMO-Type
 - CQI/PMI/RI are reported
- Mechanism 3: for hybrid CSI with one CSI process, CLASS A or CLASS B K=1 for the 1st eMIMO-Type and CLASS B K>1 for the 2nd eMIMO-Type
 - For the 1st eMIMO-Type: i_1 is reported
 - For the 2nd eMIMO-Type: two options
 - Option 1: CRI and CQI/PMI/RI for the recommended CSI-RS resource are reported
 - Option 2: CQI/PMI/RI for a CSI-RS resource
- Mechanism 4: Hybrid CSI reporting with CSI process pair
 - UE calculates CSI for only one CSI process at a time
- Mechanism 5: the proposal in [R1-165617](#)
- Other mechanisms are not precluded
- Down select from the above mechanisms and/or options in RAN1#86
- Each proposal should include clear description on use case(s) and specification impact
 - For CLASS B K=1, proponent needs to clarify whether both codebook options are applicable for not.

[R1-164880](#) Considerations on hybrid non-precoded CSI-RS and beamformed CSI-RS CMCC

Not treated

<u>R1-164147</u>	Evaluation of beam selection in Class B for hybrid FD-MIMO	Intel Corporation
<u>R1-164313</u>	Discussion on CSI reporting for hybrid CSI-RS	ZTE
<u>R1-164778</u>	CSI reporting for hybrid CSI-RS	Samsung
<u>R1-164895</u>	Discussion on CSI reporting for hybrid CSI-RS	Beijing Xinwei Telecom Techn.
<u>R1-165098</u>	Hybrid CSI Reporting with One and Two CSI Processes	Ericsson

6.2.3.2.3 Advanced CSI reporting and interference measurement

(Second priority) Evaluate and, if needed, specify enhancements on CSI reporting to improve eNB precoding and interference measurement for MU transmissions

- [R1-164781](#) LC based explicit CSI feedback and simulation results Samsung
[R1-165100](#) High Resolution CSI feedback Ericsson
[R1-164150](#) Explicit CSI reporting for FD-MIMO Intel Corporation
[R1-165789](#) Initial performance evaluation on advanced implicit CSI LG Electronics ([R1-164527](#))
[R1-164098](#) Enhancement on CQI measurement and feedback for MU-MIMO Huawei, HiSilicon
[R1-165203](#) Advanced Interference Measurement and CSI Reporting NTT DOCOMO, INC.
- [R1-165801](#) WF on advanced CSI feedback Huawei, Hisilicon, China Unicom, China Telecom, Deutsche Telekom
Proposal:

- Specify at least Analog CSI feedback in Rel-14 with the following restrictions
 - CQI is quantized and CQI derivation is based on associated unquantized CSI (i.e. implicit feedback)
 - Only support Aperiodic feedback in Rel-14;
 - Only support {2, 4} ports per CSI-RS resource in Rel-14

Not treated

- [R1-164090](#) CSI feedback for beam space MIMO Huawei, HiSilicon
[R1-164097](#) Discussion and evaluation of analog CSI feedback Huawei, HiSilicon
[R1-164148](#) Beam combining codebook enhancements for Class B FD-MIMO Intel Corporation
[R1-164223](#) On Interference enhancement for multi-user MIMO operation CATT
[R1-164315](#) Discussion on interference measurement for MU-CSI ZTE
[R1-164432](#) Discussion on advanced CSI reporting and initial evaluation results Qualcomm Incorporated
[R1-164659](#) Considerations on MU-CQI Transmission Sony
[R1-164779](#) Advanced CSI reporting paradigm Samsung
[R1-164780](#) Linear combination (LC) codebook based CSI reporting and simulation results Samsung
[R1-164782](#) Discussions on auxiliary CSI for MU transmission Samsung
[R1-164783](#) Discussions on interference measurement enhancement in eFD-MIMO Samsung
[R1-164856](#) Advanced CSI feedback framework for LTE Huawei, HiSilicon
[R1-164881](#) Enhancing interference measurement for MU transmissions CMCC
[R1-164897](#) Discussion on Advanced CSI Reporting Beijing Xinwei Telecom Techn.
[R1-165099](#) Discussion on Interference Measurement Enhancements Ericsson
[R1-165408](#) Explicit CSI reporting for FD-MIMO Intel Corporation
[R1-165444](#) Discussion on CSI reporting of linear combination codebook ZTE
[R1-165597](#) Discussion on the performance of CQI reporting based on the NZP CSI-RS Intel Corporation [R1-164090](#)
CSI feedback for beam space MIMO Huawei, HiSilicon

6.2.3.3 DMRS-based Open-Loop and Semi-Open-Loop Transmission

Evaluate and, if needed, specify necessary CSI reporting scheme and open-loop (without PMI feedback) as well as semi-open-loop (with reduced PMI feedback) transmission scheme

- [R1-165102](#) Email Summary: Use of 3D RMa Channel Model in Semi-Open Loop Evaluations Ericsson

Conclusion:

- No consensus to change RMa channel model assumptions for (semi-)open loop evaluations at present. Implications:
 - 2D RMa currently supported in evaluations is suitable for 1D horizontal arrays.
 - Companies bringing in preliminary results for FD-MIMO (2D) arrays will need to explain how they approximated a 3D model from the 2D ITU model
- Use of 3D RMa may be further discussed in evaluations during specification phase.
- Clarify that 2D RMa can be simulated with 30, 60, 120 kmph, as shown below.
- Amend slide 3 of [R1-163832](#) as follows, leaving the 'UE Speed' row unchanged.

Parameters	Value
Scenarios	3D-UMa ISD 500m (~~at 30km/h, 60kmph, and/or 120km/h~~) RMa ISD 1732m (~~120km/h~~) in ITU-R model [note: this is a 2D model]

- [R1-165407](#) DMRS-based Open-loop MIMO Ericsson ([R1-165101](#))
[R1-164433](#) Discussion on DMRS based OL and Semi-OL Transmission Qualcomm Incorporated
[R1-164859](#) Discussion on DMRS based open and semi open loop transmission Huawei, HiSilicon

- [R1-164341](#) Evaluation Results of DMRS-based open-loop transmission schemes Nokia, Alcatel-Lucent
Shanghai Bell
- [R1-164225](#) Evaluation of DMRS-based open-loop and semi-open-loop MIMO CATT
- [R1-165790](#) WF on the three “evaluate and, if needed, specify” Items Nokia, Alcatel-Lucent Shanghai Bell,
Samsung, CATT

Agreements:

- UL DMRS Enhancement
 - Specify enhancement on uplink DMRS to support (more than 2) orthogonal DMRS for MU-MIMO with partially overlapping BWs allocation, i.e. one of IFDMA with OCC2 or new DMRS sequence design
- Advanced CSI
 - Specify enhancement on CSI reporting to improve eNB precoding. The specified enhancement is to be selected from the following categories:
 - Enhancements to Rel-13 feedback codebooks (FFS which numbers of antenna ports from the set {8, 12, 16, 20, 24, 28, 32}) that increase CSI resolution through improved beam selection / construction in W1 and/or improved beam/port selection / combining / weighting mechanisms in W2
 - Parameters representing channel coefficients, or some reduced space representation thereof including beam combining / weighting with coefficient quantisation or channel quantisation or channel covariance matrix quantisation
 - Uplink physical channel enhancements to carry the representation of channel coefficients can be included if selected
 - Also, interference measurement enhancement can be considered
- DMRS-based semi-open-loop
 - Specify enhancement to support DMRS-based semi-open-loop transmission with the existing numbers of CSI-RS ports as well as the newly supported number of CSI-RS ports, in the following areas
 - CSI reporting scheme with partial PMI feedback, and/or
 - Transmission method with transmit diversity and/or precoder cycling, with possible enhancements to precoder bundling
 - Associated enhancements to DMRS if required
 - Further system level simulations (e.g. considering wideband scheduling and BLER targets at high speed) will be conducted in order to identify the exact scheme to be specified.

Send LS to RAN plenary reflecting the above, with update to WID - [R1-165493](#).

Friday

- [R1-165493](#) LS on Rel.14 eFD-MIMO WID update Nokia
Decision: The document is noted and final LS is agreed in [R1-166029](#)

- [R1-165860](#) Draft LS on Rel.14 eFD-MIMO WID update Samsung

Agreement:

Change “RAN1 has agreed to request RAN to amend the WID as follows” to “RAN1 has agreed on the following”
The agreed LS is to be prepared in [R1-165493](#).

Not treated:

- [R1-164151](#) Evaluation of open loop schemes Intel Corporation
- [R1-164224](#) Discussion on DMRS based open-loop MIMO CATT
- [R1-164528](#) Initial performance evaluation on semi-OL MIMO LG Electronics
- [R1-164784](#) Discussions on open and semi-open loop transmission in eFD-MIMO Samsung
- [R1-164898](#) Discussion on Semi-Open-loop Transmission Beijing Xinwei Telecom Techn.
- [R1-165341](#) Discussions on DMRS based Open/Semi-open loop MIMO schemes CEWiT
- [R1-165411](#) Initial simulation results of DMRS based semi-open-loop MIMO CATR
- [R1-165433](#) Evaluation Results of DMRS-based open-loop transmission schemes Nokia, Alcatel-Lucent Shanghai Bell
- [R1-165445](#) Discussion on DMRS-based Open-Loop and Semi-Open-Loop Transmission ZTE

6.2.4 Downlink Multiuser Superposition Transmission for LTE - WID in [RP-160680](#)

- [R1-165937](#) Chairman's Notes of Agenda Item 6.2.4 on MUST Ad-hoc chair (Qualcomm)
The document was presented by Wanchi Chen from Qualcomm and provides the outcomes of the MUST session.
Decision: The document is endorsed. Contents incorporated below.

- [R1-165888](#) Draft LS on RAN1 Agreements in MUST MediaTek

The draft LS is **approved in R1-165984**, with the following updates:

- Remove the yellow parts
- Last paragraph is updated to:
 - For exact values of power ratios, although RAN1 concludes that [R1-165763](#) and [R1-165797](#) can be used as examples for further evaluation, RAN1 has not achieved consensus yet and further evaluations are to be performed in RAN1.

6.2.4.1 Superposition transmissions

Down select between single and multiple power ratios, potential power ratios, modulation, etc.

[R1-164079](#) Discussion on power ratios for MUST Huawei, HiSilicon
[R1-164282](#) Performance evaluation of MUST for selection of potential power ratios ZTE
[R1-164435](#) Power ratio set considerations for MUST Qualcomm Incorporated
[R1-164529](#) Discussion on power ratio and modulation order LG Electronics
[R1-164977](#) Selection of Power Ratios and Modulation for MUST PDSCH MediaTek Inc.
[R1-164997](#) On transmission power ratios for MUST Sharp
[R1-165831](#) Discussion on power ratios optimization for MUST scheme NTT DOCOMO, INC. ([R1-165204](#))

[R1-165764](#) WF on modulation order LG Electronics, Intel, MediaTek, NTT DOCOMO, ZTE, Nokia

Agreement:

- For Case 1 and 2 described in MUST WID, Far UE's modulation order is limited to QPSK when it is co-scheduled with near UE in a given subframe.

[R1-165796](#) Way Forward on MUST Power Ratio MediaTek, China Unicom, CHTTL, Huawei, HiSilicon, HTC, III, Intel, ITRI, LG, NTU, Sharp, Sony, ZTE
Also supported by CMCC

Agreement:

- For MUST Case 1 and Case 2, multiple power ratios are supported at least for some combinations of MUST-near UE and MUST-far UE modulation orders
 - For case 3, FFS

[R1-165763](#) Way Forward on MUST Power Ratio Set Qualcomm
[R1-565765](#) WF on power ratios LG Electronics, ZTE, Nokia

Agreement:

- For Case 1 and 2, and for each combination of modulation order,
 - The number of power ratios generating non-uniform composite constellation should be chosen from 0 (for some combinations, if any), 1, 2 or 3.
 - The details are FFS.
 - Power ratios generating non-uniform composite constellation should be selected from the range [0.7, 0.95].
 - The values of power ratio is FFS.
 - 0.7 should be excluded in case of 64QAM (for near UE) + QPSK (for far UE).

[R1-165797](#) Way Forward on MUST Transmission MediaTek, ASUSTEK COMPUTER (SHANGHAI), CHTTL, Huawei, HiSilicon, HTC, III, ITRI, NTT DOCOMO INC., NTU, Sharp, ZTE

[R1-165798](#) Way Forward on MUST Transmission when MUST-Far UE Has 16QAM MediaTek, CHTTL, Huawei, HiSilicon, HTC, III, ITRI, NTU, Sharp

Conclusion:

- Companies are encouraged to perform more evaluations especially regarding the detailed set of power ratio(s) for each combination (e.g., refer to the WFs in [R1-165763](#), [R1-165797](#) as an example)

Not treated:

[R1-164152](#) Discussion on superposition transmission Intel Corporation
[R1-164226](#) Selection of superposition transmission scheme and parameterization CATT
[R1-164281](#) Multiuser superposition transmission scheme for LTEZTE
[R1-164434](#) Superposition transmissions Qualcomm Incorporated
[R1-164530](#) Discussion on Gray mapping for superposed constellation LG Electronics
[R1-164593](#) down-selection for superposition scheme Sequans Communications
[R1-164816](#) Constellation combinations in MUST with legacy composite constellations

[R1-164978](#) Discussion on the EVM requirement for MUST MediaTek Inc.
[R1-165136](#) MUST Case 1 and 2 schemes Nokia, Alcatel-Lucent Shanghai Bell

6.2.4.2 Mechanisms for efficient operation

Related to RRC signaling, DCI, UE blind detection, etc.

[R1-165135](#) On network assistance and operation of MUST Nokia, Alcatel-Lucent Shanghai Bell
[R1-164979](#) Blind detection evaluation on interference existence for Case 1 MediaTek Inc.

[R1-165799](#) Way Forward on Mechanism for MUST operation MediaTek, China Telecom, CHTTL, CMCC, Huawei, HiSilicon, HTC, III, ITRI, NTT DOCOMO INC., NTU, Sharp, Sony, ZTE

Agreement:

- No new TM for MUST
- MUST Case 1 and Case 2 using up to 2Tx is supported in the following TMs
 - TM 2/3/4
 - FFS TM 8/9/10
- A UE is signalled by RRC if it is to be configured for potential MUST operation
- FFS MUST Case 3 using up to 8Tx is supported in the following TMs
 - TM 4/8/9/10
 - Companies are encouraged to perform more evaluations especially using the agreed FTP model
- At least one new DCI to be monitored by a UE once configured into MUST operation
 - FFS on details
- FFS MUST-near UE may assume MUST interference presence/absence is consistent among all of its scheduled PRBs for CRS-based TM and DMRS-based TM

[R1-165793](#) Way forward on transmission mode for MUST ZTE, NEC, MediaTek, Sequans
Also supported by Sharp

Agreement:

- For MUST case 1/case 2/case 3, dynamic switching between MUST and non-MUST operation is supported
- Maximum number of spatial layers for MUST
 - For MUST case 1 and case 2, up to 2 spatial layers for each UE are used.
 - For MUST case 3, the maximum number of spatial layers for a UE should be limited, with details FFS.

[R1-165794](#) Way forward on DCI transmission for MUST ZTE, MediaTek, Qualcomm
Revised in [R1-165956](#)

[R1-165803](#) Way Forward on MUST codewords multiplexing Huawei, HiSilicon, MediaTek, ZTE
[R1-165881](#) WF on far UE spec impact LG Electronics, Intel, ASUSTeK, ZTE

Not treated

[R1-164080](#) Signaling mechanisms for MUST Huawei, HiSilicon
[R1-164153](#) On downlink control signalling for MUST Intel Corporation
[R1-164227](#) Support of downlink superposition transmission CATT
[R1-164283](#) Method to provide assistance information to a UE ZTE
[R1-164284](#) Potential mechanisms for MUST operation ZTE
[R1-164345](#) Discussion on control signalling of MUST Fiberhome Technologies Group
[R1-164436](#) Mechanisms for efficient operation Qualcomm Incorporated
[R1-164478](#) Discussion on candidate assistance information for signalling or blind detection NEC
[R1-164531](#) Discussion on Signaling Assistance Information LG Electronics
[R1-164594](#) initial configuration and dynamic indication Sequans Communications
[R1-164669](#) Considerations of Efficient Control Signaling for MUST Sony
[R1-164980](#) Mechanisms for Operation of MUST MediaTek Inc.
[R1-164981](#) Downlink power allocation for MUST MediaTek Inc.
[R1-165068](#) Operation mechanism for MUST case 1 and case 2 China Telecommunications
[R1-165137](#) On the specification approach of MUST Nokia, Alcatel-Lucent Shanghai Bell
[R1-165205](#) Discussion on remaining issues and signaling design for DL MUST NTT DOCOMO, INC.
[R1-165265](#) Discussion on Downlink Control Signaling for MUST ASUSTEK COMPUTER (SHANGHAI)
[R1-165736](#) Feasibility of interference presence blind detection in case 1 MUST Nokia
[R1-165956](#) WF on DCI transmission for MUST ZTE, MediaTek, Qualcomm

6.2.4.3 Evaluation for MUST using up to 8Tx

R1-164285	Evaluation for MUST using up to 8Tx antennas	ZTE
R1-164882	Updated Evaluation results for MUST using 8Tx with different precoders	CMCC
R1-164982	Preliminary evaluation results for MUST Case 3	MediaTek Inc.
R1-165138	System-level Evaluation of Case 1 and 3 MUST	Nokia, Alcatel-Lucent Shanghai Bell
R1-165206	Evaluation for CRS-based MUST with 4 Tx antennas	NTT DOCOMO, INC.

6.2.4.4 Other

R1-164437	MUST UE pairing with existing CQI feedback	Qualcomm Incorporated
R1-164832	Consideration on implementation for MUST transmitter	Huawei, HiSilicon

6.2.5 eMBMS enhancements for LTE - WID in RP-160675

R1-165938	Chairman's Notes of Agenda Item 6.2.5 on eMBMS	Rapporteur (Ericsson)
The document was presented by Joerg Huschke from Ericsson and provides the outcomes of the eMBMS session.		
Decision: The document is endorsed. Contents incorporated below		

6.2.5.1 Longer cyclic prefix for MBSFN subframe

R1-164082	Evaluations of different numerologies for eMBMS	Huawei, HiSilicon
R1-164438	Evaluation results for longer cyclic prefix	Qualcomm Incorporated
R1-165437	System simulation results for longer CP in MBSFN subframes	Ericsson (R1-165219)
R1-165342	MBSFN Measurements	Alcatel-Lucent Shanghai Bell
R1-164154	On the support of longer cyclic prefix for MBSFN subframes	Intel Corporation
R1-164439	Design options for longer cyclic prefix for MBSFN subframes	Qualcomm Incorporated
R1-165220	Link level simulation assumptions for evaluation of longer CP for MBSFN subframes	Ericsson

Offline discussion to develop simulation assumptions – Joerg Huschke (Ericsson) - [R1-165438](#) (email approval until June 30th)

6.2.5.2 Increased number of MBSFN subframes per radio frame

R1-164440	Increased number of MBSFN subframes per radio frame	Qualcomm Incorporated
R1-164155	On the support of increased number of MBSFN subframes per radio frame	Intel Corporation
R1-165221	Radio frame design for extended MBSFN subframe allocation	Ericsson
R1-164083	Radio frame design for increased number of MBSFN subframes	Huawei, HiSilicon
R1-164306	Consideration on increasing number of MBSFN subframes	ZTE
R1-165222	DRS design for carrier with extended MBSFN subframe allocation	Ericsson

6.2.5.3 MBSFN subframes without a unicast control region and cell-specific reference signals

R1-164156	On the support of MBSFN subframes without a unicast control region and cell-specific reference signals	Intel Corporation
R1-164307	Consideration on support of MBSFN subframes without a unicast region	ZTE
R1-164441	MBSFN subframes without a unicast control region and cell-specific reference signals	Qualcomm Incorporated
R1-164849	On MBSFN subframes without a unicast control region and cell-specific reference signals	Huawei, HiSilicon
R1-165223	Unicast control region configuration for eMBMS enhancements	Ericsson

6.2.5.4 Other

R1-164442	Standalone eMBMS carrier	Qualcomm Incorporated
R1-164443	Simultaneous reception of broadcast and unicast	Qualcomm Incorporated
R1-165340	Considerations for eMBMS	Nokia, Alcatel-Lucent Shanghai Bell

Way Forwards

R1-165609	eMBMS WF unicast control region, incl. CRS	Ericsson, Qualcomm, BBC, EBU
R1-165611	eMBMS WF link level simulations and RS design	Ericsson, Qualcomm, BBC, EBU
R1-165615	WF on system information and idle mode reception for eMBMS enhancements	Qualcomm, EBU, BBC, Ericsson

[R1-165610](#) Way Forward on longer CP for MBSFN

Ericsson, Qualcomm, BBC, EBU

[R1-165614](#) WF on numerology supported in MBSFN subframes

Huawei, HiSilicon, Orange, Intel, ZTE

[R1-165846](#) Way Forward on eMBMS enhancements Ericsson, Qualcomm, BBC, EBU, Nokia, ASB, Dish, AT&T, Telstra, Fraunhofer IIS

Proposed agreement

- If a carrier is operated with 100% MBSFN subframe allocation, a single CP longer than or equal to X is supported
 - It is understood 100% MBSFN subframe allocation allows for non-MBSFN subframes set aside for e.g. cell search, SI
 - 100% MBSFN subframe allocation applies to objective b), and objective d) if specified
 - This carrier does not have unicast control in the MBSFN subframes
 - FFS: Where to indicate MCCH change notification
- For a carrier that is operated with 100% MBSFN subframe allocation, legacy CPs are supported
 - FFS whether it is needed to have unicast control on this carrier
- FFS whether the longer CP numerology can be supported in carriers with less than 100% MBSFN subframe allocation
- If a carrier supports mixed unicast and MBMS, at least 2 subframes separated by 5ms are non-MBSFN subframes
- 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.

Proposed working assumption: $x=100\mu s$, need for more evaluation

Huawei: is first proposal for standalone only? If so it is for study only.

Qualcomm: also applies to objective b), not only for standalone

ZTE, Huawei believe should be only for standalone operation

Telstra emphasizes need for support of large ISD not only for standalone but in existing spectrum

Huawei: What is standalone?

Ericsson: a carrier operating on its own. Currently MBMS on SCell does not work for Telstra because their ISDs are too large.

Huawei: So this is for mixed ISD? Has not been evaluated.

Telstra: Has taken it as given that CP for 15km will be specified, reading from WI

Ericsson: Mixed unicast/MBMS does not have to be evaluated separately. Addressing real operator problem.

Huawei: Can 15km ISD really provide contiguous PCell coverage.

Huawei: Proposes to have more time to evaluate longer CP scenario

Pro: Nokia, ASB, Qualcomm, Ericsson, BBC, EBU, Dish, Fraunhofer, KT, Telstra

Con: Huawei, HiSilicon, ZTE, Orange

This should be revisited on Friday

Friday: Email approval regarding the above proposed agreement and proposed working assumptions until June 30th – (Qualcomm)

6.2.6 SRS switching between LTE component carriers - WID in [RP-160676](#)

[R1-165939](#) Chairman's Notes of Agenda Item 6.2.6 on SRS Ad-hoc chair (Qualcomm)

The document was presented by Wanshi Chen from Ericsson and provides the outcomes of the SRS session.

Decision: The document is endorsed. Contents incorporated below.

[R1-165054](#) An additional requirement on SRS switching

SoftBank Corp.

Conclusion:

- Companies are encouraged to check [R1-165054](#), especially considering input from RAN4
- Revisit in RAN1#86

6.2.6.1 SRS Transmission on TDD CCs without PUSCH

Including power control, timing advance, and possible new symbol positions

[R1-164107](#) SRS subframe design for SRS carrier based switching Huawei, HiSilicon

[R1-164228](#) Considerations on SRS carrier based switching CATT

[R1-164444](#) SRS Transmission on TDD CCs without PUSCH Qualcomm Incorporated

[R1-164786](#) SRS Transmission without PUSCH Samsung

[R1-164936](#) On SRS transmission on TDD CCs without PUSCH Ericsson

[R1-165760](#) Way Forward on SRS Transmission on TDD CCs without PUSCH Huawei, HiSilicon

Agreement:

- Support non-contention based PRACH transmission over SRS Scell without PUSCH
 - Re-using existing procedure
- Timing advance commands are supported for SRS Scell without PUSCH
 - Re-using existing procedure
- Support power control mechanism for SRS transmission in cells without configured PUSCH transmission
 - Specify power control parameters for SRS transmission without PUSCH.
 - Aim for re-using existing parameters. Details FFS
 - Specify closed-loop power control signaling. Details FFS
 - Specify power headroom reports. Details FFS
 - FFS specify dropping/power scaling rules. Details FFS

Agreement:

- As defined in Rel-13, for SRS carrier based switching, the SRS transmission opportunities include:
 - In at least one symbol out of up to 6 symbols in a special subframe
 - In the last symbol of a UL subframe
 - Note: from UE perspective, there may be impact on SRS transmission opportunities due to switching time depending on RAN4 input
- FFS whether or not to further allow more symbol positions for SRS transmissions on a switching-to carrier in special subframes, UL subframes and/or after the control region in MBSFN subframes

Not treated

R1-164108	Power control for SRS on TDD CCs without PUSCH Huawei, HiSilicon
R1-164109	Timing advance for SRS on TDD CCs without PUSCH Huawei, HiSilicon
R1-164157	Consideration on Support SRS Carrier based Switching Intel Corporation
R1-165281	UL transmission on DL-only carrier for SRS carrier based switching Nokia, Alcatel-Lucent Shanghai Bell

6.2.6.2 Support of Periodic and/or aperiodic SRS

R1-164110	Support of periodic and/or aperiodic SRS Huawei, HiSilicon
R1-164937	On Periodic and aperiodic SRS switching Ericsson
R1-165075	Support of SRS transmission switching Intel Corporation
R1-165282	Discussion on SRS transmission triggering Nokia, Alcatel-Lucent Shanghai Bell

[R1-165761](#) Way Forward on Support of Periodic and/or Aperiodic SRS Huawei, HiSilicon, Softbank

Agreement:

- Aperiodic SRS on a CC without PUSCH is supported for SRS carrier-based switching
 - Details FFS
- Periodic SRS on a CC without PUSCH is supported for SRS carrier-based switching
 - Details FFS
 - Strive for minimizing additional complexity (w.r.t. A-SRS), if any, and additional specification impact for supporting P-SRS

Not treated

R1-164445	Support of Periodic and/or aperiodic SRS Qualcomm Incorporated
R1-164787	P-SRS and A-SRS Transmission with Carrier Switching Samsung

6.2.6.3 Collision Handling

R1-164446	Collision Handling Qualcomm Incorporated
R1-164788	SRS Collisions due to Carrier Switching Samsung
R1-165283	Collision handling for SRS carrier based switching Nokia, Alcatel-Lucent Shanghai Bell

[R1-165762](#) Way Forward on Collision Handling Huawei, HiSilicon, Qualcomm

Agreement:

- To handle collision due to SRS carrier-based switching
 - Define priority/dropping rules by taking into account the factors including periodic/aperiodic SRS type, channel/UCI type, and PCell/SCell type

- Rel-13 collision handling rules between SRS and other UL transmissions as baseline, taking into account switching time based on input from RAN4
- Details FFS
- FFS shortened PUSCH format and possible mechanisms to mitigate the effect of puncturing (e.g. power control, different beta value for UCI).
- FFS approaches to help avoid collision, e.g.,
 - Introduction of different HARQ timing (e.g. by introduction of HARQ reference subframes)
 - Introduction of flexible A-SRS transmission timing
 - Group DCI for A-SRS triggering

Not treated:

[R1-164111](#)

Collision handling for SRS carrier based switching Huawei, HiSilicon

[R1-164938](#)

On collision handling of SRS and channels on other carriers Ericsson

6.2.6.4 Other

[R1-164081](#)

SRS carrier based switching for UEs with multiple antennas

Huawei, HiSilicon

Conclusion:

- Discuss further for the case when UEs have more than one receiving antenna but only one transmitting antenna at one time, how to handle the transmit antenna for SRS
 - Note: this may be related to UE capability

6.2.7 Further Indoor Positioning enhancements for UTRA and LTE - *WID in RP-160538*

[R1-165940](#)

Chairman's Notes of Agenda Item 6.2.7 on enh_Ind_Pos Ad-hoc chair (Qualcomm)

The document was presented by Wanshi Chen from Qualcomm and provides the outcomes of the IndPos_enh session.

Decision: The document is endorsed. Contents incorporated below.

6.2.7.1 OTDOA Enhancements

[R1-165553](#)

WF on OTDOA for the same PCI Huawei, HiSilicon, Intel, ZTE

Agreement:

- For OTDOA same PCI, RAN1 decides to:
 - Define N_{ID}^{PRS} for PRS sequence/vshift generation per TP
 - With N_{ID}^{PRS} values ranging FFS
- Send LS to RAN2 and RAN3 for signaling design (including agreements from last meeting) – Xue Jiantao (HW)
 - Draft LS is in [R1-165835](#), approved in [R1-165853](#) with the following update:
 - CC RAN4

Not treated:

[R1-163976](#)

TP-specific PRS sequence generation for indoor positioning Ericsson

[R1-163977](#)

PRS pattern enhancements for indoor positioning Ericsson

[R1-163978](#)

Richer RSTD reporting for indoor positioning Ericsson

[R1-164447](#)

Introduction of OTDOA enhancements for the shared Cell-ID scenario Qualcomm Incorporated

[R1-164448](#)

Draft CR Introduction of OTDOA enhancements for the shared Cell-ID scenario Qualcomm Incorporated

[R1-164449](#)

Introduction of UE inter-frequency RSTD calibration accuracy reporting Qualcomm Incorporated

[R1-164661](#)

Adaptive RSTD reporting for indoor positioning Ericsson

[R1-164668](#)

OTDOA Enhancement for Same PCI Issue Nokia, Alcatel-Lucent Shanghai Bell

[R1-164852](#)

VCID PRS sequence generation Huawei, HiSilicon

[R1-165232](#)

OTDOA enhancement Intel Corporation

[R1-165526](#)

Summary of PRS sequence generation proposals for indoor positioning Ericsson

6.2.7.2 PRS-based Beacons

[R1-164451](#)

Way Forward on PRS-based Beacons

Qualcomm Incorporated

[R1-165825](#)

Way Forward on PRS-based Beacons

Qualcomm Incorporated

Agreement:

- For PRS-based TBS, as a starting point for Rel-14 WI, RAN1 decides to prioritize the following:
 - Support PRS-based TBS where the TPs transmit positioning reference signals with the same general design as defined for eNBs in Rel-14.
 - The PRS for the TBS TPs can be configured in up to all 10 subframes within a radio frame.
 - The PRS for the TBS TPs can be configured in up to all radio frames of a DL carrier.

Not treated:
[R1-164450](#)

Introduction of PRS based Terrestrial Beacon Systems

Qualcomm Incorporated

6.2.7.3 E-CID Enhancements

[R1-165552](#)
[R1-165834](#)

WF on E-CID for the same PCI
WF on E-CID for the same PCI

Huawei, HiSilicon
Huawei, HiSilicon

Proposal:

- RAN1 decides to prioritize the following for the same PCI E-CID enhancement
 - Support CSI-RSRP reporting to E-SMLC
 - Note: this is only supported when the UE is configured with CSI-RS based DRS
 - Detailed reporting is up to RAN2/RAN3
 - Send LS to RAN2 and RAN3 for signaling design - Xue Jiantao (HW)
- Note: Other E-CID enhancements are not precluded

Further discussion offline.

Conclusion: No consensus to approve above proposal – draft LS in [R1-165839](#) is irrelevant and not pursued.

Not treated:

[R1-163980](#)
[R1-164853](#)
[R1-164854](#)

E-CID enhancements for indoor positioning Ericsson

Discussion on the same PCI case for E-CID enhancements Huawei, HiSilicon

Discussion on the UE Rx-Tx measurement over multiple serving cells Huawei, HiSilicon

6.2.7.4 Other

[R1-163981](#)

Indoor/outdoor classification for indoor positioning Ericsson

6.2.8 Uplink Capacity Enhancements for LTE - *WID in RP-160664*

Finalize the design of MCS table and the remaining details to support UL 256QAM.

[R1-165951](#)

Chairman's Notes of Agenda Item 6.2.8 on UL_Cap_enh Ad-hoc chair (Nokia)

The document was presented by Matthew Baker from Nokia and provides the outcomes of the UL_Cap_enh session.

Decision: The document is endorsed. Contents incorporated below.

MCS & TBS Tables

[R1-164850](#)
[R1-164091](#)
[R1-164092](#)
[R1-164453](#)
[R1-164883](#)
[R1-165320](#)
[R1-165321](#)
[R1-165322](#)

Evaluation results for UL 256QAM

Huawei, HiSilicon

TBS table design for UL 256QAM

Huawei, HiSilicon

MCS table design for UL 256QAM Huawei, HiSilicon

MCS table design considerations for UL 256QAM Qualcomm Incorporated

Discussion on UL 256QAM design CMCC

Further Discussion on MCS Table Design for UL 256QAM Ericsson

Design Principles for New UL 256 QAM MCS Entries Ericsson

New TBS Designs Supporting UL 256QAM Ericsson

[R1-165880](#)

WF on UL 256QAM TBS table Huawei, HiSilicon, CMCC, CATR, China Unicom, China Telecom, ZTE, Deutsche Telekom, Sprint, AT&T

Agreements:

- Introduce at least a new TBS index for 256QAM supporting a code rate of around 948/1024
- Principles for design of new TBS entries:
 - Reuse Rel-8-12 design principles, including:
 - Use of same code block sizes for a given entry
 - Max TBS given by 100PRB size
 - Aligned with QPP principle
 - The following MCS/TBS entries are removed:

MCS	MO	TBS
1	2	1
3	2	3
5	2	5
7	2	7
9	2	9
11	4	10
16	4	15
21	6	19
28	6	26

- Introduce 6 MCS values for 256QAM:
 - TBS indices 30, 31, 32, 32A (new), 33, 34 (new)

MCS	Modulation Order	TBS
23	8	30
24	8	31
25	8	32
26	8	32A
27	8	33
28	8	34

r x 1024	SE
700.8333	5.4753
as in spec	as in spec
763.7500	5.9668
829.5417	6.4808
895.3333	6.9948
948.0000	7.4063

I_{TBS}	N_{PRB}									
	1	2	3	4	5	6	7	8	9	10
32A	904	1864	2792	3752	4584	5544	6456	7480	8248	9144
34	1032	2088	3112	4264	5160	6200	7224	8504	9528	10296
I_{TBS}	N_{PRB}									
	11	12	13	14	15	16	17	18	19	20
32A	10296	11064	12216	12960	14112	14688	15840	16416	17568	18336
34	11448	12576	13536	14688	15840	16992	17568	19080	19848	20616
I_{TBS}	N_{PRB}									
	21	22	23	24	25	26	27	28	29	30
32A	19848	20616	21384	22152	22920	24496	25456	26416	27376	27376
34	22152	22920	24496	25456	26416	27376	28336	29296	30576	31704
I_{TBS}	N_{PRB}									
	31	32	33	34	35	36	37	38	39	40
32A	28336	29296	30576	31704	32856	32856	34008	35160	36696	36696
34	32856	34008	35160	35160	36696	37888	39232	39232	40576	42368
I_{TBS}	N_{PRB}									
	41	42	43	44	45	46	47	48	49	50
32A	37888	39232	40576	40576	42368	42368	43816	43816	45352	46888
34	42368	43816	45352	46888	46888	48936	48936	51024	51024	52752
I_{TBS}	N_{PRB}									
	51	52	53	54	55	56	57	58	59	60
32A	46888	48936	48936	51024	51024	52752	52752	52752	55056	55056
34	52752	55056	55056	57336	57336	59256	59256	61664	61664	63776
I_{TBS}	N_{PRB}									
	61	62	63	64	65	66	67	68	69	70
32A	57336	57336	59256	59256	59256	61664	61664	63776	63776	63776
34	63776	63776	66592	66592	68808	68808	71112	71112	71112	73712
I_{TBS}	N_{PRB}									
	71	72	73	74	75	76	77	78	79	80
32A	66592	66592	68808	68808	68808	71112	71112	73712	73712	73712
34	75376	76208	76208	78704	78704	78704	81176	81176	81176	84760

I_{TBS}	N_{PRB}									
	81	82	83	84	85	86	87	88	89	90
32A	75376	76208	76208	78704	78704	78704	81176	81176	81176	84760
34	84760	84760	87936	87936	87936	90816	90816	93800	93800	93800
I_{TBS}	N_{PRB}									
	91	92	93	94	95	96	97	98	99	100
32A	84760	84760	87936	87936	87936	87936	90816	90816	90816	93800
34	93800	97896	97896	97896	97896	101840	101840	101840	105528	105528
I_{TBS}	N_{PRB}									
	101	102	103	104	105	106	107	108	109	110
32A	93800	93800	93800	97896	97896	97896	97896	101840	101840	101840
34	105528	105528	105528	105528	105528	105528	105528	105528	105528	105528

- 2-layer mapping:

TBS L1	TBS L2
101840	203704
105528	211936

Signalling and UE cats

R1-165319	Remaining Physical Layer Design Aspects of UL 256QAM Ericsson
R1-164093	Physical layer aspects for UL 256QAM Huawei, HiSilicon
R1-164944	On 256QAM to 64QAM MCS table fall-back Nokia, Alcatel-Lucent Shanghai Bell
R1-164452	Discussion of UL 256QAM Qualcomm Incorporated

Agreement:

- Signalling of 256QAM MCS table:
 - Separately for DCI formats 0 & 4

R1-165495	On 256QAM UL UE categories & related capabilities	Nokia, Alcatel-Lucent Shanghai Bell	R1-164944
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Agreement:

- Introduce the 256QAM extension also for UL UE category 8 (in addition to the already agreed extensions of UL Categories 5, 13 and 14).
- The following 2 tables are agreed:

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 0	1000	1000	No	No
UL Category 3	51024	51024	No	No
UL Category 5	75376	75376	Yes	No
UL Category 7	102048	51024	No	No
UL Category 8	1497760	149776	Yes	No
UL Category 13	150752	75376	Yes	No
UL Category 14	9585664	149776	Yes	No
UL Category 15	105528	105528	Yes	Yes
UL Category 16	2119360	211936	Yes	Yes
UL Category 17	211056	105528	Yes	Yes
UL Category 18	13563904	211936	Yes	Yes

UE DL Category	UE UL Category	UE categories
DL Category 0	UL Category 0	N/A
DL Category 6	UL Category 5	Category 6, 4
DL Category 6	UL Category 15	Category 6, 4 DL Category 6 and UL Category 5
DL Category 7	UL Category 13	Category 7, 4
DL Category 7	UL Category 17	Category 7, 4 DL Category 7 and UL Category 13
DL Category 9	UL Category 5	Category 9, 6, 4
DL Category 9	UL Category 15	Category 9, 6, 4 DL Category 9 and UL Category 5
DL Category 10	UL Category 13	Category 10, 7, 4
DL Category 10	UL Category 17	Category 10, 7, 4 DL Category 10 and UL Category 13
DL Category 11	UL Category 5	Category 11, 9, 6, 4
DL Category 11	UL Category 15	Category 11, 9, 6, 4 DL Category 11 and UL Category 5
DL Category 12	UL Category 13	Category 12, 10, 7, 4
DL Category 12	UL Category 15	Category 12, 10, 7, 4 DL Category 12 and UL Category 13
DL Category 13	UL Category 3	Category 6, 4
DL Category 13	UL Category 5	Category 6, 4
DL Category 13	UL Category 7	Category 7, 4
DL Category 13	UL Category 13	Category 7, 4
DL Category 13	UL Category 15	Category 6, 4 DL Category 13 and UL Category 5
DL Category 13	UL Category 17	Category 7, 4 DL Category 13 and UL Category 13
DL Category 14	UL Category 8	Category 8, 5
DL Category 14	UL Category 16	Category 8, 5 DL Category 14 and UL Category 8
DL Category 15	UL Category 3	Category 11, 9, 6, 4
DL Category 15	UL Category 5	Category 11, 9, 6, 4 DL Category 11 and UL Category 5
DL Category 15	UL Category 7	Category 12, 10, 7, 4
DL Category 15	UL Category 13	Category 12, 10, 7, 4 DL Category 12 and UL Category 13
DL Category 15	UL Category 15	Category 11, 9, 6, 4 DL Category 11 and UL Category 5 DL Category 15 and UL Category 5
DL Category 15	UL Category 17	Category 12, 10, 7, 4 DL Category 12 and UL Category 13 DL Category 15 and UL Category 13
DL Category 16	UL Category 3	Category 11, 9, 6, 4
DL Category 16	UL Category 5	Category 11, 9, 6, 4 DL Category 11 and UL Category 5
DL Category 16	UL Category 7	Category 12, 10, 7, 4
DL Category 16	UL Category 13	Category 12, 10, 7, 4 DL Category 12 and UL Category 13
DL Category 16	UL Category 15	Category 11, 9, 6, 4 DL Category 11 and UL Category 5 DL Category 16 and UL Category 5
DL Category 16	UL Category 17	Category 12, 10, 7, 4 DL Category 12 and UL Category 13 DL Category 16 and UL Category 13
DL Category 17	UL Category 14	Category 8, 5 DL Category 14 and UL Category 8
DL Category 17	UL Category 18	Category 8, 5 DL Category 14 and UL Category 8 DL Category 17 and UL Category 14

Send these UE cat and RRC signalling related agreements to RAN2 in an LS - [R1-165496](#) – (Ericsson)

Friday:

[R1-165496](#) [DRAFT] LS on Uplink Capacity Enhancements for LTE Ericsson

[R1-166017](#) [DRAFT] LS on Uplink Capacity Enhancements for LTE Ericsson

Decision: The document is noted and final LS is [agreed in R1-166034](#).

PUSCH in UpPTS

For information preparatory to starting detailed work at RAN1#86:

[R1-164884](#) Discussion on PUSCH transmission for UpPTS CMCC
[R1-164851](#) Initial discussion on UL PUSCH in TDD special subframes Huawei, HiSilicon

6.2.9 Study on LTE-based V2X Services - SID in RP-160657

[R1-165941](#) Chairman's Notes of Agenda Item 6.2.9 on V2X Ad-hoc chair (Nokia, Huawei)

The document was presented by Matthew Baker from Nokia and provides the outcomes of the V2X session.

Decision: The document is endorsed.

[R1-164532](#) 3GPP TR 36.885 v.1.1.0 Study on LTE-based V2X Services LG Electronics
Revisit this Friday

6.2.9.1 Evaluation results

To collect the evaluation results to be included in TR36.885

[R1-165795](#) Discussion on collecting V2X evaluation results in TR36.885 LG Electronics ([R1-164533](#))

Companies provide results according to [R1-165795](#) by this Friday.

Friday: Email approval of TP and updated simulation results by June 2nd – (LGE)

Email approval of the next version of TR June 2nd – (LGE)

6.2.9.1.1 Uu transport for V2V, V2P, and V2I/N

Including evaluation of the feasibility in terms of meeting latency requirements, network coordination required, resource efficiency, and energy efficiency of UE

Simulation results

[R1-164158](#) Performance analysis of Uu broadcast transmission schemes for V2V communication Intel Corporation

[R1-164454](#) System level performance using SC-PTM and eMBMS Qualcomm Incorporated

[R1-165403](#) Evaluation results on the enhancement of Uu transport for V2V, V2P and V2I/N LG Electronics ([R1-164534](#))

[R1-165527](#) Text proposal for Uu-V2P power consumption analysis in TR36.885 LGE

6.2.9.1.2 PC5 transport for V2P and V2I/N

Including potential V2V performance degradation

Simulation results

[R1-164230](#) Evaluation results on PC5-based V2P CATT

[R1-164231](#) Evaluation results on PC5-based V2I CATT

[R1-164535](#) Evaluation results on PC5 transport for V2P and V2I/N LG Electronics

[R1-164790](#) Evaluation results for PC5 based V2P and V2I/N Samsung

[R1-164861](#) Evaluation results for PC5-based V2X Huawei, HiSilicon

[R1-165207](#) Evaluation of PC5 transport for V2P/V2I/V2V communications NTT DOCOMO, INC.

V2P enhancement (under agenda 6.2.9.2.3)

[R1-165275](#) Discussion on P2x-x2P Ericsson

[R1-164229](#) Discussion on resource allocation for PC5-based P2V CATT

[R1-164455](#) PC5 for V2P Qualcomm Incorporated

6.2.9.2 Support of Uu transport for V2V, and PC5/Uu transport for V2I/N and V2P

6.2.9.2.1 Enhancement to DL multicast/broadcast transmissions

Including details of how to enable the enhancements identified in RAN1#84bis

Overview on all the aspects

[R1-164456](#) Downlink Enhancements for Uu based V2V Qualcomm Incorporated

[R1-165254](#) Downlink Enhancements for V2X Ericsson

[R1-165815](#) WF on DL broadcast enhancement for V2X LG Electronics, Deutsche Telekom, III, ITEL, KRRI, KT Corporation, LG Uplus, Samsung, SK Telecom, Xinwei

Proposal:

- A set of enhancements concluded as beneficial in RAN1#84bis can be implemented by supporting the following feature:
 - V2X messages are broadcast, e.g. by:
 - A CP length shorter than extended CP in the current MBSFN architecture for broadcast from multiple eNBs.

- Issues to be considered to support this include
 - DCI format/content and the search space
 - Quasi-colocation, rate matching, RS sequence generation
 - OL precoding and CSI feedback

Continue offline discussion until Friday.

Friday:

R1-165960 Way forward on DL and PC5 for V2X LG Electronics, Huawei, HiSilicon, Ericsson, NTT DOCOMO, Samsung, Panasonic, Nokia, ASB

Decision: The way forward is agreed.

Multicast/broadcast area decision according to Geo-info

R1-164325 Discussion on enhancement to DL multicast/broadcast transmissions Fujitsu
R1-164970 Enhancement to DL multicast/broadcast transmissions ZTE

R1-164159 Discussion on multi-cell multicast/broadcast enhancements for V2V communication Intel Corporation
R1-164326 Multicast/Broadcast enhancements for V2X Fujitsu

CoMP and MIMO enhancement

R1-164536 Further details on enhancements for multi-cell multicast/broadcast LG Electronics
R1-164791 MIMO support for V2X multicasting Samsung

UE feedback

R1-164057 Uu DL enhancements for V2X Huawei, HiSilicon
R1-164537 Discussion on UE feedback for DL multicast/broadcast LG Electronics

R1-165729 WF on HARQ Feedback LG Electronics, Huawei, ITRI

Conclusion to be captured in the technical part of the TR:

- In the event that HARQ feedback for DL multicast/broadcast transmissions were to be introduced, at least in a single cell, two options are identified for HARQ feedback resource allocation:
 - UE-common resource: Multiple UEs receiving the same DL multicast/broadcast transmission transmit HARQ feedback on the same resource.
 - UE-specific resource: Different UEs receiving the same DL multicast/broadcast transmission transmit HARQ feedback on different resources.

6.2.9.2.2 Enhancements to unicast

Including UL enhancement (e.g., SPS enhancement, SR enhancement)

R1-164538 Discussion on UL SPS for V2X LG Electronics
R1-164580 Discussion on SR Enhancements for V2X Spreadtrum Communications
R1-164971 Uu transport enhance for V2X ZTE
R1-165274 UL SPS and reporting to eNB for V2X Ericsson

6.2.9.2.3 Enhancements to sidelink

Including details of resource selection in pedestrian UEs

Whether to support P UE transmit only

R1-164819 Power consumption analysis of PC5 V2P Huawei, HiSilicon
R1-165275 Discussion on P2x-x2P Ericsson

Observation: the motivation to support random resource selection/partial sensing is at least for power saving purpose.

Note: RAN1 has not evaluated potential cost reduction.

Continue offline discussion.

Resource allocation and sensing for P UE

R1-165208 Further detail of partial sensing for P2V operation NTT DOCOMO, INC.
R1-164972 Discussion on V2P design aspects ZTE
R1-164229 Discussion on resource allocation for PC5-based P2V CATT
R1-164455 PC5 for V2P Qualcomm Incorporated
R1-164935 Zone based dynamic resource management in V2X service ITRI

6.2.9.3 Identification of high level coexistence approaches (long-term basis) between PC5 transport for V2V services and DSRC/IEEE 802.11p services in the same channel

R1-164089	Co-channel of PC5 V2V with other techniques	Huawei, HiSilicon
R1-164457	Co-channel coexistence between V2V and DSRC	Qualcomm Incorporated
R1-164540	Discussion on coexisting LTE-V2V and IEEE802.11p on the same carrier	LG Electronics
R1-164792	Interlaced transmissions for co-existence with DSRC	Samsung
R1-165243	Detection Sequence in LTE-ITS Sidelink for Coexistence with IEEE 802.11p	Ericsson

[R1-165826](#) Way Forward on DSRC co-existence Samsung, ZTE, LG Electronics, Sony

[R1-165830](#) WF on DSRC/LTE-based ITS Coexistence Ericsson, Huawei, HiSilicon

[R1-165844](#) WF on DL broadcast enhancement for V2X Huawei, HiSilicon, Ericsson

Agreements:

- RAN1 believes that other radio access technologies and LTE-based ITS transmissions on sidelink can co-exist; some standardization and/or regulatory actions need to be taken in other bodies in order to enable this.
- The possible solutions identified by RAN1 for high level coexistence approaches (long-term basis) between PC5 transport for V2V services and DSRC/IEEE 802.11p services in the same channel are as follows:
 - Geo-location and database.
 - Time sharing between systems based on GNSS timing; this would require some modifications to DSRC.
 - Sensing-based vacate/switching approaches with or without transmission of a predetermined signal(s) (e.g. LTE-ITS preamble, SLSS)
 - Sensing with a predetermined signal(s) would require some modifications to DSRC.
 - RAN1 has not conducted any system-level evaluations for these solutions, although some link-level results have been provided for some solutions.
- RAN1 respectfully asks RAN to provide RAN1 findings to other relevant bodies.

LS containing the above to be sent to RAN plenary – Stefano (Ericsson) - [R1-165494](#) - revisit on Friday.

Friday:

[R1-165494](#) [DRAFT] LS on high level coexistence approaches between PC5 transport for V2V services and DSRC/IEEE 802.11p services in the same channel Ericsson

Decision: The document is noted and final LS is [agreed in R1-166033](#).

6.2.9.4 Other

[R1-165270](#) Proposed TP for 36.885 Conclusions Ericsson

[R1-165870](#) Proposal for SI conclusions LG

Proposed conclusion for TR:

The RAN WGs concluded that it is feasible to support transport for V2V, V2I/N and V2P services over Uu. The RAN WGs identified solutions to improve the latency, capacity, and reliability performance of LTE Uu interface and observed that UL enhancements to the SPS protocol [and DL enhancements to multicast/broadcast] are beneficial from performance perspective. It is recommended to specify [TBD after the discussion on the detailed technical solutions] for Uu-based V2X. The RAN WGs concluded that it is feasible to support V2I and V2P services (the latter by means of P2V transmissions) over PC5. The RAN WGs identified that some changes to the PC5 interface would be beneficial in terms of power consumption and UE complexity in case of P2V transmissions. It is recommended to specify [TBD after the discussion on the detailed technical solutions] for PC5-based V2X.

Way forward:

- Discuss offline until Friday:
 - What can be put in the two TBD parts.
 - How to handle conclusions from RAN2/3 – check with RAN2/3 chairmen
 - Whether the TR can be further clarified to indicate clearly which statements are for further study and which are conclusions of RAN1
 - Check throughout the TR whether the terms V2P services and V2P/P2V/etc transmissions are correctly used
- If on Friday there is consensus on text to replace the TBDs, then the conclusions above can be agreed with the new text replacing the TBDs
- If on Friday there is no consensus, either
 - Delete the two recommendation sentences and agree the rest of the conclusion anyway
 - Postpone the conclusion and do further evaluation until RAN1#86 with a view to closing the TBD items

Friday:

[R1-165899](#) Way forward on V2X study conclusion LG Electronics, Huawei, HiSilicon, Samsung, Panasonic, Nokia, ASB, NTT DOCOMO, Ericsson

Agreements: The following text is agreed as

- the conclusion on the feasibility of LTE-based V2X, and
- the recommendation from RAN1.

Email discussion is triggered to discuss how to recommend the solutions identified in other WGs.

Text:

The RAN WGs concluded that it is feasible to support transport for V2V, V2I/N and V2P services over Uu. The RAN WGs identified solutions to improve the latency, capacity, and reliability performance of LTE Uu interface and observed that UL enhancements to the SPS protocol and DL enhancement to multicast/broadcast are beneficial from performance perspective. It is recommended to support the following solutions identified in this TR for Uu-based V2X:

- Transmission using a single CP shorter than extended CP, with normal CP as the baseline, with necessary additional study
- HARQ feedback and retransmissions for SC-PTM and MBSFN, with necessary additional study
- Geo-information report from RRC_Connected UEs
 - No additional specification work is needed.
- [TBD on the solutions from other WGs]

The RAN WGs concluded that it is feasible to support V2I and V2P services over PC5. It is concluded that V2P services where P-UE sends V2X messages but not receives V2X messages is substantially more power efficient than V2P services where P-UE receives V2X messages from V-UEs. The RAN WGs identified that some changes to the PC5 interface would be beneficial in terms of power consumption and UE complexity in case of P2V transmissions. It is recommended to support following solutions identified in this TR for PC5-based V2X:

- Random resource selection for P-UEs potentially on the resource pool shared with V-UE transmissions, with additional study on sensing operation during a limited time for P-UEs
- [TBD on the solutions from other WGs]

6.2.10 Study on Latency reduction techniques - SID in RP-150465

Focus on this SI in 2Q 2016 will follow approved WF (RP-160650)

R1-165942 **Chairman's Notes of Agenda Item 6.2.10 on Latency** **Ad-hoc chair (Qualcomm)**

The document was presented by Wanshi Chen from Qualcomm and provides the outcomes of the Latency session.

Decision: The document is endorsed. Contents incorporated below.

R1-165827 **Offline session notes** **Ericsson**

R1-165835 **TP for conclusion of latency reduction SI** **Ericsson**

R1-165836 **TP for latency reduction** **Ericsson**

R1-165828 **[Draft] LS on TR update for latency reduction** **Ericsson**

Decision: The document is noted and **final LS is agreed in R1-165913**.

6.2.10.1 Channel design for shortened TTI

Provide channel design including reference signals for s(E)PDCCH, sPDSCH, sPUSCH, sPUCCH. Provide recommendations on supported sTTI length(s).

R1-164160 **Downlink control signaling design for shorten TTI** **Intel Corporation**

R1-164233 **Design of sPUCCH for shortened TTI** **CATT**

R1-164459 **UL channel design for shortened TTI** **Qualcomm Incorporated**

R1-164544 **Discussion on sPUSCH design with TTI shortening** **LG Electronics**

R1-164867 **CQI feedback overhead reduction in short TTI** **Huawei, HiSilicon**

R1-164923 **Simultaneous Transmissions of UL Signals for Shortened TTI Operation** **Nokia, Alcatel-Lucent**
Shanghai Bell

R1-165549 **Way forward on sTTI length** **Huawei, HiSilicon, Ericsson**

Decision: The document is noted.

Working assumption:

- It is recommended to support a design that is based on 2-symbol sTTI and 1-slot sTTI for sPDSCH/sPDCCH
- It is recommended to support a design that is based on 2-symbol sTTI, 4-symbol sTTI, and 1-slot sTTI for sPUCCH/sPUSCH
 - During the WI phase, down-selection is not precluded
- The working assumption is automatically confirmed by the end of Thursday if no significant issues are found
- Note: the supported sTTI lengths are not intended to impact discussion on additional subframe types in TDD.

Note: the above working assumption is already confirmed for FDD, and updated for TDD

Friday: Huawei Above WA should be turned into an agreement for both FDD and TDD

[R1-165544](#) **Way Forward on sPUCCH design** **LG Electronics, Ericsson , Panasonic, NTT DOCOMO, Sharp, KDDI**

Agreement:

- The following sPUCCH formats are recommended to be supported
 - One sPUCCH format for HARQ-ACK and/or SR feedback for a serving cell
 - sPUCCH format(s) for multiple HARQ-ACK bits, e.g. as in CA and frame structure type 2
 - The amount of sPUCCH formats to support is depending on the maximum identified payload size to support
 - sPUCCH format allows for multiplexing of HARQ-ACK and SR
 - FFS: sPUCCH format supports CSI feedback

[R1-165550](#) **WF on UL DMRS for sTTI** **Huawei, HiSilicon, Ericsson, Qualcomm**
[R1-165545](#) **WF on DM-RS for sPUSCH** **LG Electronics, CATT, NTT DOCOMO, Samsung**

Agreement:

- For DM-RS of sPUSCH, the followings are recommended to be supported:
 - For the case of 1-slot TTI length, reuse the current DM-RS
 - For the case of less than 1-slot TTI length, support DM-RS sharing/multiplexing of consecutive TTIs from one or multiple UEs
 - At least 2 contiguous TTIs can be shared/multiplexed. FFS on sharing /multiplexing of more than 2 contiguous TTIs
 - FFS on how to share/multiplex DM-RS (e.g., CDM, FDM, different BW between RS & data, and hybrid thereof)
 - FFS the DMRS position and whether it is indicated by eNB

[R1-165631](#) **Way forward on sPDCCH** **Ericsson, Nokia, Alcatel-Lucent Shanghai Bell, Mediatek, Sharp, Huawei, HiSilicon, CATT, CATR, Motorola Mobility, ZTE**

Agreement:

- Confirm the working assumption
 - Working Assumption:
 - CRS-based sPDCCH is recommended to be supported
 - FFS whether CRS-based sPDCCH can be transmitted in the legacy PDCCH region
 - DMRS-based sPDCCH is recommended to be supported
 - Design of both CRS-based sPDCCH and DMRS-based sPDCCH will be studied further.
- From resource utilization perspective, sPDSCH assigned by a sPDCCH can be mapped to resources that are left unused by any sPDCCH
 - Details are for further study, e.g., FFS whether unused resources is RB or RE level

[R1-165548](#) **Way Forward on sPDCCH transmitted in sTTI and legacy PDCCH region** **ZTE, ZTE Microelectronic**

[R1-165522](#) **Way forward on sPDSCH** **Ericsson, Huawei, HiSilicon, Panasonic**

Agreement:

- For sPDSCH based on a CRS based transmission scheme the maximum number of supported layers is 4
- For sPDSCH based on a DM-RS based transmission scheme shall be down-selected among the following options
 - the maximum number of supported layers is 2
 - the maximum number of supported layers is 4
 - the maximum number of supported layers is 8
- FFS for sPDSCH based on a DM-RS based transmission scheme it is recommended to increased PRB bundling size compared to PDSCH for at least sTTI lengths shorter than 1-slot

[R1-165551](#) **Way Forward on TDD FS2 for latency reduction** **Huawei, HiSilicon, Panasonic, CATT, Qualcomm, Nokia, Alcatel-Lucent Shanghai Bell**

[R1-165892](#) **WF on TDD latency reduction** Huawei, HiSilicon, CMCC, Nokia, ASB, Panasonic, Ericsson, ZTE

Agreement:

- Regarding sTTI length:
 - Confirm the working assumption for FS1 FDD
 - Take the following agreement for FS2 TDD
 - It is recommended to support a design that is based on 1-slot sTTI for sPDSCH/sPDCCH/sPUSCH/sPUCCH for FS2 TDD in Rel-14
 - It is recommended to consider enhancements including other shorter sTTI duration(s), and additional DL-UL switching points/ additional subframe types for FS2 TDD latency reduction in Rel-15

[R1-165546](#) **WF on UCI transmission on sPUSCH** LG Electronics, Ericsson, Intel, Nokia, Alcatel-Lucent
Shanghai Bell, NTT DOCOMO, Sharp

Agreement:

- The following principles on sPUSCH are recommended to be supported:
 - UCI transmission on sPUSCH is supported
 - FFS UCI mapping rule, especially considering the impact of DM-RS design
 - FFS on which carrier to multiplex UCI on in case different sTTI lengths are used on different UL CA
 - Note:
 - The UCI herein refers to at least the ones for sTTI operations
 - FFS whether or not the UCI also includes the ones for legacy TTI operations

[R1-164232](#) **Design of sPDCCH for shortened TTI** CATT

[R1-164793](#) **sPDCCH and sDCI design** Samsung

[R1-165237](#) **On two-level DL control channel design for shorter TTI operation** Nokia, Alcatel-Lucent Shanghai Bell

[R1-164060](#) **DCI design for short TTI** Huawei, HiSilicon

Conclusion:

- Further discussion during the WI phase (if WI is approved) regarding the single-level DCI vs. two-level DCI considering aspects such as overhead, complexity, potential scheduling restriction, search space design, the corresponding performance, impact of different TTI lengths (if any), etc.
 - Note: this conclusion is not be included in the TR

Not treated:

R1-164058	Views on TTI length	Huawei, HiSilicon
R1-164059	sPDCCH design for short TTI	Huawei, HiSilicon
R1-164061	PUCCH design for short TTI	Huawei, HiSilicon
R1-164062	Discussion on DL RS for short TTI	Huawei, HiSilicon
R1-164063	Discussion on UL RS for short TTI	Huawei, HiSilicon
R1-164065	Discussion on CSI feedback for short TTI	Huawei, HiSilicon
R1-164068	The co-existence consideration of legacy TTI and sTTI in one carrier	Huawei, HiSilicon
R1-164115	Reducing UL RS overhead for sPUSCH	Mitsubishi Electric
R1-164161	Consideration on S-PDCCH design for latency reduction	Intel Corporation
R1-164162	UL design aspects of TTI shortening	Intel Corporation
R1-164234	Design of sPUSCH DMRS	CATT
R1-164235	Discussion on the simultaneous transmissions of normal TTI and sTTI	CATT
R1-164458	DL channel design for shortened TTI	Qualcomm Incorporated
R1-164487	Details of Two-stage downlink control channel	NEC
R1-164541	Discussion on candidate length for sTTI	LG Electronics
R1-164542	Discussions on DCI and sPDCCH for latency reduction	LG Electronics
R1-164543	Discussions on sPDSCH for latency reduction	LG Electronics
R1-164545	Discussion on sPUCCH for HARQ-ACK in latency reduction	LG Electronics
R1-164546	Discussion on sPUCCH for CSI in latency reduction	LG Electronics
R1-164581	Discussion on DL control for shortened TTI	Spreadtrum Communications
R1-164582	Considerations on shortened TTI transmission within MBSFN subframe	Spreadtrum Communications
R1-164583	sTTI schedule impact due to MBSFN or ABS subframe	Spreadtrum Communications
R1-164639	Discussion on sPDCCH for shortened TTI	ZTE
R1-164640	PUCCH design and evaluation for shortened TTI	ZTE
R1-164642	Study on PDSCH transmission in shortened TTI	ZTE
R1-164643	Study on PUSCH transmission in shortened TTI	ZTE

R1-164649	Design of DL channels for shortened TTI	Lenovo (Beijing) Ltd
R1-164650	Design of UL channels for shortened TTI	Lenovo (Beijing) Ltd
R1-164663	Discussion on control signaling design for reduced TTI	HTC
R1-164794	sPUCCH design	Samsung
R1-164795	Discussion on sPDSCH	Samsung
R1-164796	Discussion on sPUSCH	Samsung
R1-164820	PUSCH design for short TTI	Huawei, HiSilicon
R1-164821	PDSCH design for short TTI	Huawei, HiSilicon
R1-164886	Discussion on low latency control channel design	CMCC
R1-164909	Discussion on reference signal design for shortened TTI	Panasonic
R1-164910	Discussion on multiplexing between sTTI and TTI in the same subframe	Panasonic
R1-164911	Discussion on single level DCI and two-level DCI	Panasonic
R1-164914	UL aspect of shortened TTI	Panasonic
R1-164922	sPUCCH Design for Shortened TTINokia, Alcatel-Lucent Shanghai Bell	
R1-164945	On supported Shorter TTI lengths and its configurability	Nokia, Alcatel-Lucent Shanghai Bell
R1-164946	On simultaneous unicast PDSCH and sPDSCH operation	Nokia, Alcatel-Lucent Shanghai Bell
R1-164999	Shortened TTI for DL transmissions	Sharp, MTI
R1-165001	Channel design of shortened PUCCH	Sharp
R1-165049	Consideration on sPDCCH Design	InterDigital
R1-165050	Consideration on sPDSCH Design	InterDigital
R1-165051	Consideration on sPUCCH Design	InterDigital
R1-165052	Consideration on sPUSCH Design	InterDigital
R1-165069	Discussion on length of shortened TTI	China Telecommunications
R1-165109	Shortened TTI Design	Motorola Mobility
R1-165110	Multiplexing of Regular TTI and shortened TTI	Motorola Mobility
R1-165123	Control channel design for latency reduction	Mediatek
R1-165209	sPDCCH for shortened TTI	NTT DOCOMO, INC.
R1-165210	sPDSCH for shortened TTI	NTT DOCOMO, INC.
R1-165211	sPUSCH for shortened TTI	NTT DOCOMO, INC.
R1-165212	sPUCCH for shortened TTI	NTT DOCOMO, INC.
R1-165213	Views on sTTI length	NTT DOCOMO, INC.
R1-165236	On DL control channel design for shorter TTI operation	Nokia, Alcatel-Lucent Shanghai Bell
R1-165249	Impact of shortened TTI on uplink transmission	ASUSTEK COMPUTER (SHANGHAI)
R1-165267	Discussion on PUCCH design for shortened TTI	KDDI Corporation
R1-165290	Discussions on the channel design for latency reduction	CATR
R1-165292	Physical design aspects of sPDCCH	Ericsson
R1-165293	sPDCCH search space design	Ericsson
R1-165294	DCI for sTTI scheduling	Ericsson
R1-165295	Physical design aspects of sPDSCH	Ericsson
R1-165296	Physical design aspects of sPUSCH	Ericsson
R1-165297	Physical design aspects of sPUCCH	Ericsson
R1-165298	Short TTI operation in FS2	Ericsson
R1-165299	On the operation with different TTI lengths	Ericsson
R1-165310	Discussion on short PUSCH design	KT Corp.
R1-165547	Way forward on latency reduction for TDD	ZTE, CMCC, Ericsson, CATT, Sharp, NTT DOCOMO

6.2.10.2 Processing time reduction and related procedures

Provide targets on how much the processing time/maximum TA can be reduced

Agreement:

- It is recommended to reduce the maximum TA for short TTI operation with processing time reduction compared to Rel-13
 - Details are FFS
- A single minimum delay between UL grant and UL data and between DL data and DL HARQ feedback is recommended to be supported for a given sTTI length

[R1-165854](#) **Way forward on processing timing reduction for sTTI** **Ericsson**

Agreements:

- The minimum timing for UL grant to UL data and for DL data to DL HARQ is $n + k$ sTTI for short TTI operation;
 - Processing time $\geq$ the legacy processing time linearly downscaled with TTI length
 - $4 \leq k \leq 8$

- FFS whether or not to support processing time is lower than the legacy processing time linearly downscaled with TTI length for at least slot based TTI
 - $k < 4$ for slot based TTI.
- Note that sTTI refers to
 - sPUSCH sTTI for the UL grant to UL data timing
 - sPDSCH sTTI for the DL data to DL HARQ feedback timing
- FFS how to handle the minimum timing for the case when DL sTTI and UL sTTI have different lengths
- Further study whether or not the eNB would indicate an additional parameter m (Note: the value may be dependent on the discussion on the max TA), resulting in a timing of $n + k + m$ sTTI
 - FFS: semi-static or dynamic configuration of m , if introduced
- The minimum timing for UL grant to UL data and for DL data to DL HARQ is $n + k$ TTI for subframe-long TTI operation and short TTI capable UEs.
 - $k = 4$ is supported
 - Further study whether a reduced minimum timing is possible, e.g. $k = 2$, $k = 3$, and if a reduced maximum TBS is needed to achieve this
- Note: CQI feedback enhancements for short TTI and legacy TTI are not precluded

R1-164236 TDD system design for shortened TTI and related procedures for latency reduction CATT

Not treated

R1-164064	Discussion on UL scheduling timing for short TTI	Huawei, HiSilicon
R1-164066	Discussion on DL HARQ timing for short TTI	Huawei, HiSilicon
R1-164067	Processing time reduction for short TTI	Huawei, HiSilicon
R1-164163	On the processing time reduction and maximum TA limitations	Intel Corporation
R1-164460	Processing time reduction and related procedures for DL	Qualcomm Incorporated
R1-164461	Processing time reduction and related procedures for UL	Qualcomm Incorporated
R1-164462	TDD-specific processing time reduction and related procedures	Qualcomm Incorporated
R1-164470	Discussion on TTI shortening	Guangdong OPPO Mobile Telecom.
R1-164638	Latency reduction solutions for TDD	ZTE
R1-164641	Processing time reduction and related procedures	ZTE
R1-164797	Discussion on processing time for TTI shortening	Samsung
R1-164885	Discussion on latency reduction for TDD	CMCC
R1-164912	Evaluation results on processing time reduction in physical layer	Panasonic
R1-164947	Legacy TTI processing time considerations for supporting latency reduction	Nokia, Alcatel-Lucent
R1-164948	sTTI processing time considerations for supporting latency reduction	Nokia, Alcatel-Lucent Shanghai Bell
R1-165214	Views on processing time reduction and related procedures	NTT DOCOMO, INC.
R1-165269	Discussion on HARQ Process for Slot-based TTI	ASUSTEK COMPUTER (SHANGHAI)
R1-165300	On reduced processing time for short TTI	Ericsson
R1-165429	Processing time reduction for latency reduction	LG Electronics

6.2.10.3 Remaining evaluation results

Remaining aspects of system and link evaluation results, e.g. FS2 related aspects

R1-165518 Updates to Link Level results Ericsson

Conclusion:

- The TP is endorsed, but without the parts concerning the puncturing performance

R1-165519 Updates to Link Level observations Ericsson

Conclusion:

- The TP is endorsed, except the following:
 - Removing the following:

One source showed that puncturing of an PDSCH within a subframe long TTI by an short TTI significantly degrades the BLER performance and at higher modulation orders makes the PDSCH undecodable. Whether there are any enhancements to PDSCH reception in this case that would allow better reception performance has not been studied.
 - Update the last sentence in the sPUCCH section with the following:

- For larger payload sizes e.g. 5 to 40 bits, can achieve tolerable performance with a longer sTTI length. Note that there is some coverage impact with shorter TTI lengths with large payload sizes.

R1-165520 Updates to System level results Ericsson

Conclusion:

- The TP is endorsed
 - Note: further update is necessary based on the new results available till midnight Tuesday

R1-165521 Updates to System level observations Ericsson

Conclusion:

- The TP is endorsed, with the following updates in the last paragraph
 - Updating:
 - At least shown by two sources, under a given TDD UL/DL subframe configuration, introducing additional subframe types for a new UE can further reduce the U-plane latency for TDD compared to the case without introducing additional subframe types in the evaluated scenarios.
- Including the impact analysis not limited to additional subframes types – Laetitia (Ericsson)
 - Detailed wording to be worked on offline
- Further discussion offline whether or not to further update the following sentences:
 - Two sources show that the performance of 14OS TTI length with reduced processing time (i.e. with reduced HARQ RTT and UL access delay) comes close to the one of slot based TTI length. However, source 4 shows that if 14OS TTI follows the same TBS assumption as 7OS TTI length, gains of 14OS TTI length with reduced processing time are smaller than the ones of other short TTI lengths.
 - Three sources ([R1-164548](#), [R1-164637](#), [R1-164823](#)) show that in the most favourable situation for TTI shortening, introducing short TTI in existing TDD UL/DL configuration without additional subframe type can lead to large user perceived throughput improvement. Four sources ([R1-164823](#), [R1-164237](#), [R1-164637](#), [R1-164548](#)) show that in the most favourable situation for TTI shortening, introducing short TTI with additional subframe type within existing UL/DL configuration can lead to improved user perceived throughput compared to introducing short TTI without additional subframe type within existing UL/DL configurations, especially for short TTI length as 2OS. One source ([R1-164548](#)) shows that significant performance loss in 5th percentile user throughput with shorter TTI length like 2OS both with and without additional subframe type.

R1-165632 TP for inclusion of evaluation assumptions for FS2 Ericsson

Conclusion:

- The TP in [R1-165632](#) is endorsed

R1-165705 Updates to System level results Ericsson

Conclusion:

- The TP in [R1-165705](#) is endorsed

R1-165706 Updates to System level observations Ericsson

Conclusion:

- The TP is endorsed, except the following update:
 - From “There is difficulty to schedule legacy UEs in the additional subframes and therefore the performance of legacy UEs is degraded. How much the degradation for legacy UEs is has not been evaluated in the study item.”
 - To “The performance of legacy UEs is degraded with the introduction of additional subframe type. It has not been evaluated during the SI on how much degradation for legacy UEs.”

Not treated

R1-164164	Link level evaluation for PDSCH in a short TTI	Intel Corporation
R1-164237	TDD system performance evaluation of latency reduction	CATT
R1-164464	Updated link-level evaluation of TTI shortening in UL	Qualcomm Incorporated
R1-164549	Further link level evaluation of sPUSCH for shortened TTI	LG Electronics
R1-164637	System-level performance evaluation for TDD	ZTE
R1-164823	Summary of performance evaluation for latency reduction in TDD	Huawei, HiSilicon
R1-164824	Performance evaluation for latency reduction based on frame structure set 3	Huawei, HiSilicon
R1-164825	Performance evaluation for latency reduction based on enhanced frame structure set 1	Huawei, HiSilicon
R1-164826	Performance evaluation for latency reduction based on enhanced frame structure set 2	Huawei, HiSilicon
R1-165076	Link level simulation results for S-PDCCH	Intel Corporation
R1-165238	System level study on processing time reduction and TCP parametrization impact	Nokia, Alcatel-Lucent
R1-165301	Additional system level results for short TTI and downlink traffic	Ericsson

R1-165302	Additional system level results for short TTI and uplink traffic	Ericsson
R1-165303	Additional system level results for short TTI with different processing times	Ericsson
R1-165304	Additional link results for sPDSCH	Ericsson
R1-165418	System level simulations with FTP model 3	Intel Corporation
R1-165421	Additional link results for sPUCCH	Ericsson
R1-165430	System-level simulation results for TDD scenario with latency reduction	LG Electronics
R1-165446	System performance evaluation for dynamic control channel overhead	CATT
R1-165455	Updated system level evaluations	Qualcomm Incorporated
R1-165571	Way forward on scheduling mechanism for sTTI	Ericsson, Intel, Nokia, Alcatel-Lucent Shanghai Bell
R1-165928	System level study on processing time reduction of 2OS and 7OS TTI	Nokia, Alcatel-Lucent Shanghai Bell

6.2.10.4 Other

R1-164069	Discussion on enhanced frame structure type 2 for latency reduction	Huawei, HiSilicon
R1-164070	Discussion on U-plane latency for TDD	Huawei, HiSilicon
R1-164584	HARQ feedback for sTTI scheduling	Spreadtrum Communications
R1-164798	TDD-specific issues on TTI shortening	Samsung
R1-164913	Additional subframe type for TDD	Panasonic
R1-164924	Considerations on shorter TTI for TDD duplex mode	Nokia, Alcatel-Lucent Shanghai Bell
R1-165003	Short TTI and processing time reduction for TDD	Sharp, MTI
R1-165215	Further Discussion about TDD Frame Structure for Latency Reduction	NTT DOCOMO, INC.
R1-165256	Latency Reduction for FS2 with 1-ms TTI	Nokia, Alcatel-Lucent Shanghai Bell

6.2.11 Study on Further enhancements to Coordinated Multi-Point Operation

SID in [RP-160665](#)

[R1-165943](#) Chairman's Notes of Agenda Item 6.2.11 on eCOMP Ad-hoc chair (Qualcomm)

The document was presented by Wanshi Chen from Qualcomm and provides the outcomes of the Latency session.

Decision: The document is endorsed. Contents incorporated below.

[R1-164165](#) Work plan for FeCoMP study item Intel Corporation, ZTE

Decision: The document is noted.

[R1-164298](#) TR Skeleton for Study on FeCoMP ZTE

Decision: The document is noted.

Conclusion:

- The TR skeleton in [R1-164298](#) is endorsed, with the following updates:
 - Section 5.1: Evaluation Scenarios for **Non-coherent** Joint Transmission
 - Section 6.1: Potential Enhancements for **Non-coherent** Joint Transmission

Not treated

R1-164084	Overview on further enhancements to Coordinated Multi-Point Operation	Huawei, HiSilicon
R1-164299	Overview on FeCoMP	ZTE

6.2.11.1 Deployment scenarios and system-level evaluation assumptions

Consider the existing dense deployment scenarios and evaluation assumptions as starting point. The priority at RAN1#85 will be given to the scenarios and evaluation assumptions.

[R1-164167](#) Evaluation assumptions for FeCoMP evaluations Intel Corporation

Decision: The document is noted.

[R1-164300](#) Deployment scenarios and evaluation assumptions for JT ZTE

Decision: The document is noted.

[R1-164974](#) Scenarios for feCoMP SoftBank Corp.

Decision: The document is noted.

[R1-165845](#) Way Forward on scenarios for FeCoMP evaluations Intel, ZTE, ZTE Microelectronic, Softbank, KT Corporation, Huawei, HiSilicon, LGE, CATT, Xinwei, Ericsson, Samsung, Nokia, ASB

Decision: The document is agreed.

[R1-165852](#) Way Forward on Evaluation Assumptions for FeCoMP ZTE, ZTE Microelectronics, Intel, Ericsson, Nokia, ASB, Huawei, LGE, CATT, ASTRI, Samsung

Decision: The document is noted.

Agreement:

- The WF in [R1-165852](#) is agreed, with the following updates:
 - Macro cell layer TP:
 (8,4,2), (8,8,2) optional, (8,1,2) ~~optional~~
 - Small cell layer TP:
 M=1 (~~FFS whether or not additionally have M=4 as optional~~), N=1, 2 or 4 (optional), P = 2
 - Baseline 3TPs, ~~other values are not precluded and if used should be reported. If a different value is used, it should be indicated.~~
 - Non full buffer FTP traffic model 1, S = 0.1Mbytes (optional) or 0.5Mbytes
 - 2Rx, 4Rx (only for non-coherent JT), 0°/90° polarization slants, 0.5 wavelength spacing
 - CS/CB for FD-MIMO: 2 or more ports per NZP CSI-RS resource (~~total number of CSI-RS ports up to 16~~)
 - Baseline scheme:
 - ~~Option 1: DPS/DPB for JT, Single point for CS/CB~~
 - ~~Option 2: Rel 11 CoMP and non-CoMP Rel 13 FD-MIMO~~
 - Option 3: Provided by each company for now. Further discussion to finalize a baseline scheme till RAN1#86

[R1-165851](#) Way Forward on Prioritization of Scenarios for FeCoMP ZTE, ZTE Microelectronics, Intel, ASTRI
Decision: The document is noted.

Not treated

R1-164085	Discussion on simulation scenarios and methodology for FeCoMP	Huawei, HiSilicon
R1-164166	Scenarios for FeCoMP evaluations	Intel Corporation
R1-164239	Discussion on scenarios and evaluation assumptions for CoMP enhancement	CATT
R1-164301	Deployment scenarios and evaluation assumptions for CS/CB	ZTE
R1-164342	Considerations of FeCoMP deployment scenarios	Nokia, Alcatel-Lucent Shanghai Bell
R1-164799	Deployment scenarios and system-level evaluation assumptions	Samsung
R1-165103	feCoMP Scenarios and Evaluation	Ericsson

6.2.11.2 Potential enhancements for non-coherent joint transmission

[R1-165876](#) WF on non-coherent JT schemes for FeCoMP Huawei, HiSilicon, Intel, SoftBank Corp, ZTE, CATT
Decision: The document is noted.

Not treated

R1-164086	Potential enhancement for FeCoMP with ideal backhaul links	Huawei, HiSilicon
R1-164087	Discussion on FeCoMP with non-ideal backhaul links	Huawei, HiSilicon
R1-164168	CSI feedback enhancements for non coherent JT	Intel Corporation
R1-164169	Control signalling enhancements for non coherent JT	Intel Corporation
R1-164170	Initial evaluation results for non coherent JT	Intel Corporation
R1-164240	Enhancement for non-coherent joint transmission	CATT
R1-164302	Potential Enhancements for Joint Transmission	ZTE
R1-164303	QCL Issues of Joint Transmission	ZTE, ASTRI
R1-164343	Overview of non-coherent joint transmission for FeCoMP	Nokia, Alcatel-Lucent Shanghai Bell
R1-164550	Discussion on enhancements for non-coherent JT	LG Electronics
R1-164800	Discussion on non-coherent joint transmission for FeCoMP	Samsung

6.2.11.3 Potential enhancements for coordinated scheduling/beamforming with FD-MIMO

Not treated

R1-164088	Discussion on CSI measurement and feedback for FeCoMP	Huawei, HiSilicon
R1-164171	Enhancements for CS/CB CoMP	Intel Corporation
R1-164241	Coordinated beamforming with FD-MIMO	CATT
R1-164304	Using FD-MIMO framework for CS/CB	ZTE
R1-164344	Overview of FD-MIMO based CSCB transmission	Nokia, Alcatel-Lucent Shanghai Bell
R1-164551	Discussion on enhancements for CS/CB with FD-MIMO	LG Electronics
R1-164801	Potential enhancement for coordinated beamforming with FD-MIMO	Samsung
R1-165104	feCoMP Motivations and Techniques	Ericsson

6.2.11.4 Other

Not treated

R1-164489	Enhancements to Coordinated Multi-point Operation: Impact of interference averaging	NEC
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7 NR

7.1 Study on New Radio Access Technology - SID in RP-160671

[R1-165216](#) Draft TR 38.802 Study on New Radio (NR) Access Technology - Physical Layer Aspects NTT
DOCOMO, INC.

The document was presented by Kazuaki Takeda from NTT DOCOMO.

Decision: The document is **endorsed as v0.0.2**.

Wednesday

[R1-165804](#) Draft TR 38.802 Study on New Radio (NR) Access Technology - Physical Layer Aspects NTT
DOCOMO

The document was presented by Kazuaki Takeda from NTT DOCOMO.

Discussion: Huawei, Qualcomm requested more time for detailed review.

Decision: The document is noted. Continue offline discussion until Thursday –(NTT DOCOMO)

[R1-165720](#) Draft Reply LS on Parameters for WP5D sharing and compatibility studies NTT DOCOMO

Decision: The document is noted. Continue offline discussion about the notes – (NTT DOCOMO)

[R1-165805](#) Draft Reply LS on Parameters for WP5D sharing and compatibility studies NTT DOCOMO

Decision: The document is noted and **final LS is agreed in [R1-165820](#)**.

Thursday

[R1-165804](#) Draft TR 38.802 Study on New Radio (NR) Access Technology - Physical Layer Aspects NTT
DOCOMO

Decision: The document is noted. Further revised in:

[R1-165882](#) Draft TR 38.802 Study on New Radio (NR) Access Technology - Physical Layer Aspects NTT
DOCOMO

Discussion: Huawei → can the meaning of “baseline” used in multiple instances through the TR be clarified? Replaced by “is supported” may be better

DOCOMO: agreed – Terminology “baseline” will be updated in a later version

Decision: The document is noted and **endorsed as v0.0.3 in [R1-165882](#)**, with following update in Section 6.1:

The downlink transmission scheme is based on OFDM.

Not treated

[R1-165170](#) Workplan for Study on Study on New Radio Access Technology NTT DOCOMO, INC.

7.1.1 Forward compatibility for new radio interface

Solutions how to achieve forward compatibility with Phase II specification and beyond.

[R1-164046](#) Forward compatibility consideration on reference signals and control information/channels Huawei,
HiSilicon

The document was presented by Zukang Shen from Huawei.

- *Proposal 1: The reference signal for cell identification and coarse time/frequency synchronization in NR is not in a fixed frequency location within a carrier.*
- *Proposal 2: A minimum bandwidth shall be defined for the reference signal for RRM measurement in NR. Consider to derive the time/frequency location of the reference signal for RRM measurement based on the reference signal for cell identification and coarse time/frequency synchronization.*
- *Proposal 3: NR shall support orthogonal reference signals among different links (such as downlink, uplink, sidelink, backhaul link).*

Decision: The document is noted.

[R1-164242](#) NR system design for forward compatibility CATT

The document was presented by Fang Chen Cheng from CATT.

- *Proposal 1: For forward compatibility of support low cost mMTC, the NR system needs to support the operations of narrowband carrier standalone or embedded in a wideband carrier, single transceiver chain and communication with passive devices.*
- *Proposal 2: For forward compatibility of massive MTC power efficiency, the NR system should support on-demand wakeup for the sleeping device and communication with passive devices.*
- *Proposal 3: The channel coding scheme with extremely high coding gain should be supported for URLLC applications.*
- *Proposal 4: The NR system design should target common design of control channels and reference signals in the frame structure for downlink, uplink and sidelink. The control channel design should support both central and distributed resource allocation and coordination.*

- *Proposal 5: The NR system should support opportunistic access for the operation on dedicated and shared spectrum.*

Decision: The document is noted.

R1-164633 On forward compatibility Ericsson

The document was presented by Stefan Parkvall from Ericsson and proposes the following to improve future compatibility:

- Avoid fixed timing relations across subframe borders
- Self-contained transmission where data (and control) transmissions have, e.g., their own reference signals.
- Avoid tying multiple quantities to a single underlying quantity unless there is a clear motivation.

Decision: The document is noted.

R1-165367 On forward compatibility for NR China Unicom

The document was presented by Xiao Han from China Unicom.

Observation 1: the blank resources design should enable the Phase 1 UEs successfully receive and decode the UE-specific channels transmitted on adjacent time and frequency resources.

Observation 2: the cell-specific RS should be minimized on resources and configurable for usage scenarios and numerologies and necessary cell-specific RS should be supported.

Observation 3: single TDM and FDM solutions for multiplexing may not sufficient satisfy NR requirements.

Decision: The document is noted.

R1-164552 Forward compatibility support design of NR LG Electronics

The document was presented by Yunjung Yi from LGE.

- *Proposal 1: NR design should minimize (semi-)statically configured signal/channels but synchronization signals and system information in the very initial access state may be (semi-) statically and periodically transmitted.*
- *Proposal 2: Flexible and dynamic TDD operation should be enabled in consideration of ICI in NR.*
- *Proposal 3: Flexible HARQ timing for both DL and UL should be designed in consideration of UE processing capability and latency requirements of NR.*

Decision: The document is noted.

R1-164292 On forward compatibility for new radio interface ZTE

The document was presented by Ruyue Li from ZTE.

- *Proposal 1: The number of symbols per 1 ms is 2m, where m is an integer, since it allows smooth multiplexing of future services and use cases.*
- *Proposal 2: The design of NR numerology and frame structure should prioritize forward compatibility, in order to ensure smooth evolution to accommodate future services and use cases. Within one carrier of a network, numerology adaptation based on changing the number of symbols per subframe is preferred to scaling of subcarrier spacing, since it ensures better forward compatibility and reduces overhead.*
- *Proposal 3: Regarding reference signal design, we propose the following design principles:*
 - *Avoid always-on reference signals*
 - *Avoid periodic reference signals in a non-standalone system*
 - *Use aperiodic reference signals or configurable multi-shot reference signals*
 - *Granularity and overhead of reference signals should be flexibly configured depending on the different requirements of CSI measurement*
 - *Support multi-level CSI-RS with different configurable granularities*
- *Proposal 4: Avoid unnecessary periodic system information. Identify the fundamental system information for UE to access network. The fundamental system information should adapt to different use cases/scenarios.*
- *Proposal 5: Regarding control channel design, we propose the following design principles:*
 - *Design of downlink control channel should be flexible to adapt to different application.*
 - *Multi-level downlink control channel structure should be considered in NR.*
- *Proposal 6: Support multi-component and multi-level design in MIMO CSI feedback framework in NR*

Decision: The document is noted.

R1-165603 WF on NR forward compatibility Huawei, HiSilicon

The document was presented by Zukang Shen from Huawei.

- Forward compatibility of NR shall ensure smooth introduction of future services and features with no impact on the access of earlier services and UEs
 - Multiplexing different numerologies within a same NR carrier is supported
 - Reference signal for synchronization is not in a fixed frequency location within a carrier.
 - Transmission of system information is not in a fixed frequency location within a carrier
 - Avoid tying multiple parameters to a same parameter and rely more UE specific parameters as much as possible

- Common design (e.g. waveform) shall be aimed for various link directions in NR, e.g. downlink, uplink, sidelink, backhaul link

Decision: The document is noted, further revised in [R1-165628](#) as follows:

- Forward compatibility of NR shall ensure smooth introduction of future services and features with no impact on the access of earlier services and UEs
 - Multiplexing different numerologies within a same NR carrier bandwidth (from the network perspective) is supported
 - Reference signal for synchronization and transmission of MIB is not in a fixed frequency location within a NR carrier bandwidth (from the network perspective).
 - The frequency location of MIB is derived from the reference signal for synchronization (e.g. the same frequency location)
 - Avoid tying multiple parameters to a same parameter and rely more UE specific parameters as much as possible
 - Common design should be aimed for various link directions in NR, e.g. downlink, uplink, sidelink, backhaul link

Agreements:

- Forward compatibility of NR shall ensure smooth introduction of future services and features with no impact on the access of earlier services and UEs
 - Multiplexing different numerologies within a same NR carrier bandwidth (from the network perspective) is supported
 - FDM and/or TDM multiplexing can be considered

Possible agreements:

- Reference signal for synchronization and transmission of MIB is not in a fixed frequency location within a NR carrier bandwidth (from the network perspective).
 - The frequency location of MIB is derived from the reference signal for synchronization (e.g. the same frequency location)
- Avoid tying multiple parameters to a same parameter and rely more UE specific parameters as much as possible
- Common design should be aimed for various link directions in NR, e.g. downlink, uplink, sidelink, backhaul link

[R1-165607](#) WF on implicit dependencies assumptions InterDigital, Ericsson, Huawei, HiSilicon

The document was presented by Paul Marinier from InterDigital.

- Implicit (i.e. non-configurable) dependencies between transmissions that exist in LTE design are not by default assumed to be introduced in NR design.
- An identity parameter may tie signals for search/synchronization (e.g. PSS/SSS) to the broadcast transmission of essential system information (e.g. MIB)
 - Name of identity parameter TBD (e.g. cell ID, hypercell ID, system ID)
 - Other dependencies to this identity parameter can be introduced if considered beneficial taking into account forward compatibility, signalling overhead and complexity

Decision: The document is noted.

Possible agreements:

- For NR design, implicit (i.e. non-configurable) dependencies can be introduced if considered beneficial taking into account forward compatibility, signalling overhead and complexity
 - It is not assumed by default that implicit dependencies that exist in LTE design are introduced in NR design

Possible agreements:

- An identity parameter ties signals for search/synchronization to the broadcast transmission of essential system information
 - Name of identity parameter TBD (e.g. cell ID, hypercell ID, system ID)
 - Other dependencies to this identity parameter can be introduced if considered beneficial taking into account forward compatibility, signalling overhead and complexity

Agreements:

- Timing between data transmission and corresponding HARQ A/N is indicated explicitly
 - FFS if implicit indication is supported in some cases
- Essential system information (MIB) should be decodable based on an identity parameter used for generation of search/synchronization signal (e.g. PSS/SSS)
 - Name of identity parameter TBD (e.g. cell ID, hypercell ID, system ID)
 - Other dependencies to this identity parameter are FFS

Wednesday

[R1-164674](#)

Channel bandwidth consideration for forward compatibility

Qualcomm Incorporated

Petitioners' Exhibit 1014, p. 77

AT&T et al v. Asustek Technology & Celerity

IPR2024-01121

The document was presented by Tingfang Ji from Qualcomm.

- Proposal 1: NR UE should be allowed to support a subset of NR channel bandwidth.
- Proposal 2: NR channel bandwidth should be defined to allow efficient unlicensed spectrum access.
- Proposal 3: NR UEs should be tested for a limited set of channel bandwidth. Additional Tx/Rx requirements for service multiplexing in frequency domain should be studied for baseband filtering.

Decision: The document is noted.

R1-165806 WF on Supporting different Numerologies in a NR carrier LG Electronics, Huawei, HiSilicon

- It is supported that a NR carrier can be divided into multiple Frequency Resource Groups (FRGs) in frequency domain
 - Different FRGs can have different numerologies
 - Each FRG may have independent synchronization signal(s)
 - Multiple FRGs may share the same synchronization signal(s)
 - Further consider DC subcarrier aspects in a NR carrier comprising multiple FRGs

Decision: The document is noted. Continue offline.

Thursday

R1-165837 WF on Supporting different Numerologies in a NR carrier LG Electronics, Huawei, HiSilicon, Panasonic

Decision: The document is noted.

Possible agreements:

- Contiguous frequency resources using one numerology in a NR carrier is called frequency resource group (FRG)
 - A numerology is defined at least by CP duration and subcarrier spacing
 - One numerology is applied in FRG over T time duration
 - FFS on details of T
 - Multiple FRGs in a NR carrier with different numerologies is supported
 - Multiple FRGs in discontinuous frequency resources in a NR carrier can use the same or different numerology
 - FFS
 - sizes of FRG
 - whether FRG (e.g., size of FRG and T) can change dynamically or semi-statically.
 - whether different FRGs can overlap or not
 - whether/how to handle DC subcarrier aspects in a NR carrier comprising multiple FRGs
 - FFS: NR supports the following
 - Each FRG has its own synchronization signal(s)
 - Multiple FRGs share the same synchronization signal(s)

Continue offline discussion until Friday –(LGE)

Friday

R1-166008 WF on Supporting different Numerologies in a NR carrier LG Electronics, Huawei, HiSilicon, Panasonic, Ericsson

Decision: The document is noted and modified as follows:

Agreements:

- For a NR carrier (from network perspective) using multiple numerologies, at least the following is for further study
 - multiple frequency/time portions using different numerologies share a synchronization signal
 - Note: The synchronization signal refers to the signal itself and the time-frequency resource used to transmit the synchronization signal

R1-165873 Way Forward on fixed DL physical resource for dynamic operation in NR LG Electronics, Qualcomm, Panasonic, NTT Docomo

- A UE may assume NR has downlink reference signal(s) with a certain periodicity/duration in time at least for the purpose of synchronization.
 - FFS: necessary frequency domain resource for the reference signal(s)
 - FFS: necessary time domain periodicity/duration for the reference signal(s)
 - FFS: whether the UE may assume the reference signal(s) is transmitted with the periodicity irrespective of the UE condition (e.g., already/yet synchronized with LTE/NR)
 - FFS: whether UE may assume a common numerology for this signal
- Downlink physical resources that composes the above downlink reference signal(s) may also comprise downlink reference signal(s) for the purpose of RRM measurement.
 - FFS : the downlink physical resources are contiguous in time
 - FFS : the downlink physical resources are contiguous in frequency
- FFS: other signal(s)/channel(s) necessary in the downlink physical resource.

- Physical resources except for the above downlink physical resources are flexibly utilized either as DL or UL or SL

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

Friday: no progress.

R1-165674 Way forward on forward compatibility for waveform evolution Spreadtrum, CATR, CMCC, Cohere, Deutsche Telekom, InterDigital, Orange, Sony, Telstra, Telefonica, ZTE

- Forward compatibility for waveform evolution should be ensured in system framework design.
 - Downlink, uplink and sidelink share the same framework of physical layer processing.

Discussion: Also supported by Fraunhofer HHI, NTU, Panasonic

Concern from a number of companies

Spreadtrum stressed how forward compatibility can be ensured?

Spreadtrum would like to see it included in the TR

Chair: TP to TR will come at a later stage, let's discuss technical solutions before trying to capture anything

Decision: The document is noted.

Not treated

R1-163982	Forward compatibility for NR	Samsung
R1-164047	General consideration on forward compatibility for new radio interface	Huawei, HiSilicon
R1-164172	Forward compatible and low overhead structure for NR	Intel Corporation
R1-164387	Forward compatibility considerations on physical layer procedures	Huawei, HiSilicon
R1-164471	On forward compatibility of NR	Guangdong OPPO Mobile Telecom.
R1-164585	Forward compatibility for waveform evolution	Spreadtrum Communications
R1-164651	Forward compatibility for new radio interface	Lenovo (Beijing) Ltd
R1-164654	Consideration on forward compatibility for NR	Sony
R1-164664	Framework for forward compatible NR design	INTERDIGITAL COMMUNICATIONS
R1-164931	Discussion on Reference Signal Design	ITRI
R1-165160	Discussion on Forward Compatible System Design for NR	MediaTek Inc.
R1-165171	Forward compatibility for NR	NTT DOCOMO, INC.
R1-165172	Forward compatibility related to mMTC and URLLC	NTT DOCOMO, INC.
R1-165356	On the forward compatibility of new radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-166002	WF on synchronization for NR forward compatibility	LG Electronics, Panasonic

7.1.2 Remaining issues on evaluation assumptions for new radio interface

R1-163984 Discussion on phase noise modeling Samsung

- Proposal 1: Use multi-pole/zero model with configurable parameters such as PSD0 and multiple pole/zero frequencies for practical phase noise performance evaluations.*
- Proposal 2: Study how to decide the model parameters.*
- Observation 1: Discussion on the relationship between OFDM subcarrier spacing and phase noise is effective only when the CPE of phase noise is compensated properly.*
- Observation 2: Considering phase noise, large subcarrier spacing can help to enhance EVM performance when large bandwidth up to a few GHz needs to be supported in higher frequencies.*
- Observation 3: For higher frequencies, the $f_0 * 2^n$ subcarrier spacing set shows too big EVM performance gap between adjacent subcarrier spacing values considering phase noise. On the other hand, the $f_0 * 2^n * 5^m$ subcarrier spacing set with finite integers such that $n=0,1,2,3,4,5,6,7,8$ and $m=0,1,2$ seems to be good enough to support large bandwidth up to a few GHz in viewpoint of phase noise impacts.*

Decision: The document is noted.

R1-165944 Chairman's Notes of Agenda Item 7.1.2 on NR eval_assumptions Session Chairman (Nokia, Qualcomm Inc.)

The document was presented by Matthew Baker from Nokia and provides the outcomes of the session.

Decision: The document is endorsed. Contents incorporated below.

R1-165482 Remaining issues on evaluation assumptions NTT Docomo

Decision: The document is noted.

Indoor hotspot

R1-164383 Further discussion on evaluation assumption for eMBB deployment scenarios Huawei, HiSilicon

Decision: The document (Section 2.1) is noted.

R1-165483 Discussion on System-Level Evaluations for NR Samsung (R1-164718)

Decision: The document (Section 2) is noted.

Proposal for indoor open office: optional additional ISD of 40m --[R1-165489](#)

Friday

[R1-165830](#) **WF on antenna placement in Indoor scenarios** Intel, NTT DoCoMo, Samsung, Ericsson

Decision: The document is agreed.

[R1-165950](#) **WF on Remaining Evaluation Assumptions** NTT DOCOMO, Intel

Decision: The document is noted. Further revised and agreed in:

[R1-166007](#) **WF on Remaining Evaluation Assumptions** NTT DOCOMO, Intel

[R1-165994](#) **WF on the antenna model for outdoor TRP** Intel, NTT DOCOMO

Decision: The document is noted. Further revised and agreed in:

[R1-166026](#) **WF on the antenna model for outdoor TRP** Intel, NTT DOCOMO, ZTE, Samsung, Xinwei, CATT, Ericsson, Nokia, ASB, Huawei

Email approval about brackets in [R1-166026](#) until June 9th - (Intel)

[R1-165982](#) **WF on UE antenna number** Huawei, HiSilicon

Decision: The document is noted.

[R1-166011](#) **WF on UE antenna number** Huawei, HiSilicon

- For UE at 70GHz, companies are also allowed to investigate the case with 64 total number of antenna elements
 - The number of TXRUs remains the same as 30GHz

[R1-164677](#) **mmW related simulation assumption parameters** Qualcomm Incorporated

Decision: The document is noted.

Agreements:

Attributes	Values or assumptions
Maximum Tx power	BS: Above 6GHz: 23 dBm for system bandwidth ≥ 100 MHz. EIRP should not exceed [51] dBm (NOTE1). UE: 30GHz: 23dBm 70GHz: 21dBm EIRP should not exceed 43 dBm (NOTE1).
UE receiver noise figure	Below 6GHz: 9dB Above 6GHz: 13dB (baseline performance), 10dB (high performance)
Traffic model	Alt. 1: Full buffer Alt. 2: FTP Proposal: Consider full buffer and FTP model 1/2/3 with packet size 0.5 Mbytes, 0.1 Mbytes (other value is not precluded). Other traffic models are not precluded.
Traffic load (Resource utilization)	For baseline scheme: 25%, 50%, 80% (other value is not precluded)

NOTE1: See Appendix in [R1-164383](#) for the derivation of maximum allowed EIRP

[R1-165693](#) **Way Forward on UE Noise Figure** Straight Path, Samsung, Intel, Nokia, KT

Decision: The document is noted.

[R1-165742](#) **WF on UE Receiver Noise Figures** Samsung, Ericsson, Intel, Nokia, ZTE, MediaTek, Straight Path, KT Corp., Verizon, ETRI, IITH, CeWiT, Reliance-jio, Tejas Networks, Fiberhome, Sony, Coolpad, InterDigital, Potevio, Mitsubishi Electric, SK Telecom, OPPO, Lenovo, Skyworks, Xiaomi, AT&T

Decision: The document is noted.

Dense urban

[R1-164383](#) **Further discussion on evaluation assumption for eMBB deployment scenarios** Huawei, HiSilicon

Decision: The document (Section 2.2) is noted.

Agreements:

Attributes	Values or assumptions
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Carrier frequency	Micro layer: Around 30GHz, 4 GHz; optional: 70GHz
Aggregated system bandwidth	Around 30GHz and 70GHz : Up to 1GHz (DL+UL)
Tx power	Micro BS: Proposal: 4 GHz: 33dBm for 20MHz system bandwidth– check on Wed Above 6GHz: 33 dBm for system bandwidth ≥ 100MHz. EIRP should not exceed [69] dBm (NOTE1). UE: 30GHz: 23dBm 70GHz: 21dBm EIRP should not exceed 43 dBm (NOTE1).
UE receiver noise figure	Below 6GHz: 9dB Above 6GHz: 13dB
Traffic model	Alt. 1: Full buffer Alt. 2: FTP Proposal: Consider full buffer and FTP model 1/2/3 with packet size 0.5 Mbytes, 0.1 Mbytes (other value is not precluded). Other traffic models are not precluded.
Traffic load (Resource utilization)	For baseline scheme: 25%, 50%, 80% (other value is not precluded)
NOTE1: See Appendix in R1-164383 for the derivation of maximum allowed EIRP	

[R1-164243](#) Remaining issues on deployment scenarios CATT
Decision: The document is noted.

Agreement: Capture the following in 38.802:

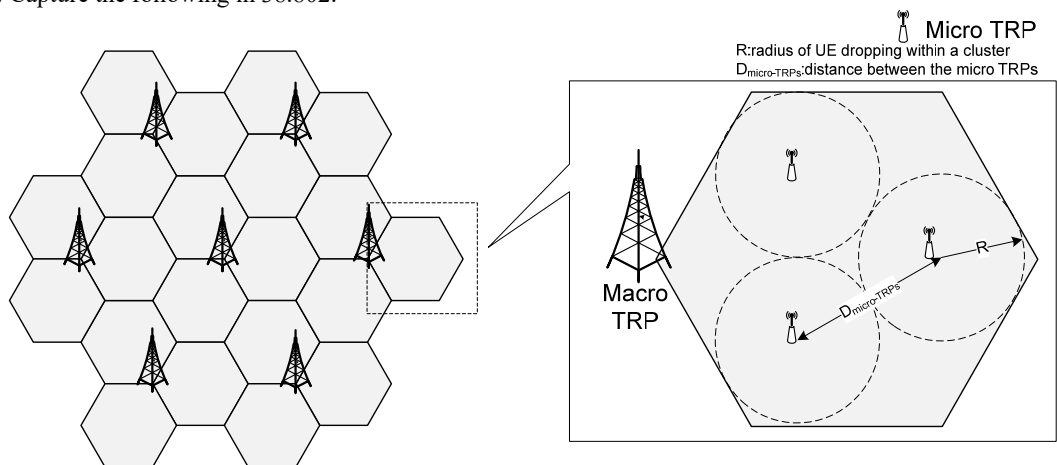


Figure: Layout illustration of deployment scenario of “Dense Urban”: 3 Micro TRPs per Macro TRP

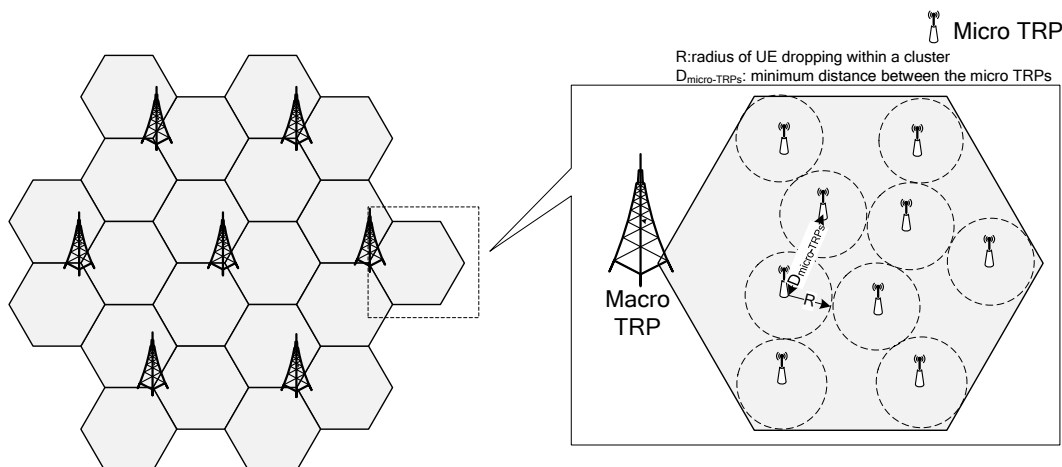


Figure: Layout illustration of deployment scenario of “Dense Urban”: 9 Micro TRPs per Macro TRP

Table: Number of Micro TPP per Macro TRP vs. minimum distance between TRPs and UE cluster radius

Number of the micro TRPs per macro TRP	Minimum distance between Micro TRPs (m)	Radius of UE dropping within a cluster: R (m)
3	57.9	<28.9
6	42.4	<21.2
9	32	<16

Rural

[R1-164383](#)

Further discussion on evaluation assumption for eMBB deployment scenarios

Huawei, HiSilicon

Decision: The document (Section 2.3) is noted.

Agreement:

Traffic model	Alt. 1: Full buffer Alt. 2: FTP Proposal: Consider full buffer and FTP model 1/2/3 with packet size 0.5 Mbytes, 0.1 Mbytes (other value is not precluded). Other traffic models are not precluded.
Traffic load (Resource utilization)	For baseline scheme: 25%, 50%, 80% (other value is not precluded)

Urban macro

[R1-164383](#)

Further discussion on evaluation assumption for eMBB deployment scenarios

Huawei, HiSilicon

Decision: The document (Section 2.4) is noted.

Agreements:

Attributes	Values or assumptions
Tx power	BS: 30GHz: 43 dBm for system bandwidth ≥ 100 MHz. EIRP should not exceed [78] dBm (NOTE1).. UE: 30GHz: 23dBm EIRP should not exceed 43 dBm (NOTE1).
UE receiver noise figure	Below 6GHz: 9dB Above 6GHz: 13dB
Traffic model	Alt. 1: Full buffer Alt. 2: FTP Proposal: Consider full buffer and FTP model 1/2/3 with packet size 0.5 Mbytes, 0.1 Mbytes (other value is not precluded). Other traffic models are not precluded.
Traffic load (Resource utilization)	For baseline scheme: 25%, 50%, 80% (other value is not precluded)
NOTE1: See Appendix in R1-164383 for the derivation of maximum allowed EIRP	

High-speed

[R1-164887](#)

Remaining Evaluation Assumptions for High Speed Train Scenario CMCC

Decision: The document is noted.

[R1-165576](#)

WF on evaluation assumptions for high speed train scenario

CMCC, CATT, Huawei, CATR,

China Unicom, ZTE

Decision: The document is noted. Also supported by Qualcomm.

Agreements:

- All proposals in [R1-165576](#), with removal of “same cell ID” on slide 5.
- Other scenarios can be further discussed, e.g.:
 - 30GHz (see below)
 - Unidirectional beams

[R1-164029](#)

Clarification and proposals on parameters for high speed train scenarios

Mitsubishi Electric Co.

Decision: The document is noted.

[R1-165484](#)

WF for high speed train scenario at 30GHz

Mitsubishi, ETRI (Also supported by E//)

Decision: The document is agreed.

Notes:

- Focus is on evaluation of the base station to relay link.
- 1 relay node per train is assumed.

R1-164383 Further discussion on evaluation assumption for eMBB deployment scenarios

Huawei, HiSilicon

Decision: The document (Section 2.5) is noted.

Agreements:

Attributes	Values or assumptions
UE receiver noise figure	Below 6GHz: 9dB Above 6GHz: 13dB
Traffic model	Alt. 1: Full buffer Alt. 2: FTP Proposal: Consider full buffer and FTP model 1/2/3 with packet size 0.5 Mbytes, 0.1 Mbytes (other value is not precluded). Other traffic models are not precluded.
Traffic load (Resource utilization)	For baseline scheme: 25%, 50%, 80% (other value is not precluded)

Extreme rural

R1-164680 Other KPI evaluation assumptions

Qualcomm Incorporated

Decision: The document is noted.

Agreement:

- For the evaluation of Long Range (single cell SLS), consider a single cell radius target (e.g. 100km), and identify the data rate with which the edge users can be served; then observe how many users such a cell site can serve.

FFS: detailed parameters for long range scenarios – (Qualcomm) - [R1-165485](#)

R1-165485 WF on Extreme Long Range KPI Evaluation Qualcomm

Decision: The document is agreed.

Friday

R1-165917 Way forward on High Speed Link Level evaluation

Cohere, AT&T, CMCC, Deutsche Telekom,

InterDigital, Orange, Spreadtrum, Telefonica, Telstra

Decision: The document is noted. Revised in:

R1-166020 Way Forward on High Speed link level evaluation Cohere, AT&T, CMCC, Deutsche Telekom,

InterDigital, National Taiwan University, Orange, Spreadtrum, Telefonica, Telstra

Decision: The document is noted. Further revised and agreed in [R1-166031](#).

R1-165926 WF on additional evaluation assumptions for high speed train scenario: Macro + relay around 30GHz

Mitsubishi Electric, ETRI, Ericsson

Decision: The document is noted.

Agreements:

- On additional evaluation assumptions for high speed train scenario: Macro + relay around 30GHz
 - Number of antenna elements of relay
 - Relay Tx: up to 256
 - Relay Rx: up to 256
 - Note: The antenna of the relay for RRH-to-Relay is located outside of a train
 - Number of antenna elements of RRH
 - RRH Tx: up to 256
 - RRH Rx: up to 256
 - Note: The above values are shown in TR 38.913

Continue discussion other proposals in [R1-165926](#) offline

Friday

R1-166001 Proposal for email discussion on evaluation assumptions for high speed train scenario: Macro + relay

around 30GHz Mitsubishi Electric, ETRI

Decision: The document is noted.

Conclusion: Agreed [R1-166001](#) except for brackets and FFS parts

Email approval until June 8th about brackets and FFS parts – (Mitsubishi)

Urban coverage for massive connectivity

R1-164044 Evaluation assumption for non-eMBB deployment scenarios

Huawei, HiSilicon

Decision: The document (Section 2.1) is noted.

Highway

R1-164044 Evaluation assumption for non-eMBB deployment scenarios

Huawei, HiSilicon

Decision: The document (Section 2.2) is noted.

R1-164679 Highway and urban grid evaluation scenarios Qualcomm Incorporated
Decision: The document is noted.

R1-165612 WF on SLS evaluation assumptions for eV2X LG Electronics, Deutsche Telekom
Decision: The document is noted.

Offline discussion on evaluation assumptions for Highway / Urban Grid scenarios / eV2X – (LGE) - revisit on Wed.

R1-165704 WF on SLS evaluation assumptions for eV2X LG Electronics, Deutsche Telekom
Decision: The document is noted.

Agreements: (including below add-on from Friday online session)

Parameters	Urban grid for eV2X	Highway for eV2X
Layout	Option 1: Macro only (with the road configuration in Figure 6.1.10-1 in TR38.913) Option 2: Macro + RSUs (with the road configuration in Figure 6.1.10-1 in TR38.913) Note: An RSU can be a BS type RSU or UE type RSU Out of coverage can be evaluated assuming eNB or RSU to be disabled. Sidelink evaluation with partly out of coverage Ues and partly in coverage Ues are FFS.	Option 1: Macro only (straightline eNB placement with Road configuration in TR36.885) Option 2: Macro + RSUs (straightline eNB with Road configuration in TR36.885) Note: An RSU can be a BS type RSU or UE type RSU Out of coverage can be evaluated assuming eNB or RSU to be disabled. Sidelink evaluation with partly out of coverage Ues and partly in coverage Ues are FFS.
Inter-BS distance	Inter Macro: 500m Inter RSU: RSU is dropped at each intersection	Inter Macro: 1732m, 500m (optional) Inter RSU: Uniform allocation with 100m spacing in the middle of the highway
Carrier frequency	Macro to/from vehicle/pedestrian UE : 4 GHz Between vehicle/pedestrian UE: 6 GHz BS-type-RSU to/from vehicle/pedestrian UE : 4 GHz UE-type-RSU to/from vehicle/pedestrian UE: 6 GHz Note: Agreed value does not mean non-ITS band is precluded for real deployment for sidelink	Macro to/from vehicle/pedestrian UE : 2 GHz or 4GHz Between vehicle/pedestrian UE: 6 GHz BS-type-RSU to/from vehicle/pedestrian UE : 4 GHz UE-type-RSU to/from vehicle/pedestrian UE: 6 GHz Note: Agreed value does not mean non-ITS band is precluded for real deployment for sidelink
Aggregated system bandwidth	Up to 200 MHz (DL+UL) Up to 100 MHz (SL)	Up to 200 MHz (DL+UL) Up to 100 MHz (SL)
Simulation bandwidth	20 or 40 MHz (DL+UL) 10 or 20 MHz (SL)	20 or 40 MHz (DL+UL) 10 or 20 MHz (SL)
Channel model	Macro to/from vehicle/pedestrian UE : 3D UMa Between vehicle/pedestrian UE: V2X Channel model in TR36.885 RSU to/from vehicle/pedestrian UE : V2X Channel model in TR36.885 FFS whether V2V channel model enhancements are needed	Macro to/from vehicle/pedestrian UE: 3D UMa for 500m ISD 3D RMa for 1732m ISD (2D RMa may be used until 3D RMa is complete) Between vehicle/pedestrian UE: V2X Channel model in TR36.885 RSU to/from vehicle/pedestrian UE : V2X Channel model in TR36.885 FFS whether V2V channel model enhancements are needed
Tx power	Macro BS: 49dBm PA scaled with simulation BW when system BW is higher than simulation BW. Otherwise, 49dBm [TBD for TDD] BS-type-RSU: 24dBm PA scaled with simulation BW when system BW is higher than simulation BW. Otherwise, 24dBm Vehicle/pedestrian UE or UE type RSU: 23dBm Note: 33dBm for RSU or UE is not precluded	Macro BS: 49dBm PA scaled with simulation BW when system BW is higher than simulation BW. Otherwise, 49dBm [TBD for TDD] BS-type-RSU: 24dBm PA scaled with simulation BW when system BW is higher than simulation BW. Otherwise, 24dBm Vehicle/pedestrian UE or UE type RSU: 23dBm Note: 33dBm for RSU or UE is not precluded
BS antenna configuration	Macro BS: Up to 256 TX/RX antenna elements BS-type-RSU: Up to 8 TX/RX antenna elements	Macro BS: Up to 256 TX/RX antenna elements BS-type-RSU: Up to 8 TX/RX antenna elements

BS antenna pattern	Macro BS: Follow the modeling of TR 36.873 BS-type RSU: Follow the modeling of TR 36.873 Note: Further study if needed, e.g., vertical beamforming, vehicle-to-vehicle channel.	Macro BS: Follow the modeling of TR 36.873 BS-type RSU: Follow the modeling of TR 36.873 Note: Further study if needed, e.g., vertical beamforming effect, vehicle-to-vehicle channel.
BS antenna height	Macro BS: 25m BS-type-RSU: 5m	Macro BS: 35m for ISD 1732m 25m for ISD 500m BS-type-RSU: 5m
BS antenna element gain + connector loss	Macro BS: 8 dBi BS-type-RSU: 8dBi	Macro BS: 8 dBi BS-type-RSU: 8dBi
BS receiver noise figure	Macro BS:5dB BS-type-RSU: 5dB	Macro:5dB BS-type-RSU: 5dB
UE antenna elements	Vehicle/pedestrian UE: Up to 8 TX/RX antenna elements UE-type RSU: Up to 8 TX/RX antenna elements	Vehicle/pedestrian UE: Up to 8 TX/RX antenna elements. UE-type RSU: Up to 8 TX/RX antenna elements
UE antenna pattern	Vehicle/pedestrian UE: Half spherically uniform distribution with upper direction UE-type-RSU: Half spherically uniform distribution with bottom direction Note: directional antenna pattern is not precluded Note: uniform antenna models should be used for 2-D channel models	Vehicle/pedestrian UE: Half spherically uniform distribution with upper direction UE-type-RSU: Half spherically uniform distribution with bottom direction Note: directional antenna pattern is not precluded Note: uniform antenna models should be used for 2-D channel models
UE antenna height	Vehicle/pedestrian UE: 1.5m UE-type-RSU: 5 m	Vehicle/pedestrian UE: 1.5m UE-type-RSU: 5 m
UE antenna gain	Vehicle UE: 3dBi Pedestrian UE: 0dBi UE-type RSU: 3dBi	Vehicle UE: 3dBi Pedestrian UE: 0dBi UE-type RSU: 3dBi
UE receiver noise figure	Vehicle UE: 9dB UE-type RSU: 9dB	Vehicle UE: 9dB UE-type RSU: 9dB
Traffic model	[50 messages] per 1 second with [60km/h], [10 messages] per 1 second with [15km/h] in TR38.913 Note: This value is tentative. After SA1 input, it can be modified.	[50 messages] per 1 second with absolute average speed of [100-250 km/h] (relative speed: 200 – 500km/h) in TR38.913 Note: This value is tentative. After SA1 input, it can be modified.
Traffic load (Resource utilization)	FFS	FFS
UE distribution	Urban grid model (car lanes and pedestrian/bicycle sidewalks are placed around a road block. 2 lanes in each direction, 4 lanes in total, 1 sidewalk, one block size: 433m x 250m) in TR38.913 Average inter-vehicle distance (between two vehicles' center) in the same lane is [1sec * average vehicle speed] (average speed [15 – 120km/h]) in TR38.913 Vehicle UE location update in TR36.885 should be used for the evaluation of PRR in sidelink or communication interruption in uplink/downlink. Vehicle UE location update may not be assumed for the evaluation of PRR in uplink/downlink Note: Inter-vehicle distance is tentative. After SA1 input, it can be modified. Pedestrian UE distribution: Inter-pedestrian distance 20m, which is tentative. After SA1 input, it can be modified.	Average inter-vehicle distance (between two vehicles' center) in the same lane is [0.5 sec or 1sec * average vehicle speed] (average speed: [100-250 km/h]) in TR38.913 Vehicle UE location update in TR36.885 should be used for the evaluation of PRR in sidelink or communication interruption in uplink/downlink. Vehicle UE location update may not be assumed for the evaluation of PRR in uplink/downlink Note: Inter-vehicle distance is tentative. * After SA1 input, only one value will be selected.
Feedback assumption	FFS	FFS
Channel estimation	Realistic	Realistic
Performance metric	FFS	FFS

Friday: Email discussion on performance metrics, starting from the ones in R1-165612, till August 6th.

Urban Grid

[R1-164044](#)

Evaluation assumption for non-eMBB deployment scenarios

Huawei, HiSilicon

Decision: The document (Section 2.3) is noted.

Other mMTC assumptions

[R1-165008](#) UE battery life evaluation for mMTC use cases Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted.

Conclusion:

- Discuss until RAN1#86 to define simple UE energy modelling approach for NR mMTC radio access energy efficiency analysis which is not specific to any particular radio access solution (contact: Karri Ranta-aho)

[R1-165696](#) WF on evaluation methodologies for mMTC LG Electronics, Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted.

Agreements:

- Evaluation methods and relevant evaluation metrics per KPIs for mMTC in RAN1 are as follows:
 - Coverage is evaluated by link budget
 - Connection density is evaluated by SLS and analysis
 - UE battery life is evaluated by analysis
 - Statistics of wake-up time duration of UE in consideration of the number of (re)transmissions
 - Battery life is evaluated in consideration of RAN2 procedure

Other URLLC assumptions

[R1-164681](#) URLLC KPI evaluation assumptions Qualcomm Incorporated

Decision: The document is noted. Discuss these proposals offline, including:

- the exact definition to be used for latency evaluation
- reliability KPI:

Revisit on Tuesday evening - [R1-165487](#)

[R1-165487](#) WF on URLLC KPIs and Evaluation Qualcomm

Decision: The document is noted.

Proposed Working Assumption for URLLC KPIs:

- URLLC latency and reliability KPIs are defined in conjunction
 - (Latency, Reliability) of (L, R) is met if packet of X bytes is delivered within L ms latency from radio protocol ingress point to egress point with packet error rate < R.
 - E.g., (1ms, 1e-5)

Revisit later in the week.

Friday: To be revisited at next meeting.

Agreements:

The following performance metrics are defined for evaluation and feature selection in RAN1 (FFS the method of evaluation, including whether SLS are required):

- URLLC capacity is defined as delivered traffic given the (L, R) constraint
 - Denoted as $C(L,R)$
- URLLC/ eMBB multiplexing capacity is defined as the simultaneously delivered URLLC capacity $C(L,R)$ and eMBB capacity T

FFS until RAN1#86:

- Proposal 1: Single URLLC traffic model should be used evaluate URLLC KPIs
 - Example: Fixed packet size of 32 Bytes, Poisson arrival rate of λ ,
 - Example: single directional and bi-directional traffic could be considered
- Proposal 2: Latency metric should capture transmission latency, processing latency, retransmission latency and queuing/scheduling latency
- Proposal 3: Link level BLER evaluation should include control and data channels
 - With and without other cell interference
- Proposal 4: System level evaluation should capture other cell interferences

[R1-163988](#) Evaluation methodology and KPI for URLLC Samsung

Decision: The document is noted.

V2X

[R1-164173](#) Discussion on URLLC evaluation assumptions and scenarios Intel Corporation

Decision: The document is noted.

Conclusion: Aim for a single set of assumptions for evaluations of URLLC.

MIMO & antenna modelling

R1-164950 On new antenna model for NR basestation Ericsson

Decision: The document is noted.

Agreements:

- TXRUs within a panel can be assumed to be synchronized and phase-calibrated (at least to the same level as in LTE).
- It should be possible as one option to assume QCL between ports of two different panels of the same transmission points
- Distances ($d_{g,H}$, $d_{g,V}$) between panels should be limited to at most [FFS] metres.
- NR evaluations may consider both cases of phase-calibration and no phase-calibration between panels

R1-163986 Remaining details of TRP antenna modeling and TXRU mapping/virtualization Samsung

Discussion: Telecom Italia insists on realistic numbers of antenna elements at lower frequencies.

Decision: The document is noted.

R1-165488 WF on TRP antenna model Samsung, Intel, Ericsson

Decision: The document is noted. Revisit on Wednesday.

R1-164554 Proposal for UE antenna model for new RAT LG Electronics

Decision: The document is noted.

R1-165712 WF on hybrid UE antenna modelling Intel, Samsung, LG

Decision: The document is noted.

Companies are requested to check both [R1-165488](#) (->[R1-165490](#)) and [R1-165712](#) (->[R1-165491](#)) by the end of the morning coffee break; WF owners to provide editable versions (in Word).

R1-165490 Way-forward for TRP antenna modeling Samsung, Intel, Ericsson, Qualcomm, Xinwei

Decision: The document is noted.

Agreements on TRP antenna modelling:

- For evaluation, consider the following antenna configurations:
 - Baselines are at least for MIMO-related calibration (and can also be used for other features unless a different baseline is defined for evaluation of a particular feature). Companies are encouraged to evaluate other configurations as well.
 - **At 4GHz:**
 - Dense urban and Urban macro:
 - Baseline: $(M,N,P,M_g,N_g) = (8,8,2,1,1)$, $(d_{V,H}) = (0.8, 0.5)\lambda$.
 - Note that for Urban macro, companies are also encouraged optionally to investigate larger panels, e.g. $(8,16,2,1,1)$
 - Indoor hotspot:
 - FFS
 - **At 30GHz:**
 - Dense urban and Urban macro:
 - Baseline: $(M,N,P,M_g,N_g) = (4,8,2,2,2)$. $(d_{V,H}) = (0.5, 0.5)\lambda$. $(d_{g,V},d_{g,H}) = (2.0, 4.0)\lambda$.
 - Note that companies are also encouraged to investigate a larger panel spacing, e.g. $(d_{g,V},d_{g,H}) = (4,8)\lambda$
 - Indoor hotspot:
 - FFS
 - **At 70GHz:**
 - Dense urban:
 - Baseline: $(M,N,P,M_g,N_g) = (8,16,2,2,2)$. $(d_{V,H}) = (0.5, 0.5)\lambda$. $(d_{g,V},d_{g,H}) = (4.0, 8.0)\lambda$.
 - Note that companies are also encouraged to investigate a larger panel spacing, e.g. $(d_{g,V},d_{g,H}) = (8,16)\lambda$
 - Indoor hotspot:
 - FFS
- Consider the following a TXRU to antenna elements mapping as examples
 - **At 4GHz:** the same as TR36.897
 - **At 30GHz and 70GHz:**

- **Option 1:** a single TXRU is mapped per panel per polarization.
- **Option 2:** a single TXRU is mapped per panel per subarray per polarization,
 - E.g., where a subarray consists of consecutive $M/2$ vertical antennas and $N/2$ horizontal antennas with the same polarization.
 - Other subarray configurations are not precluded.
- **Option 3:** Fully connected TXRU mapping within a panel per polarization.
 - Other Fully connected TXRU mapping is not precluded.
- For evaluating multi beam based approaches at 30GHz and 70GHz, consider the following:
 - TXRU to antenna mapping weights are adjustable and used to steer the panel beam direction in multi beam based approaches in time domain.
 - Companies should describe TXRU mapping weights for the panel beams

[R1-165640](#) **WF on antenna placement in Indoor scenarios** Intel, NTT DOCOMO [\(R1-165587\)](#)

Decision: The document is noted. Companies are invited to review this – revisit on Friday.

Agreements on UE antenna modelling:

- For UE with (M_g, N_g) directional antenna panels.
 - Introduce $(\Omega_{mg,ng}, \Theta_{mg,ng})$ for orientation of the panel (m_g, n_g) , $0 \leq m_g < M_g$, $0 \leq n_g < N_g$, where the orientation of the first panel $(\Omega_{0,0}, \Theta_{0,0})$ is the same as UE orientation, $\Omega_{mg,ng}$ is the array bearing angle and $\Theta_{mg,ng}$ is the array downtilt angle defined in [TR 36.873].
 - For NR MIMO evaluation:
 - Config 1: $(M_g, N_g) = (1, 2)$; $\Theta_{mg,ng} = 90$; $\Omega_{0,1} = \Omega_{0,0} + 180$; $(d_{gH}, d_{gV}) = (0, 0)$
 - Config 2: $(M_g, N_g, M_g, N_g) = (1, 4)$; $\Theta_{mg,ng} = 90$; $\Omega_{0,1} = \Omega_{0,0} + 90$; $\Omega_{0,2} = \Omega_{0,0} + 180$; $\Omega_{0,3} = \Omega_{0,0} + 270$; $(d_{gH}, d_{gV}) = (0, 0)$
 - Other configurations can have panel specific position offset $(d_{gH, mg, ng}, d_{gV, mg, ng})$. Note in this case the notation of (M_g, N_g, M_g, N_g) does not leads to rectangular shape.
 - UE orientation for mobile device $(\Omega_{0,0}, \Theta_{0,0}) = (U(0,360), 90)$; UE orientation for customer premise equipment (CPE) can be optimized
 - Each antenna array has shape $d_H = d_V = 0.5\lambda$
 - Config 1 can be used with config a/b; Config 2 can be used with config c/d/e
 - Config a: $(M, N, P) = (2, 4, 2)$, the polarization angles are 0 and 90
 - Config b: $(M, N, P) = (4, 4, 1)$, the polarization angle for even panel is 0 and for odd panel is 90
 - Config c: $(M, N, P) = (2, 2, 2)$, the polarization angles are 0 and 90
 - Config d: $(M, N, P) = (2, 4, 1)$, the polarization angle for even panel is 0 and for odd panel is 90
 - Config e: $(M, N, P) = (1, 4, 2)$, the polarization angles are 0 and 90
 - FFS: Other configurations, e.g. $(M, N, P) = (4, 4, 2)$ or $(M, N, P) = (4, 8, 1)$ can be considered for 70GHz band, without exceeding the limit on the maximum number of UE antenna elements
 - The antenna elements of the same polarization of the same panel is virtualized into one TXRU
 - FFS: one TXRU can connect to different subarrays dynamically
 - Note: The channel coefficients for each UE panel can be generated using spatial channel model
- Companies should describe the method used for TRP association with UE-side beamforming

UE PA model

[R1-165006](#) **On the evaluation of PA model** Nokia, Alcatel-Lucent Shanghai Bell

Decision: The document is noted.

[R1-164721](#) **On justification of the parameter selection for PA models in link level evaluation** Huawei, HiSilicon

Decision: The document is noted.

Conclusion: Discuss further when LS reply is received from RAN4.

Waveform

[R1-164586](#) **LLS assumptions for waveform evaluation in mMTC UL transmissions** Spreadtrum

Communications

Decision: The document is noted.

[R1-165675](#) **Way forward on Case 5 for waveform LLS evaluation** Spreadtrum, Orange, ZTE

Decision: The document is noted.

[R1-164034](#) **Further evaluation assumptions for waveform** Huawei, HiSilicon

Decision: The document is noted. To be revised in [R1-165759](#) – revisit later

[R1-165859](#) **Way forward on further evaluation assumptions for NR waveform** Huawei, HiSilicon, InterDigital, NTT DOCOMO, LGE

Decision: The document is agreed.

R1-165914 **WF on further evaluation assumptions for NR waveform 30GHz and beyond** **Nokia, Intel**

Decision: The document is noted. Continue discussion offline

Friday

R1-165989 **Way forward on calibration assumptions for NR waveform** **Huawei, HiSilicon, NTT DOCOMO, Nokia**

- Use an email discussion to collect the calibration results for all agreed simulation cases before RAN1#86 meeting.
 - OFDM/DFT-S-OFDM with CP as baseline for performance reference. (LMMSE receiver assumed)
 - At least BLER vs SNR should be reported for calibration

Note: This calibration is not for down-select purpose.

Note: The selection of the parameters on page 3 is only for calibration purpose

Decision: The document is agreed. **Email discussion on calibration for NR waveform until June 30th - (Huawei)**

R1-166016 **Way forward on email discussion for waveforms** **Huawei, HiSilicon, National Taiwan University, NTT DOCOMO, Nokia**

- Use an email discussion to collect information from each company on the details of their proposed/simulated waveform(s), including
 - used parameters
 - Tx/Rx structure
 - Corresponding performance
- Companies are encouraged to provide inputs to this email discussion as early as possible
- The purpose of this email discussion is to facilitate waveform discussion in future meetings. No conclusion is expected out of this email discussion

Decision: The document is agreed. **Email discussion to collect information for NR waveform until August 4th - (Huawei)**

R1-166000 **WF on further evaluation assumptions for NR waveform 30GHz and beyond** **Nokia, Alcatel-Lucent Shanghai Bell, Intel, Samsung, Huawei, HiSilicon**

Decision: The document is noted. Revised in:

R1-166028 **WF on further evaluation assumptions for NR waveform 30GHz and beyond** **Nokia, Alcatel-Lucent Shanghai Bell, Intel, Samsung, Huawei, HiSilicon, Qualcomm**

Decision: The document is agreed.

Multiple Access

R1-163983 **Evaluation assumptions for NR multiple access** **Samsung**

Decision: The document is noted.

R1-164045 **SLS parameters for evaluation scenarios for multiple access evaluation** **Huawei, HiSilicon**

Decision: The document is noted.

R1-165691 **Way forward on remaining issues on multiple access evaluation assumption** **Huawei, HiSilicon**

Decision: The document is noted.

Agreements for SLS parameters for UL mMTC scenario – urban coverage for massive connection:

Attributes	Values or assumptions
Layout	Single layer - Macro layer: Hex. Grid
Inter-BS distance	1732m
Carrier frequency	700MHz
Simulation bandwidth	Companies report simulation bandwidth used in evaluation
Channel model	3D UMa Take 5GCM output into account if applicable.
Tx power	UE: Max 23dBm or optional 10dBm
BS antenna configuration	Rx: 2 and 4 ports (8 as optional)
BS antenna pattern	Follow the modeling of TR36.873
BS antenna height	25m
BS antenna tilt	Companies report tilt
BS antenna element gain + connector loss	8 dBi, including 3dB cable loss
BS receiver noise figure	5 dB
UE antenna elements	1Tx
UE antenna height	1.5m
UE antenna gain	-4dBi
Traffic model	Non-full buffer small packet. Consider future trend of mMTC traffic
UE distribution	20% of users are outdoor in cars (100km/h) or 20% of users are outdoors (3km/h) 80% of users are indoor (3km/h) Users dropped uniformly in entire cell
BS receiver	MMSE-IRC as baseline, Advanced receiver is not precluded
UL power control	Companies report power control scheme

Channel estimation	Realistic
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- Notes:
 - The same table is also agreed to be used for general assumption for mMTC for UL
 - Additionally, it was agreed to additionally define the minimum packet size is [20] bytes

Discuss offline remaining slides in [R1-165691](#), including LLS assumptions.

[R1-165759](#) Way forward on further evaluation assumptions for NR waveform Huawei, HiSilicon, InterDigital

Decision: The document is noted.

[R1-165848](#) Way forward on mMTC evaluation assumptions

Decision: The document is noted.

[R1-165875](#) Way forward on remaining issues on multiple access evaluation assumptions Huawei, HiSilicon

Decision: The document is noted.

Agreement:

- PHY abstraction (L2S mapping) of LLS is encouraged to be provided for calibration purpose
- LLS evaluation with ideal and realistic channel estimation

Proposal:

- Slide 4 in [R1-165875](#) is agreed, with the following updates:
 - BS: 49dBm / **10MHz for FDD and 20MHz for TDD**
 - (eNB) 2/4/8 Tx/Rx ports as start point -> more than 2 ports
 - (UE) 1 Tx/**2Tx** and 2 Rx/**4Rx** as starting point
 - **25%**, 50%, 80% (other value is not precluded)
 - For TRP spectrum efficiency: **full buffer or ftp?**
 - Uniform distribution, 10, **20-users** per TRP or more **for full buffer traffic**
 - UE receiver and/or TRP receiver: Updated to **Advanced receiver is not precluded?**
 - **Scheduler?**

Continue offline discussion

Friday

[R1-166006](#) WF on remaining issues on SLS parameters for multiple access Huawei, HiSilicon, CATT, Orange,

NTT DOCOMO, Vodafone

Decision: The document is noted.

Agreements:

- For multiple access evaluations for eMBB scenarios, both subband and wideband scheduler can be considered
- For multiple access evaluations for eMBB rural scenario:
 - Carrier frequency: 700MHz;
 - ISD: 1732m;
 - BS antenna configuration: 2/4/8 ports
 - UE antenna configuration: 2Tx/1Tx port, 2Rx/4Rx ports;
 - Traffic model:
 - For spectral efficiency: full buffer (NOTE)
 - For user experienced data rate: FTP model 1/3
 - UE density:
 - Full buffer: 10 UE per TRP, other values are not precluded;
 - Traffic load (FTP)
 - 50%, 80%, 25% (optional)
 - NOTE: full buffer evaluation is not used for technical scheme down selection.
- For multiple access evaluations for eMBB dense urban scenario:
 - Layout: Signal layer; Two layers not precluded
 - Carrier frequency: 4 GHz for the single layer
 - BS antenna TXRUs: 4, 8, 16, 32 TXRUs
 - UE antenna TXUs and RXUs: 2/1 TXUs, 2/4 RXUs
 - Traffic model:
 - For spectral efficiency: full buffer (NOTE)
 - For user experienced data rate: FTP model 1/3
 - UE density:
 - Full buffer: 10 UE per TRP, 20 or other values are not precluded;
 - Traffic load (FTP)
 - 50%, 80%, 25% (optional)

- NOTE: full buffer evaluation is not used for technical scheme down selection
- Note: Other parameters refer to general assumptions

R1-165916 WF on DL Multiple Access for eMBB MediaTek, Spreadtrum
Decision: The document is noted.

Initial evaluations

R1-166004 **Response LS on realistic power amplifier model for NR waveform evaluation** RAN4, Nokia

Decision: The document is noted.

R1-166010 **WF on power amplifier assumptions for NR wavvform evaluations** Nokia, Alcatel Lucent Shanghai Bell

Decision: The document is noted.

Working assumption:

- RAN1 adopts the models provided in RAN4 LS ([R1-166004](#)) to the NR UL waveform evaluations

Email discussion and approval about power amplifier assumptions for NR DL waveform evaluations by utilizing [R1-166004](#) and [R1-166010](#) and also email approval to confirm above WA until 9th June – Mihai (Nokia)

R1-165675 **Way forward on Case 5 for waveform LLS evaluation** Spreadtrum, Orange, ZTE

Decision: The document is noted.

Not treated:

R1-163985	Discussion on achieving data rate and spectral efficiency KPIs for NR	Samsung
R1-163987	Remaining details of UE antenna modeling and TXRU mapping/virtualization	Samsung
R1-164041	Phase noise model for above 6GHz	Huawei, HiSilicon
R1-164174	Discussion on channel modeling framework for UE-UE and eNB-eNB interference	Intel Corporation
R1-164175	Traffic model for small packet size	Intel Corporation
R1-164244	Remaining issues on link/system-level evaluation assumptions for MA	CATT
R1-164245	Discussion on link-level evaluation assumptions for channel coding	CATT
R1-164262	Remaining issue with link level simulation for multiple access	ZTE
R1-164263	Remaining issue with system level simulation for multiple access	ZTE
R1-164264	Requirement KPIs and system performance targets for multiple access	ZTE
R1-164373	Evaluation methodology for Massive MIMO in New Radio	Huawei, HiSilicon
R1-164391	Overview of remaining issues of evaluation assumption	Huawei, HiSilicon
R1-164553	Evaluation assumptions for eV2X	LG Electronics
R1-164555	Remaining Issues on Evaluation Assumptions for New Radio Interface	LG Electronics
R1-164587	Further consideration on the evaluation assumption of multiple access	Spreadtrum Communications
R1-164675	Initial DL KPI evaluation for eMBB	Qualcomm Incorporated
R1-164676	Initial UL KPI evaluation for eMBB	Qualcomm Incorporated
R1-164678	High speed train scenario clarification	Qualcomm Incorporated
R1-164683	Multiple access evaluation assumption	Qualcomm Incorporated
R1-164868	Evaluation assumptions for high speed scenario	ETRI
R1-164888	Phase Noise in High Frequency Bands for New Radio Systems	CMCC
R1-164951	Scenarios and Evaluation methodology for NR	Ericsson
R1-165005	On the evaluation of PN model	Nokia, Alcatel-Lucent Shanghai Bell
R1-165009	System level simulation assumptions for mMTC use cases	Nokia, Alcatel-Lucent Shanghai Bell
R1-165010	Waveform comparison simulation assumptions for 30 GHz and beyond	Nokia, Alcatel-Lucent Shanghai Bell
R1-165078	Remaining details of NR evaluation assumptions	Intel Corporation
R1-165424	On baseline UE receiver for NR	ORANGE, Vodafone
R1-165443	Evaluation Assumptions for NR MIMO	ZTE
R1-165491	WF on hybrid UE antenna modelling	Intel, Samsung, LGE
R1-165633	Way Forward on SLS evaluation assumptions	LG Electronics
R1-165690	WF on eMTC evaluation assumptions	Huawei, HiSilicon
R1-165697	Way Forward on KPIs discussion for RAN1 evaluation	LG Electronics
R1-165735	WF on assumption details for case 5 in waveform LLS evaluation	Spreadtrum, Fraunhofer IIS, National Taiwan University, Orange, ZTE
R1-165930	WF on evaluation assumptions for eMBB	LGE
R1-166005	WF on Channel coding selection	Qualcomm Incorporated, ZTE

7.1.3 Waveform and multiple access schemes for new radio interface

7.1.3.1 Waveform

R1-164265 Discussion on FB-OFDM of new waveform for new radio interface ZTE

The document was presented by Yifei Yuan from ZTE.

- *Observation 1: FB-OFDM shares the same baseband signal formulation with some other OFDM-based multi-carrier waveforms including CP-OFDM, CP-OFDM with WOLA, FBMC, FBMC-OQAM and GFDM.*
- *Observation 2: Due to use of polyphase filter, FB-OFDM has the simple implementation in both transmitter and receiver.*
- *Observation 3: FB-OFDM has good flexibility and adaptability in choosing pulse functions and symbol intervals.*
- *Observation 4: Polyphase filter can be used with various OFDM-based multi-carrier waveforms. It is beneficial to make the NR waveform compatible with polyphase filter for the NR forward compatibility.*
- *Observation 5: FB-OFDM has much better OOB performance than CP-OFDM, particularly in the region closing to the edge of transmission band.*
- *Observation 6: FB-OFDM performs better than CP-OFDM when adjacent subbands have different numerologies.*
- *Proposal: To include FB-OFDM with polyphase filter as a waveform scheme in the further NR study.*

Decision: The document is noted.

R1-164619 Flexibly configured OFDM (FC-OFDM) waveform ORANGE

The document was presented by Hao Lin from Orange.

- *Proposal 1: Study FC-OFDM as a solution to enable multiple configuration modes' 'multiplexing in frequency domain, allowing necessary flexibility for the NR to support different use cases.*
- *Proposal 2: Study FC-OFDM as a solution for window design in time domain bringing advantages in terms of support of flexible numerology, coexistence of sync/non-sync transmission, spectral confinement.*

Decision: The document is noted.

R1-165011 OFDM based Waveform for 5G new radio interface Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by Karri Ranta-aho from Nokia.

- *Proposal 1: Zero prefix with short sub-band wise filter should be considered when multiplexing different numerologies at low bands.*
- *Proposal 2: PA model needs to be considered into final evaluation of sub-band wise filtered waveforms.*
- *Proposal 3: UL/DL symmetric CP-OFDMA should be used for eMBB optimized frequency band 3-40 Ghz.*
- *Proposal 4: Single carrier without carrier aggregation should be considered for frequency bands over 40 Ghz*
- *Proposal 5: Replacement of CP by zero value which are part of the symbol itself needs to be considered.*

Decision: The document is noted.

R1-164355 Circularly Pulse Shaped OFDM-based Waveform Idaho National Laboratory

The document was presented by Ramon Khalona from INL.

- *Proposal: DFT-S-OFDM should be considered as the baseline waveform for the uplink due its PAPR performance.*
- *Proposal: Filtering/windowing techniques must be added to the DFT-S-OFDM to improve its OOB characteristics.*
- *Observation: To meet the NR requirements such as improving battery life of the mMTC and D2D devices new functionalities must be added to improve the existing OFDM-based DFT-S-OFDM waveform.*
- *Observation: Circular Pulse Shaping provides significant gain of at least 1.2dB and at least 3.2dB over DFT-S-OFDM and OFDM respectively.*
- *Proposal: RAN1 should consider SC-CPS-FDMA because of its improved PAPR performance over SC-FDMA while still providing all the benefits of SC-FDMA.*
- *Observation: SC-CPS-OFDM is amicable to MIMO technologies and provides greater flexibility for CFO compensation.*

Decision: The document is noted.

R1-165035 [NR] 5G waveforms PAPR and out of channel emissions measurements Skyworks Solutions Inc.

The document was presented by Dominique Brunel from Skyworks.

- *Proposal 1: Refocus efforts on reduced PAPR for the 5G NR UL, whether*
 - *Retaining the present PAPR performance of single-carrier SC-FDMA as in LTE-A,*
 - *Revisiting encoding and multiple access schemes that enable PAPR reduction, and*
 - *Explore alternative means to guarantee out-of-channel emissions than simply to rely on native PA linearity at significant DC current consumption penalty for the UE.*
- *Proposal 2*
 - *LTE and Wi-Fi PA measurements results with candidate waveforms shall serve as the benchmark for modelling.*
 - *Impact of memory effect for higher frequencies and wider bandwidths as intended by NR/5G shall be assessed for power amplifier modelling.*
- *Observation 1*
 - *For a fully allocated channel, at the output of the PA, initial waveform localization properties are lost and out-of-channel spectral emissions are degraded to the same values limited by the PA nonlinearity.*

- For a fully allocated channel, higher PAPR waveforms result in lower transmitted power and reduced DC efficiency
- Observation 2
 - For a partially allocated channel, at the output of the PA initial waveform localization properties are lost and out-of-channel emissions are degraded to the same values limited by the PA nonlinearity
 - For a partially allocated channel, higher PAPR waveforms result in lower transmitted power and reduced DC efficiency
- Observation 3: Both LTE high band and Wi-Fi 5GHz high performance PAs are good candidates for modelling and testing NR waveforms at less than 6GHz frequencies for channel bandwidths at least equal to 200MHz.
- Observation 4: Simple AM/AM + AM/PM model is not representative of power amplifier non linear behaviour for wide bandwidth and/or frequencies higher than 6GHz. Models accounting for memory effects, bias network bandwidth limitations, etc. should be studied in order to refine the accuracy and predictability of such models. Application of PA models for mm Wave will also need to be inclusive of additional parasitics and test method limitations.

Decision: The document is noted.

R1-165113 OFDM-Based Waveform With Precoding Techniques National Taiwan University

The document was presented by ... from NTU.

- Proposal: For any OFDM-based waveform, both frequency-domain precoding and time-domain filtering techniques for low OOB shall be considered.
- Observation: GFDM can be regarded as a precoded-OFDM waveform that meets the objective of this study item [1]:
 - Fundamental physical layer signal structure for new RAT
 - Waveform based on OFDM, with potential support of non-orthogonal waveform and multiple access

Decision: The document is noted.

R1-165257 Link level evaluation of waveforms for open-loop synchronized Uplink KDDI Corporation

The document was presented by ... from KDDI.

- *Observation 1: In an open-loop synchronized Uplink scenario, ZT-OFDM presents performance close to the case with zero delay for moderate SNR and reaches an error floor (below BLER = $1e-2$ for 16-QAM) at high SNR.*
- *Observation 2: In an open-loop synchronized Uplink scenario, the use of low power tail truncation, in addition to providing potential energy saving gains, appears beneficial to the performance when performed at a local minimum of the low power tail of the time-domain waveform.*
- *Proposal: We suggest that in future evaluations, the case in which the ratio of IDFT and DFT sizes at the transmitter is an integer may be considered, as it results in specific time-domain characteristics of the ZT-OFDM waveform with the potential to increase the performance gain obtained by truncation of the low power tail.*

Decision: The document is noted.

R1-164028 Link-level evaluation results for UW-DFT-s-OFDM Mitsubishi Electric Co.

The document was presented by Cristina Ciochina-Duchesne from Mitsubishi.

- Observation 1: UW DFT-s-OFDM has superior OoB suppression performance with respect to SC-FDMA.
- Observation 2: UW-DFT-s-OFDM and SC-FDMA have the same PAPR performance.
- Observation 3: DFT-FDE-IDFT modules in LTE-SC-FDMA can be used for UW-DFT-s-OFDM and CP removal module is not needed
- Observation 4: UW serves as CP and sufficient FER performance can be obtained by controlling length of UW
- Observation 5: At the OOB target 26.3dB, UW DFT-s-OFDM outperforms SC-FDMA at SNR below 30dB in the ETU channel. In the EPA channel, UW DFT-s-OFDM outperforms SC-FDMA.
- Observation 6: UW-DFT-s-OFDM is robust against interference from adjacent channels
- Observation 7: UW-DFT-s-OFDM is a waveform with suppressed OOB, robust performance in multipath fading and tolerance against adjacent channel interference.
- Proposal 1: Investigate UW-DFT-s-OFDM as a potential waveform candidate
- Proposal 2: Investigate location and length of UW for UW-DFT-s-OFDM to achieve the best tradeoff

Decision: The document is noted.

R1-165620 Performance Results for OTFS Modulation Cohere Technologies

The document was presented by ... from Cohere and provides performance comparisons showing the superior performance of OTFS especially in the high mobility (high speed train) use case; 6 dB improvement or more is seen at vehicle speeds of 500 Km/h. This kind of improvement can allow high throughput operation in high mobility cases without requiring increasing the subcarrier spacing and incurring the increased CP overhead associated with a larger subcarrier spacing.

Decision: The document is noted.

R1-165108 Waveform candidates for NR Motorola Mobility

The document was presented by ... from MotM.

- RAN1 should consider additional criteria/metrics for evaluation of waveforms for downlink and uplink, such as complexity/efficiency of pilot signal generation/channel estimation, integration/pairing with MIMO, latency/efficiency of short-packets transmission / reception, time/frequency synchronization robustness.
 - A metric may have a different degree of importance for sub-6Hz and >6GHz frequency bands.
- The criteria/metrics should be used to study benefits of new waveforms over LTE OFDM/SC-FDM waveform with improved (e.g., 95%) bandwidth occupancy.

Decision: The document is noted.

R1-165648 WF on OFDM based waveform in NR Samsung

- The following OFDM-based waveform variants should be evaluated for RAN1 NR waveform candidates
 - OFDM with guard interval (e.g., CP, ZP, ...)
 - DFT-s-OFDM with guard interval
 - SC-FDE with guard interval can be considered as a special case of DFT-s-OFDM
 - Note: Each company should provide details on the DFT-spreading, filtering/windowing applied to OFDM waveform for evaluation
 - RAN1 strives for minimization of the number of waveform(s) supported in NR considering performance, specification impact, and UE/eNB complexity

Discussion: Huawei → no real progress compared to what has been already agreed.

Decision: The document is noted.

Possible agreements:

- The following OFDM-based waveform variants should be evaluated for RAN1 NR waveform candidates
 - OFDM with guard interval (e.g., CP, ZP, ...)
 - DFT-s-OFDM with guard interval
 - SC-FDE with guard interval can be considered as a special case of DFT-s-OFDM
 - Filtering and/or windowing on OFDM/DFT-s-OFDM with guard interval
 - Note: Each company should provide details on the DFT-spreading, filtering/windowing applied to OFDM waveform for evaluation
 - RAN1 strives for minimization of the number of waveform(s) supported in NR considering performance, specification impact, and UE/eNB complexity

Wednesday:

Agreements:

- The following OFDM-based waveforms should be used as RAN1 NR waveform performance reference:
 - OFDM with CP
 - DFT-s-OFDM with CP
- All waveform in RAN1 #84bis/#85 meeting can be evaluated based on agreed assumptions
 - Note: Each company should provide details on the DFT-spreading, guard interval, Tx/Rx filtering and/or windowing applied to OFDM waveform for evaluation

R1-165665 WF on definition of OFDM based waveform Spreadtrum, Orange, Sony, Cohere, NTU

The document was presented by Jinhui Chen from Spreadtrum.

- Definition: An OFDM-based waveform is a waveform based on IDFT(IFFT) operation.
 - Includes at least CP-OFDM, OFDM-WOLA, f-OFDM, FB-OFDM, UPMC, GFDM, W-OFDM, FBMC-OQAM, FC-OFDM, UW DFT-S-OFDM, GI DFT-S-OFDM, DFT-S-OFDM, variants of DFT-S-OFDM, OTFS, etc.

Discussion: Spreadtrum very upset and stressed for targetting to select/narrow-down options without much evaluation results been presented yet.

Decision: The document is noted.

R1-165666 Way forward on categorization of IFFT-based waveform candidates Orange, Spreadtrum, InterDigital, ZTE, Cohere, Telstra

Categorization of IFFT-based waveform candidates can be summarized as:

	time domain windowing	time domain filtering	w.o. windowing/filtering
multi-carrier (MC)	FBMC-OQAM FB-OFDM FC-OFDM GFDM W-OFDM OTFS*	f-OFDM FCP-OFDM UF-OFDM OTFS*	CP-OFDM OTFS

single-carrier (SC)	DFT spreading + TDW MC candidates	DFT spreading + TDF MC candidates	
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* Application of time domain windowing or filtering to OTFS is FFS

Decision: The document is noted.

Thursday

[R1-165857](#) Summary and observations on simulation results in Cases 1a, 1b and 2 Spreadtrum, Orange, National Taiwan University, ZTE

- Observation: Under the given simulation assumptions, most new waveforms discussed so far outperform CP-OFDM/DFT-S-OFDM(SC-FDMA) for Case 1a, 1b, 2.

Decision: The document is noted.

Not treated

R1-163989	Waveform for NR	Samsung
R1-163990	Preliminary evaluation results for OFDMA-based waveforms	Samsung
R1-163991	Orthogonal vs. non-orthogonal waveforms for NR	Samsung
R1-164176	Discussion on waveform for high frequency bands	Intel Corporation
R1-164177	Link-level evaluation of filtered/windowed OFDM	Intel Corporation
R1-164266	Simulation results of new waveform in case 1a and 1b	ZTE
R1-164267	Simulation results of new waveform in case 2	ZTE
R1-164327	On coexistence of new waveforms for NR	Fujitsu
R1-164369	Discussion on waveform for high frequencies	Huawei, HiSilicon
R1-164588	Initial LLS evaluation results of NR waveforms under case 1a/1b/2	Spreadtrum Communications
R1-164629	On OFDM in NR	Ericsson
R1-164655	Discussion on filtered waveform for NR	Sony
R1-164684	Single carrier waveform evaluation	Qualcomm Incorporated
R1-164687	mmW waveform selection considerations	Qualcomm Incorporated
R1-165012	New radio waveforms for the Multi-Service Air Interface below 6 GHz	Nokia, Alcatel-Lucent Shanghai Bell
R1-165013	Initial uplink performance results for new radio waveform for below 6GHz	Nokia, Alcatel-Lucent
Shanghai Bell		
R1-165014	Subband-wise filtered OFDM for New Radio below 6 GHz	Nokia, Alcatel-Lucent Shanghai Bell
R1-165015	Waveform proposal for carrier frequencies beyond 40 GHz	Nokia, Alcatel-Lucent Shanghai Bell
R1-165016	Potential for system level gains for low-PAPR waveforms	Nokia, Alcatel-Lucent Shanghai Bell
R1-165057	Performance Evaluation of UW DFT-S-OFDM for UL	INTERDIGITAL COMMUNICATIONS
R1-165065	Discussion on Unique Word DFT-S-OFDM Waveform for New Radio	INTERDIGITAL COMMUNICATIONS, Mitsubishi Electric
R1-165114	Evaluation of OFDM-Based Waveforms	National Taiwan University
R1-165161	Initial link level evaluation result for NR waveform	MediaTek Inc.
R1-165173	Comparison of candidate waveforms	NTT DOCOMO, INC.
R1-165401	Initial downlink performance results for new radio waveform for below 6GHz	Nokia, Alcatel-Lucent
Shanghai Bell		
R1-165422	Performance of GPO and OFDM with PA model and windowing	IITH, CEWiT, Reliance-jio, Tejas Networks
R1-165423	Performance evaluation of FC-OFDM	ORANGE
R1-165425	f-OFDM scheme and filter design	Huawei, HiSilicon
R1-165426	Link level evaluation results of waveform proposals	Huawei, HiSilicon
R1-165434	Initial Evaluation Result for waveform	LG Electronics
R1-165580	OFDM based waveform single user evaluation	Qualcomm Incorporated
R1-165581	OFDM based waveform multi-user evaluation	Qualcomm Incorporated
R1-165584	Design target and initial evaluation results on waveform for NR	Panasonic Corporation

7.1.3.2 Multiple access scheme

[R1-163992](#) Non-orthogonal multiple access candidate for NR Samsung

The document was presented by ... from Samsung.

- *Observation 1: The aforementioned NoMA schemes have potential to accommodate more users with limited resource, which is subject to the availability of well-designed codebooks or code sequences. It may be challenging to provide well-designed code resources for multiplexing large number of UEs in one dimension with a view to future proof.*
- *Observation 2: To bring NoMA supporting large number of UEs into reality, multi-user detection (MUD) with practically feasible complexity MUST be viable, which needs further careful verification.*

- *Observation 3: IGMA provides flexibility to choose bit level interleavers and/or grid mapping pattern to separate users. With the abundant source generated by bit-level interleavers and grid mapping patterns, the scalability to support different connection densities could be easily supported.*
- *Observation 4: The symbol-level interleaving randomizes the symbol sequence order, which may further bring benefit in terms of combating frequency selective fading and inter-cell interference.*
- *Observation 5: The IGMA scheme could apply relatively low-complexity multi-user detector and sparse grid mapping pattern could further reduce detection complexity.*
- *Proposal 1: the interleaver-based multiple access scheme (IGMA) should be evaluated as a candidate multiple access scheme for NR.*
- *Proposal 2: The proposed NoMA schemes should be evaluated taking into account their performance improvements, impact on receiver complexity, and feasibility of required specification support.*

Decision: The document is noted.

R1-164329 Initial LLS results for UL non-orthogonal multiple access Fujitsu

The document was presented by ... from Fujitsu.

- *Observation 1: LDS CDMA seems to be a simple and effective multiple access scheme.*
- *Observation 2: RE mapping across RBs has the potential to save reference signals and gain from diversity.*
- *Observation 3: User signature vector extension by transforming two signature vectors into a larger vector has a potential to further exploit diversity gain.*
- *Proposal 1: Consider RE mapping across RBs for LDS (low density spreading) types of multiple access.*
- *Proposal 2: User signature vector extension can be considered for performance enhancement.*
- *Proposal 3: Consider LDS CDMA as a candidate multiple access scheme.*

Decision: The document is noted.

R1-164656 Consideration on the Non-Orthogonal Multiple Access for NR Sony

The document was presented by ... from Sony.

- *Proposal 1: The power domain NOMA and the code domain NOMA, which includes the “Spreading”, “Scrambling” and/or “Interleaving” functions, should be considered.*
- *Proposal 2: RAN1 should consider new specific information which all superposed UEs can know without assistance information to ease the use of NOMA technologies.*

Decision: The document is noted.

R1-165019 Non-orthogonal multiple access for New Radio Nokia, Alcatel-Lucent Shanghai Bell

The document was presented by ... from Nokia.

- *Proposal 1: Both spreading and non-spreading based non-orthogonal multiple access shall be considered, targeting for diversified NR usage scenarios and use cases.*
- *Proposal 2: The design of the non-orthogonal multiple access needs to joint consider: the supported number of connections, the receiver complexity, the flexibility of resource allocation, the PAPR impact, the standard impact.*
- *Proposal 3: Non-orthogonal coded access (NOCA) using LTE defined low correlation sequences is taken as the baseline for spreading based non-orthogonal multiple access.*

Decision: The document is noted.

R1-165021 Performance of Interleave Division Multiple Access (IDMA) in combination with OFDM family waveforms Nokia, Alcatel-Lucent Shanghai Bell

Proposal: Investigate IDMA and its combination with OFDM family waveforms w.r.t. frequency diversity gain, complexity and its potential in uplink in conjunction with service requirements (such as suitability for machine type communication with relaxed timing alignment).

Decision: The document is noted.

R1-165004 Contention based multiple access for NR uplink Sharp

The document was presented by ... from Sharp.

- *Multiple access scheme candidates should be categorized based on the principle of access scheme, e.g., code, or power.*
- *Multiple access scheme candidates should be studied considering their pros and cons, their ability to maximize KPIs for the NR RAT, and whether KPIs can be enhanced by combining aspects of these schemes.*

Proposals:

- *Each company is encouraged to report the receiver assumption and whether time-domain partial contention occurs or not in the evaluation.*
- *RAN1 should clarify not only system bandwidth but also transmission bandwidth of mMTC UEs for evaluations.*

Decision: The document is noted.

R1-164869 Low code rate and signature based multiple access scheme for New Radio ETRI

The document was presented by ... from ETRI.

- *Proposal 1: Non-orthogonal multiple access with asynchronous transmission should be investigated/evaluated for the uplink of mMTC.*
- *Proposal 2: At least for mMTC, LSSA can be considered as a candidate for non-orthogonal multiple access scheme, supporting massive connectivity and low power consumption.*

Decision: The document is noted.

R1-165653 WF on scenarios for non-orthogonal multiple access CATT

The document was presented by Yanping Xing from CATT.

- Besides the study of DL transmission from single TP, study multiple data streams from different TPs transmitting to a UE with non-orthogonal multiple access scheme for eMBB
- Evaluate the above scheme in the following scenarios
 - dense urban with two-layers
 - Indoor hotspot

Decision: The document is noted. Continue offline discussion.

Wednesday: CATT suggested continuing until next meeting.

R1-165618 WF on categorizing candidate multiple access schemes for NR CMCC, Huawei, HiSilicon, CATT

The document was presented by ... from CMCC.

- The Non-orthogonal MA can be categorized based on their way to superpose users:
- Category 1: Spreading based (e.g., MUSA, PDMA, SCMA etc)
 - Subcategories for the above categories are FFS.
- Category 2: Non-spreading based (e.g., NOMA etc)
- NR MA should support flexible selection and / or adjustment between orthogonal MA and non-orthogonal MA depending on specific conditions.

Discussion: Purpose for categorizing unclear (Ericsson)

ZTE → purpose is to assess performances for each categories

Decision: The document is noted.

Possible observations:

- More than 10 non-orthogonal MA schemes are proposed in the contribution of RAN-1 #85.
- Most proposed non-orthogonal MA schemes are Spreading based schemes.

Possible agreements:

- From preliminary LLS results presented in the extensive contributions of RAN-1 #85, non-orthogonal MA has been proved to have gain over orthogonal MA, especially in overloaded transmission scenarios.
 - The Non-orthogonal MA can be categorized based on their way to superpose users:
 - Category 1: Spreading based (e.g., MUSA, PDMA, SCMA etc)
 - Subcategories for the above categories are FFS.
 - Category 2: Non-spreading based (e.g., NOMA etc)
 - NR MA should support flexible selection and / or adjustment between orthogonal MA and non-orthogonal MA depending on specific conditions.

R1-165596 WF on categorization for multiple access schemes ZTE, ZTE Microelectronics, Qualcomm Inc.

The document was presented by Yifei Yuan from ZTE.

- For uplink mMTC scenario, the scheme categorization can be based on the way UEs' data are separated
 - Category 1: Spreading using random-like sequences or patterns
 - Examples as MUSA, RSMA, NCMA, NOCA, low code rate spreading
 - Category 2: Structured-codebook based
 - Examples as SCMA, PDMA
 - Category 3: Interleaving based
 - Examples as IGMA, IDMA

Decision: The document is noted.

R1-165702 WF on categorizing candidate multiple access schemes for NR CMCC, ZTE, Huawei, HiSilicon, CATT, Intel, INTERDIGITAL

- Non-orthogonal multiple access schemes can be categorized based on the ways to separate different users:
 - Category 1: Code domain based
 - Category 2: Interleaver based
 - Category 3: Power domain based
 - Schemes that have features of combined categories are not precluded.

Discussion: Intel withdrew their support.

Also supported by Qualcomm, Spreadtrum.

LGE: at least an answer regarding their concern should be provided – what are the motivations of these categorizations?

DOCOMO: concern how the simulation results can/will be exploited?

Decision: The document is noted. Continue offline discussion.

R1-165595 WF on scenarios for multiple access ZTE, ZTE Microelectronics, InterDigital, Qualcomm Inc., Spreadtrum

The document was presented by Yifei Yuan from ZTE.

- Autonomous/grant-free/contention based UL non-orthogonal multiple access has the following characteristics
 - A transmission from UE does not need the dynamic and explicit scheduling grant from eNB
 - Each time in transmission, a UE randomly chooses a code/sequence or a pattern of interleaver from a pool known to eNB and UE before hand
 - Multiple UEs can share the same time and frequency resources
- For autonomous/grant-free/contention based UL non-orthogonal multiple access, the following should be studied
 - Collision of code/sequence/interleaver pattern from different UEs but on the same resource
 - Potentially relaxed requirement for UL synchronization (DL synchronization assumed)
 - Case 1: Timing offsets between UEs are within a cyclic prefix
 - Case 2: Timing offsets between UEs can be greater than a cyclic prefix, FFS the exact model of timing offsets
 - Potentially relaxed requirement for power control, i.e., no closed-loop
 - Case 1: Perfect open-loop power control, i.e., equal average SNR between UEs
 - Case 2: Realistic open-loop power control with certain alpha and P0 values
 - Case 3: no power control

Discussion: Also supported by ETRI.

Decision: The document is noted, modified and agreed as follows:

Agreements:

- Autonomous/grant-free/contention based UL non-orthogonal multiple access has the following characteristics
 - A transmission from UE does not need the dynamic and explicit scheduling grant from eNB
 - Multiple UEs can share the same time and frequency resources
- For autonomous/grant-free/contention based UL non-orthogonal multiple access, the following should be studied
 - Collision of time/frequency resources from different UEs, solutions potentially including
 - E.g., code, sequence, interleaver pattern
 - UL synchronization (DL synchronization assumed)
 - Case 1: Timing offsets between UEs are within a cyclic prefix
 - Case 2: Timing offsets between UEs can be greater than a cyclic prefix, FFS the exact model of timing offsets
 - Requirement for power control
 - Case 1: Perfect open-loop power control, i.e., equal average SNR between UEs for potentially link level calibration
 - Case 2: Realistic open-loop power control with certain alpha and P0 values
 - Case 3: Close-loop power control
 - Receiver impact

R1-165656 WF on multiple access scheme for NR Uplink NTT DOCOMO, Panasonic, LG

The document was presented by Ryosuke Osawa from NTT DOCOMO.

- Synchronous/UL grant-based orthogonal multiple access should be considered as the baseline UL transmission scheme at least for eMBB
 - Note: Synchronous means that timing offset between UEs is within cyclic prefix by e.g. timing alignment

Decision: The document is noted and agreed as follows:

Agreements:

- NR supports at least synchronous/scheduling-based orthogonal multiple access for DL/UL transmission schemes, at least targeting for eMBB
 - Note: Synchronous means that timing offset between UEs is within cyclic prefix by e.g. timing alignment

Wednesday

R1-165816 WF on considerations for multiple access LG Electronics, Ericsson

- For the study on multiple access,
 - Benefits of multiple access schemes should be assessed in considerations of other features especially MIMO aspect with larger number of antenna ports as below:
 - at least 8 at eNB side
 - at least 4 at UE side for eMBB usage scenario

Decision: The document is noted.

Not treated

R1-163993	Non-Orthogonal Multiple Access Considerations for NR	Samsung
R1-164036	Multiple access for UL small packets transmission	Huawei, HiSilicon
R1-164037	LLS results for uplink multiple access	Huawei, HiSilicon
R1-164178	Uplink non-orthogonal multiple access for NR access technology	Intel Corporation
R1-164246	Discussion on scenarios and use cases for MA	CATT
R1-164247	Performance on LLS of PDMA	CATT
R1-164268	Grant-based and grant-free multiple access for mMTC	ZTE
R1-164269	Contention-based non-orthogonal multiple access for UL mMTC	ZTE
R1-164270	Receiver implementation for MUSA	ZTE
R1-164346	MA for eMBB in mmWave spectrum	Fiberhome Technologies Group
R1-164354	Underlay Common Control Channel for Unlicensed Spectrum Access and Underlay Low-Rate Data Channel for Licensed Spectrum	Idaho National Laboratory
R1-164370	SLS evaluation methodology for grant-free based multiple access	Huawei, HiSilicon
R1-164557	Initial LLS Evaluation Result for NoMA	LG Electronics
R1-164558	Multiple Access scheme for eMBB	LG Electronics
R1-164634	Instant uplink access	Ericsson
R1-164672	NR multiple access	Ericsson
R1-164688	RSMA	Qualcomm Incorporated
R1-164689	RSMA and SCMA comparison	Qualcomm Incorporated
R1-164876	Design target on multiple access schemes for NR	Panasonic Corporation
R1-164889	Analytical Evaluation of Multiple Access and Preliminary Results	CMCC
R1-165017	Scheduled TDMA-OFDMA for NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-165020	Contention-based non-orthogonal multiple access with frequency hopping for mMTC uplink	Nokia, Alcatel-Lucent Shanghai Bell
R1-165022	Uplink contention-based access in 5G New Radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-165023	Scheduling framework and related requirements	Nokia, Alcatel-Lucent Shanghai Bell
R1-165058	Performance Evaluation of Asynchronous UL NOMA	INTERDIGITAL COMMUNICATIONS
R1-165174	Uplink multiple access schemes for NR	NTT DOCOMO, INC.
R1-165175	Initial views and evaluation results on non-orthogonal multiple access for NR	NTT DOCOMO, INC.
R1-165410	Initial link level simulation results of new multiple access scheme	CATR
R1-165416	Overview of the proposed non-orthogonal MA schemes	Nokia, Alcatel-Lucent Shanghai Bell
R1-165435	Initial LLS evaluation results on multiple access schemes	Spreadtrum Communications
R1-165554	Proposed TR structure for Multiple Access Studies	Huawei, HiSilicon
R1-165619	Transceiver implementation and complexity analysis for SCMA	Huawei, HiSilicon

7.1.4 Numerology and frame structure for new radio interface

[R1-165112](#) NR Numerology Design Principles Qualcomm Incorporated

The document was presented by Jing Jiang from Qualcomm and proposes the following Way Forward:

- In RAN1 #85, RAN1 could agree on the scaling methodology in frequency:
 - The subcarrier spacing for the NR scalable numerology should scale as
 - $f_{sc} = f_0 * 2^m$
 - where
 - f_0 is FFS
 - m is an integer chosen from a set of possible values
- In RAN1 #86, RAN1 could agree on the specific values of
 - f_0 and m

Decision: The document is noted.

[R1-164692](#) Numerology and TTI multiplexing for NR Forward Compatibility Analysis Qualcomm Incorporated

- Proposal 1: NR should support multiplexing of services of different numerologies in the same carrier.
- Proposal 2: NR should support short subframes by scaling the number of symbols.
- Proposal 3: NR should support low latency services with short subframes by scaling up SCS (i.e., scaling down symbol duration).
- Proposal 4: scaled numerology should have multi-symbol unit aligned with the symbol boundary of the original numerology for efficient numerology multiplexing.
- Proposal 5: subframe interval and boundary should aligned irrespective of the underlying PHY numerology for efficiency and simplicity.
- Proposal 6: power of 2 symbols numerology should be considered jointly with NR frame structure, URLLC forward compatibility design.

Decision: The document is noted.

R1-164271 Overview of numerology candidates ZTE

The document was presented by Thorsten Schier from ZTE.

- Observation 1: Alt 1 (NCP) 15 kHz and Alt 3 17.07 kHz have similar performance, also for very long DS. Alt 3 outperforms Alt 1 when achieving low-latency subframes (0.125 ms) at very long DS.
- Observation 2: Mixed-radix DFT complexity is not more than 28% higher than FFT. Mixed-radix DFT provides additional flexibility.
- Observation 3: Alt 2-4 have better forward compatibility for a smooth evolution to fewer symbols per subframe.
- Proposal 1: A mixed-radix DFT approach should be adopted, so that a smooth introduction of future features and services that may require new unscaled CP durations is ensured, without changing the unscaled symbol durations or the frame structure.
- Observation 4: All numerology candidates offer co-existence with LTE and NB-IoT.
- Proposal 2: A numerology with 2^m symbols (m is an integer) per subframe is adopted in NR.
- Proposal 3: NR adopts numerologies based on Alt 3.

Decision: The document is noted.

R1-164031 Analysis and comparison on numerology candidates Huawei, HiSilicon

The document was presented by David Mazzaresse from Huawei and provides the comparison of 15kHz family and 17.5kHz family summarized in Table4, and considering the performance in **Error! Reference source not found.**[R1-164030](#) which shows 15kHz outperforms 17.5kHz family, 15kHz family subcarrier spacing is proposed for NR.

Discussion: Qualcomm does not agree with “For NR using 15kHz, there is no interference between NR and NB-IOT”

Decision: The document is noted.

Qualcomm suggested more offline discussion on:

How to achieve reduced latency?

How to achieve multiplexing efficiency?

How to align TTI/ symbol boundary

How to fix overhead for normal CP?

R1-164622 NR numerology Ericsson

The document was presented by Stefan Parkvall from Ericsson.

- RAN1 concludes on alternative 1 (Subcarrier-spacing values include 15 kHz subcarrier-spacing (i.e., “LTE-based” numerology)) as the baseline for the NR numerology
- RAN1 concludes on scale factors $N=2^n$ as the baseline for the NR numerology.

Decision: The document is noted.

R1-165439 Views on numerology for NR NTT DOCOMO, INC.

The document was presented by Fred Takeda from NTT DOCOMO.

- Observation 1: Possible subcarrier spacing is determined by $f_0 \cdot 2^m$ where m is an integer.
 - $f_0=15\text{kHz}$ and m is an integer.
- Observation 2: Fixed CP overhead ratio for different subcarrier-spacing would be sufficient as normal CP operation.

The following table is proposed as a starting point.

	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7	Set z
SC-spacing (kHz)	15	30	60	120	240	480	960	...
CC BW (MHz)	X	2X	4X	8X	16X	32X	64X	...
Symbol length (us)	66.67	33.33	16.67	8.33	4.17	2.08	1.04	...
CP-length (us)	4.69	2.34	1.17	0.59	0.29	0.15	0.07	...
SF length (ms)	TBD after identifying detailed scheduling operations in NR							
Frame length (ms)	Periodicity of fixed DL resources can be a starting value							
Note	At least it is necessary to cover $X=20$, and it is beneficial to cover $X=40$ FFS further wider bandwidth							

Decision: The document is noted.

R1-165525 Discussion on NR numerology KT Corp., Verizon Wireless

The document was presented by Hyojin Lee from KT.

Proposal 1:

- *LTE based numerology including 15 kHz subcarrier-spacing should be the baseline for NR design*
- *Alternative proposals have to be justified based on concrete use cases and significant benefits in performance or implementation perspective*

Observation 1: Taking into account available BW for NR, there are some deployment cases that cannot be efficiently supported only with 2^m scaling values for subcarrier spacing

Observation 2:

- *The scalable way as agreed in RAN1#84bis would be beneficial for different carrier frequencies since a basic frame structure and design can be easily re-used*
- *However, it is quite difficult to find any reason why the scaling to support different carrier frequencies should be restricted in 2^m values.*

Observation 3:

- *Since the basic NR system operation would be for eMBB services in most cases, it would be a sufficient design requirement that subcarrier spacing values for URLLC and mMTC should be multiplies or divisors of the one for eMBB rather than 2^m scaling relationship*
- *More important design factors should be the requirements derived for different use cases in [TR 22.891] and [TR 38.913]*

Proposal 2: The scalable numerologies should be designed under the assumption of linear scaling values rather than being restricted in 2^m scaling values taking into account the following three aspects:

- *To efficiently utilize available 5G bandwidths*
- *To cover wide range of target frequency up to 100GHz*
- *To support multiple use cases in the same carrier frequency*

Decision: The document is noted.

R1-165517

WF on scaling of subcarrier spacing in NR

Samsung, Intel, KT Corp., Verizon Wireless,

Fiberhome

- $f_{sc} = f_0 * M$ (Alt. 2) should be taken into account as the scaling method of subcarrier spacing in NR SI where $f_0 = 15$ kHz.
- Subcarrier spacing values to be studied in NR SI include at least
 - {15, 30, 60, 75, 120, 150, 240, 300} kHz

Decision: The document is noted.

Working assumption

- RAN1 concludes on alternative 1 (15 kHz) as the baseline design assumption for the NR numerology
- RAN1 concludes on scale factors $N = 2^n$ for subcarrier spacing as the baseline design assumption for the NR numerology.

Supported by Ericsson, MediaTek, Fujitsu, Panasonic, Nokia, ASB, LGE, Huawei, HiSilicon, NTT DOCOMO, Sharp, CATT, ETRI, ITRI

CMCC: object to the working assumption

Qualcomm: does not agree with 1st bullet

KT: this represents a majority's view, no consensus - should not be taken as a working assumption

Ericsson: it can always be revisited at next meeting if deemed necessary

NTT DOCOMO: if WA is to be rediscussed, should be wise to define a deadline for bringing any critical issues up – otherwise we enter in an endless discussion

Possible working assumption (CMCC, Qualcomm, KT)

- RAN1 concludes on scale factors $N = 2^n$ as the baseline design assumption for the number of OFDM symbols per 1ms

Continue offline: CMCC

Possible conclusions:

- If RAN1 finds issues about above WA including the following criteria, RAN1 should compare WA and “scale factors $N = 2^n$ as the baseline design assumption for the number of OFDM symbols per 1 msec” by Wednesday
 - Design complexity
 - Compatibility of different numerology from time domain and frequency domain
 - Latency
 - Multiplexing efficiency
 - TTI/symbol boundary alignment
 - Overhead of Normal CP
 - Coexistence with NB-IoT and LTE

- Scalable set of supportable CC BW

[R1-165583](#) **WF on Scalable Numerology Symbol Boundary Alignment**
OPPO, Panasonic, DoCoMo, Deutsch Telecom, Convida Wireless,
Decision: The document is noted. Continue offline discussion until Wednesday

Qualcomm, ZTE, ETRI, NEC,

Wednesday

[R1-165821](#) **WF on Scalable Numerology Symbol Boundary Alignment**
Fujitsu, NTT DOCOMO
Decision: The document is noted.

Panasonic, InterDigital, Ericsson,

Possible agreements:

- In case of $F_0=15$ kHz, with $F_s=15$ kHz symbol boundary of normal CP is aligned with LTE.
- For scaled numerology $F_s = F_0 \cdot M$, in the case where Base numerology contains N symbols per ms and scaled numerology contains $N \cdot M$ symbols per ms
 - Each symbol length (including CP) of base numerology (w/ $SCS = F_0$) equals the sum of the corresponding M symbols of scaled numerology (w/ $SCS = F_s$)
 - Each symbol may not necessarily be of the same length (e.g. in LTE numerology, symbol 0 is long than symbol 1, 2, ... 6)
 - Multiple CP durations per each numerology is not precluded:
 - For each CP family (NCP or ECP), each symbol length (including CP) of base numerology (w/ $SCS = F_0$) equals the sum of the corresponding M symbols of scaled numerology (w/ $SCS = F_s$)
- Above is not related to synchronization among multiple transmitters like network synchronization, synchronization among UEs, different NR carrier bandwidth and so on.

Continue offline discussion until Thursday – Suzuki (Panasonic)

Thursday

[R1-165886](#) **WF on Scalable Numerology Symbol Boundary Alignment**
DOCOMO, Qualcomm, Huawei, Mediatek
Decision: The document is noted.

Panasonic, Intel, Samsung, NTT

Working assumption:

- In the case of subcarrier spacing 15 kHz and 14 symbols per 1ms, the following applies:
 - Baseline: Symbol boundary is aligned with LTE of normal CP

Agreement For the numerology with 15 kHz and larger subcarrier spacing, 1 msec alignment is supported

[R1-165841](#) **WF on NR CP type** **Huawei, HiSilicon, Intel, LGE, CATT, IITH, CEWiT, Reliance-jio, Tejas Networks, Samsung, NEC, Sony, Fujitsu, Vodafone**

- Multiple CP types should be allowed for each NR subcarrier spacing

Discussion: Qualcomm → concern on complexity – why not start with 1CP, optimize it and then decide

Nokia: clearly RAN1 should concentrate on normal CP, should take design decisions that do not prevent using any future extended CP.

Ericsson: Agree with Nokia – should not preclude having multiple CPs

Huawei: believes the need for multiple CP is already there

Decision: The document is noted.

Possible agreement: Multiple CP types/lengths without having scaling subcarrier spacing should be allowed

Continue offline discussion until Thursday – David (Huawei)

Thursday

[R1-165878](#) **WF on further step on numerology study** **Huawei, CMCC, National Instruments, Ericsson, Orange, Vodafone, Panasonic**

- RAN1 should investigate the impact of supporting the following non-mutually exclusive options:
 - Multiple CP lengths by scaling subcarrier spacing using a single CP type/option, and enabling OFDM symbol alignment among scaled numerologies ([R1-165821](#))
 - Multiple CP types/options without scaling subcarrier spacing ([R1-165841](#))
 - Multiple network configuration options where the system can operate with different CP overheads ([R1-165719](#))

Decision: The document is noted.

[R1-164674](#) **see 7.1.1**

[R1-164632](#) **Flexible bandwidth in NR** **Ericsson**

Decision: The document is noted.

Agreements:

- NR should support of flexible NW and UE channel bandwidth
- FFS: NR carrier bandwidth should consider to allow efficient unlicensed spectrum access
- The NR physical-layer design should allow for fine granularity in terms of NR carrier bandwidth
- The NR physical-layer design should be such that devices with different bandwidth capabilities can efficiently access the same NR carrier regardless of the NR carrier bandwidth
 - FFS: minimum bandwidth
- FFS: There should not be an assumption that devices necessarily support the same set of bandwidths for transmission and reception
- FFS: There should not be an assumption that the network carrier bandwidth is necessarily the same for downlink and uplink

Wednesday

[R1-165731](#) **Way forward on Numerology** LG Electronics, NTT DOCOMO, Sprints, LGU+

Decision: The document is noted.

[R1-165660](#) **WF on Scalable NCP** Qualcomm Incorporated, ZTE

Decision: The document is noted.

[R1-165719](#) **Discussion on frequency-domain initiated numerology and time-domain initiated numerology**
CMCC

Decision: The document is noted.

Possible conclusions:

- RAN1 will evaluate CP length(s) for different deployments scenarios and different services
- RAN1 should carefully make decision on such kind of key parameters and design principle than dependent on more studies and evaluation. Especially full comparison from different aspects should be done to guarantee we are on the right way. Based on above observation, we propose to do some comparison from following aspects(not limited to):
 - Design complexity and future design effort
 - Overall performance
 - Compatibility of different numerology from time domain and frequency domain
 - Multiplexing efficiency
 - Latency
 - Coexistence with NB-IoT and LTE
 - Scalable set of supportable CC BW

Continue offline discussion.

Thursday

[R1-165842](#) **Proposals for evaluation of CP requirements in NR** CMCC

- To evaluate what is the minimal CP length in NR considering existed knowledge on delay spread
 - Scaled CP and Scaled numerologies Vs Unscaled CP and Scaled numerologies
 - Unscale CP assumes two values for comparison
 - Comparable NCP used in LTE, e.g., for 2^N SCS scheme, 4.71us, for 2^N OS scheme 5.36us
 - Half of Comparable NCP used in LTE, e.g., for 2^N SCS scheme, about 2.36us, for 2^N OS scheme about 2.68us

Decision: The document is noted.

Conclusion: For CP based scheme, companies are encouraged to evaluate/investigate necessary CP lengths for different numerologies

[R1-165734](#) **WF on subcarrier spacing in NR** Verizon Wireless, KT Corp., Reliance-jio, CHTTL, Samsung, Intel, Potevio, Fiberhome, IITH, CEWiT, Tejas Networks

- Working Assumption discussed on Monday should be revisited to resolve the issues identified with 2^m scaling
- Take the following as the revised working assumption on subcarrier spacing:
 - *Working assumptions*
 - RAN1 concludes on alternative 1 (15 kHz) as the baseline design assumption for the NR numerology
 - RAN1 concludes on scale factors $N = 2^n$ for subcarrier spacing as the baseline design assumption for the NR numerology
 - RAN1 should include the subcarrier spacing {75} kHz for different CC BW support

Discussion: Objection from Qualcomm, Nokia, ASB, Huawei, HiSilicon, Fujitsu adding the third bullet in the WA

Decision: The document is noted.

Thursday

[R1-165891](#) **WF on subcarrier spacing in NR** Verizon Wireless, KT Corp., Reliance-jio, CHTTL, China Telecom, Samsung, Intel, Potevio, Fiberhome, IITH, CEWiT, Tejas Networks, Straight Path, ITL, WILUS

- *Working assumptions*
 - *RAN1 concludes on alternative 1 (15 kHz) as the baseline design assumption for the NR numerology*
 - *RAN1 concludes on scale factors $N=2^n$ for subcarrier spacing as the baseline design assumption for the NR numerology*
 - *RAN1 include 75 kHz for subcarrier spacing as the additional baseline design assumption for the NR numerology*

Decision: The document is noted.

Conclusion: RAN1 will continue investigations on how to achieve effective use for variable bandwidths until the next meeting

Observations: Some companies proposed followings

- introducing a complementary scale factor leading to subcarrier spacing of 75 kHz for support of 100 MHz (in [R1-165891](#))
 - $f_0 = 17.5$ kHz subcarrier spacing ([R1-165112](#))
 - $f_0 = 17.07$ kHz subcarrier spacing ([R1-164271](#))
-

[R1-165807](#) **Way forward on timing relations for NR Frame Structure** CMCC, CATT, OPPO, MediaTek, Lenovo

Decision: The document is noted. Revised in:

[R1-165871](#) **Way forward on timing relations for NR Frame Structure** CMCC, CATT, OPPO, MediaTek, Lenovo, Huawei, HiSilicon

- NR should at least support common design of timing relation for TDD and FDD (i.e., duplex agnostic timing relation design) in the following aspects,
 - Timing relations between DL assignment and the corresponding DL data transmission
 - Timing relations between DL data and the corresponding DL data acknowledgement
 - Timing relations between UL grant and the corresponding UL data transmission
 - Timing relations between UL data and the corresponding UL data transmission
- The common design shall consider, e.g.,
 - The indication of the timing relation, e.g., DCI and/or RRC and/or others, shall be duplex agnostic.
- Note: this does not preclude any optimization for either TDD only or FDD only

Decision: The document is noted.

Agreements:

- RAN1 strives for maximizing commonality between TDD and FDD
 - It is preferable that mechanisms to indicate the timing relation are duplex agnostic
 - Note: This does not preclude any optimization either for FDD only or TDD only
-

[R1-165456](#) **Summary of email discussion on frame structure** Qualcomm Incorporated

The document was presented by Joseph Soriaga from Qualcomm.

- Potential Agreement 1: NR frame structure should defined using two basic types of time intervals: time interval A which would be expressed as multiple of symbols, and time interval B which is expressed as absolute time (nominally 1ms). An integer scaling relationship between these two time intervals may follow from the numerology for subcarrier spacing.
- Observation 1: When the time interval A is shortened/extended, the frequency granularity is also scaled to wider/narrower. One atomic block size is defined dimensioned by one time interval A and one frequency granularity.
- Potential Agreement 2: An atomic block size is basically common between paired and unpaired spectrum. Specific optimization for paired and unpaired spectrum is not precluded.
- Observation 2: There was commonality in defining time interval A to have up to one switch between DL and UL.
- Potential Agreement 3: Consideration of baseline frame structures in Table 1, but FFS multiple gaps within time interval A with respect to forward compatibility.
- Potential Agreement 4: The RS used to demodulate a data transmission is located FFS near before and/or within a time interval A. FFS whether a time interval A always has the RS used to demodulate a data transmission.
- Potential Agreement 5: The NR design should strive to reduce the time between the assignment to the corresponding data and the time between the data to the corresponding acknowledgement. FFS whether the time can be short enough so that the exchange is confined within time interval A.
- Potential Agreement 6: The scaling of time interval A is realized by the changing the number of the symbols without changing the numerology, or by the keeping the number of the symbols with changing the numerology.

Decision: The document is noted.

R1-165685 WF on Phase Noise Modeling Nokia, Alcatel-Lucent Shanghai Bell, NTT DoCoMo, Samsung, Qualcomm, Ericsson, Intel, InterDigital

PN model should be developed for evaluation of NR systems for above 6GHz with the following principles

- Proposal #1:
 - Phase noise model for UE should be considered for the evaluation by default.
 - Implementation cost, complexity and power consumption at the UE should be taken into account.
 - The PN modelling in eNB is FFS.
- Proposal #2:
 - Realistic PN model should consider total oscillator PSD including the impact of reference clock, loop filter noise and VCO sub-components. (e.g. PLL-based model, multi-pole/zero model)
 - Each company should provide the model and the parameters used for the evaluation.
- Proposal #3:
 - The oscillator PSD level increases by 20dBc/Hz per decade of increase of the carrier frequency. (Baseline)
 - A different parameter set of phase noise model can be defined for specific target frequency.
- Proposal #4:
 - Companies are encouraged to provide link level evaluation result with the phase noise model. Following phase noise models are provided as examples.
 - UE model in [R1-164041](#)
 - Proposed WF in [R1-165005](#)
 - Model A in [R1-163984](#)
 - mmMagic high and low model
 - Other phase noise model is not precluded.
 - Companies should provide which phase noise model is applied for the evaluation.

Decision: The document is noted and modified as follows:

Agreements:

- Companies should use following PN model principles for evaluation of NR for above 6GHz
 - Phase noise model for UE should be considered for the evaluation by default.
 - Implementation cost, complexity and power consumption at the UE should be taken into account.
 - The PN modelling in TRP is FFS.
 - Realistic PN model should consider total oscillator PSD including the impact of reference clock, loop filter noise and VCO sub-components. (e.g. PLL-based model, multi-pole/zero model)
 - Each company should provide the model and the parameters used for the evaluation.
 - The oscillator PSD level increases by 20dB per decade of increase of the carrier frequency as a baseline to scale PSD level
 - A different parameter set of phase noise model can be defined for specific target frequency.
 - Companies are encouraged to provide link level evaluation result with the phase noise model. Following phase noise models are provided as examples which are captured in [R1-165685](#) (in page 5 – 8)
 - UE model in [R1-164041](#)
 - Proposed WF in [R1-165005](#)
 - Model A in [R1-163984](#)
 - mmMAGIC high and low model
 - Other phase noise model is not precluded.
 - Companies should provide which phase noise model is applied for the evaluation.

R1-165575 Way Forward On Frame Structure Qualcomm, Ericsson, Panasonic, NTT Docomo, ZTE, Convida, Nokia, ASB, Sony, Intel

The document was presented by Joseph Soriaga from Qualcomm.

- At least the following is studied in NR in order to reduce decoding latency
 - RS used to demodulate a data transmission is located at the beginning of the time interval to which the data and associated RS for demodulation is physically mapped

Discussion: Also supported by InterDigital.

Decision: The document is noted, agreed as follows:

Agreements:

- At least the following is studied for NR in order to reduce decoding latency
 - RS used to start to demodulate a data transmission is located at the beginning of the time interval to which the data and associated RS for demodulation is physically mapped
- Other additional RS design associated with data demodulation is not precluded

R1-165669 Way Forward On Frame Structure Qualcomm, OPPO, MediaTek, Intel, CATT, DOCOMO, InterDigital, Samsung, Sony, ZTE, Ericsson, Panasonic, ITRI, ETRI

- At least the following should be supported for NR
 - A time interval X which can contain one or more of the following
 - DL transmission part
 - Guard
 - UL transmission part
 - Dynamic and Semi-static operations are studied
 - Furthermore, the following is supported
 - The DL transmission part of time interval X to contain downlink control information and/or downlink data transmissions and/or reference signals
 - The UL transmission part of time interval X to contain uplink control information and/or uplink data transmissions and/or reference signals
 - FFS length(s) of time interval X
 - Note: The usage of DL and UL does not preclude other deployment scenarios e.g., sidelink, backhaul, relay

Decision: The document is noted and modified as follows:

Agreements:

- At least the following should be supported for NR in a frequency portion
 - A time interval X which can contain one or more of the following
 - DL transmission part
 - Guard
 - UL transmission part
 - FFS which combinations are supported and whether they are indicated dynamically and/or semi-statically
 - Furthermore, the following is supported
 - The DL transmission part of time interval X to contain downlink control information and/or downlink data transmissions and/or reference signals
 - The UL transmission part of time interval X to contain uplink control information and/or uplink data transmissions and/or reference signals
 - FFS length(s) of time interval X
 - FFS: other characteristics of time interval X
 - Note: The usage of DL and UL does not preclude other deployment scenarios e.g., sidelink, backhaul, relay

R1-165662 WF on NR frame structure Samsung, Mediatek, Intel, NTT DOCOMO, CMCC, Panasonic, Sony, ITRI, Interdigital, LG Electronics

- At least the following is supported for NR frame structure
 - Following timing relationships are indicated to a UE dynamically and/or semi-statically
 - Timing relationship between DL data reception and corresponding acknowledgement
 - Timing relationship between UL assignment and corresponding UL data transmission
 - Following timing relationship is FFS whether fixed and/or dynamically and/or semi-statically indicated
 - Timing relationship between DL assignment and corresponding DL data reception
 - For above two sub-bullets
 - Potential values for each timing relationship has to be studied further considering e.g., UE processing capability, gap overhead, UL coverage, and etc.
 - Default value, if any, for each timing relationship is FFS.

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

R1-165700 Way Forward on Frame Structure Timing Relations Ericsson, Qualcomm, ZTE, NTT DOCOMO

Decision: The document is noted.

R1-165739 NR Frame Structure Timing Relations Ericsson

Decision: The document is noted.

Agreements:

- NR design should strive at least to enable the possibility for
 - Corresponding acknowledgement reporting shortly (in the order of X μ s) after the end of the DL data transmission
 - Corresponding uplink data transmission shortly (in the order of Y μ s) after reception of UL assignment
 - Note: may depend on e.g. UE capability/category, payload size, etc
 - FFS: X and Y in the order of a few tens of or hundreds of micro sec is feasible
- Other mechanisms/configurations in addition to fast/short corresponding acknowledgement are needed
 - For example to provide coverage or enable TD-LTE coexistence

- Note: RAN1 will continue investigations about UE complexity, implementation processing time, interleaving applicability

Thursday

R1-165818 Way Forward on frame structure for NR LG Electronics, CATT, ETRI, Lenovo

Decision: The document is noted. Revised in:

R1-165896 Way Forward on frame structure for NR LG Electronics, CATT, ETRI, Lenovo

Decision: The document is noted.

R1-165931 Way Forward on time interval for NR LG Electronics, CATT

- Following type of time interval is needed in NR
 - UE-common time interval
 - This is to be known by the UE for access to network for a given numerology
 - FFS on the length of this time interval
 - FFS on the relationship between this time interval and the time interval X, in terms of the length

Decision: The document is noted.

R1-165840 Way Forward on NR frame structure with asynchronous UL HARQ ZTE, Qualcomm, Ericsson, DOCOMO, ETRI

- NR should at least support asynchronous hybrid ARQ in the UL to avoid fixed timing relationship between initial transmission and re-transmission

Decision: The document is noted and modified as follows:

Agreement: NR should support at least asynchronous hybrid ARQ in the DL and UL to avoid fixed timing relationship between initial transmission and re-transmission

R1-165872 WF on minimum HARQ Timing LG Electronics, Panasonic

Decision: The document is noted. Revised in:

R1-165887 WF on minimum HARQ Timing LG Electronics, Panasonic, Qualcomm, NTT DOCOMO

Decision: The document is noted, modified as follows:

Agreements:

- NR design should strive to enable the possibility for
 - Corresponding retransmission shortly (in the order of $Z \mu s$) after the end of acknowledgement reporting
 - FFS: Z in the order of a few tens of or hundreds of micro sec is feasible

R1-165955 WF on time interval X Huawei, HiSilicon, Qualcomm, Nokia, ASB

- At least the following combinations with time order for time interval X should be supported
 - Combination 1: DL transmission part, a possible guard
 - Combination 2: A possible guard, uplink transmission part
 - Combination 3: A DL transmission part, a guard, and an UL transmission part

Decision: The document is noted and modified as follows:

Possible agreements:

- At least the following combinations for time interval X should be supported
 - Combination 1: DL transmission part, possible guard(s)
 - Combination 2: Possible guard(s), uplink transmission part
 - FFS: Combination 3: A DL transmission part, a guard, and an UL transmission part

Continue offline discussion until Friday – (Huawei)

Friday

R1-166013 WF on time interval X Huawei, HiSilicon, Qualcomm, Nokia, ASB

Decision: The document is noted.

R1-165877 WF on wireless relay/backhaul for NR Samsung, AT&T, Ericsson

Decision: The document is noted.

R1-165902 WF on wireless backhaul for NR Samsung, AT&T, Ericsson, Intel, IITH, CEWiT, Tejas Networks, Reliance-jio, Straight Path

- NR should allow for efficient same frequency operation between the access link and backhaul link.
- NR should also allow for efficient operation when the backhaul link and access link are on different frequencies. This includes:
 - Operation of backhaul link and access link on different frequencies in the same band
 - Operation of backhaul link and access link in different bands

- Note: The term ‘backhaul link’ does not make any assumption on NR RAN architecture design options

Decision: The document is agreed.

Friday

[R1-165990](#) **WF on Frame Structure and Evaluation** **Qualcomm, Huawei, HiSilicon, NTT DOCOMO, Ericsson**

Decision: The document is noted. Also supported by ZTE, Panasonic. Revised in:

[R1-166027](#) **WF on Frame Structure and Evaluation** **Qualcomm, Panasonic, NTT DOCOMO, KT Corp, MediaTek, Intel**

Decision: The document is noted and modified as follows:

Agreements:

- At least the following time domain structures should be studied/evaluated for NR
 - DL transmission region (containing data assignments and data), guard region, UL transmission region (containing UCI)
 - DL transmission region (containing data assignments), guard region, UL transmission region (containing data, UCI)
 - Other structures not precluded
 - Note: there is no assumption between the relationship of assignments and data in the above
 - FFS: there can be guard region after the uplink transmission region.
- FFS: Study candidate solutions where 1 structure spans at most a time interval of 1 ms
- FFS: Metrics for study/evaluation
- Note: This does not preclude the same structure could span multiple 1 msec

Not treated

R1-163994	Discussions on control signaling for NR	Samsung
R1-163995	Discussions on reference signal design for NR	Samsung
R1-163996	Discussion on the base subcarrier spacing for NR	Samsung
R1-163997	Cell search for NR: design consideration	Samsung
R1-163998	Proposed set of numerologies for NR	Samsung
R1-163999	Discussion on different scaling methods for NR subcarrier spacing	Samsung
R1-164000	Unified framework for NR physical layer	Samsung
R1-164001	Framework for multiplexing verticals in NR	Samsung
R1-164002	Design aspects of URLLC for NR	Samsung
R1-164003	Dynamic TDD for NR	Samsung
R1-164004	Discussion on TTI, subframe and signaling timing for NR	Samsung
R1-164005	Support of wireless relay for NR	Samsung
R1-164006	Design aspects of mMTC for NR	Samsung
R1-164030	Evaluation of scalable numerology proposals	Huawei, HiSilicon
R1-164032	Discussion on frame structure for NR	Huawei, HiSilicon
R1-164179	Subcarrier spacing and scaling for new RAT	Intel Corporation
R1-164180	Low Latency Frame Structure Design for NR	Intel Corporation
R1-164181	NR Operation in Unlicensed Spectrum	Intel Corporation
R1-164248	NR frame structure design CATT	
R1-164249	Discussion of NR numerology	CATT
R1-164261	Forward compatibility of numerology and frame structure design	ZTE
R1-164272	Performance evaluation of numerology candidates	ZTE
R1-164273	Frequency multiplexing of different numerologies	ZTE
R1-164274	Frame structure for NR	ZTE
R1-164275	NR frame structure for unlicensed spectrum	ZTE
R1-164276	Discussions on HARQ operation for NR	ZTE
R1-164330	NR sub-carrier spacing	Fujitsu
R1-164331	TDD frame structure with mixed numerology	Fujitsu
R1-164332	NR Frame structure considerations for low latency TDD operation	Fujitsu
R1-164333	Discussion on flexible/dynamic TDD	Fujitsu
R1-164347	Numerology for 5G NR	Fiberhome Technologies Group
R1-164380	Frame Structure Design Considerations for Bands above 6 GHz	Huawei, HiSilicon
R1-164381	Impact of directional transmission on NR numerology for high frequency bands	Huawei, HiSilicon
R1-164472	Frame structure supporting flexible parameter allocations	Guangdong OPPO Mobile Telecom.
R1-164482	Considerations on the design of frame structure for NR	NEC
R1-164486	Subcarrier spacing and other parameters for numerology	NEC
R1-164560	Discussion on frame structure for NR	LG Electronics

R1-164561	Support different numerology and different usage scenarios	LG Electronics
R1-164562	Consideration of Flexible and Full duplex operation in NR design	LG Electronics
R1-164590	Discussion on numerology sets	Spreadtrum Communications
R1-164591	Discussion on frame structure	Spreadtrum Communications
R1-164621	On a 30kHz subcarrier spacing option for NR	Ericsson
R1-164627	Hybrid-ARQ acknowledgements for NR	Ericsson
R1-164628	Frame structure for NR	Ericsson
R1-164630	Performance difference between 60 and 75 kHz subcarrier spacing	Ericsson
R1-164631	Duplex schemes for NR	Ericsson
R1-164652	Frame structure design for new radio interface	Lenovo (Beijing) Ltd
R1-164657	Discussion on frame structure design for NR	Sony
R1-164658	Discussion on numerology design for NR	Sony
R1-164665	Frame structure for New Radio	INTERDIGITAL COMMUNICATIONS
R1-164666	Numerology for New Radio	INTERDIGITAL COMMUNICATIONS
R1-164690	NB-IOT Coexistence Analysis for NR Numerology	Qualcomm Incorporated
R1-164691	NR numerology design and evaluation for long delay spread channels	Qualcomm Incorporated
R1-164693	NR sampling rate related numerology considerations for eMBB and mMTC	Qualcomm Incorporated
R1-164694	Frame structure requirements	Qualcomm Incorporated
R1-164695	Candidate frame structures	Qualcomm Incorporated
R1-164723	Numerology and Frame Structure for NR-Unlicensed	Huawei, HiSilicon
R1-164870	Discussion on numerology for NR	ETRI
R1-164871	Frame structure for new radio interface	ETRI
R1-164890	Discussion on the frame structure design for new radio	CMCC
R1-164915	Transient period on NR uplink frame structure design	Panasonic Corporation
R1-164973	NR frame structure considering coexistence with TDD LTE	SoftBank Corp.
R1-164985	Discussion on the multiplexing of different numerologies	Panasonic
R1-165024	Flexible numerology for 5G	Nokia, Alcatel-Lucent Shanghai Bell
R1-165025	Comparison of different numerology scaling principles	Nokia, Alcatel-Lucent Shanghai Bell
R1-165026	Comparison of different subcarrier spacings	Nokia, Alcatel-Lucent Shanghai Bell
R1-165027	Basic frame structure principles for 5G	Nokia, Alcatel-Lucent Shanghai Bell
R1-165028	URLLC U-plane latency analysis	Nokia, Alcatel-Lucent Shanghai Bell
R1-165029	Main components for forward compatible frame structure design in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-165030	On the unlicensed band operation in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-165031	On the wireless relay operation in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-165055	Discussion on Frame Structure for NR	Cohere Technologies
R1-165083	Consideration on URLLC in NR frame structure	ZTE
R1-165107	Numerology and Frame Structure for NR	Motorola Mobility
R1-165162	On Numerology for New Radio Access Technology	MediaTek Inc.
R1-165163	Flexible Frame Structure for New Radio Access Technology	MediaTek Inc.
R1-165176	Discussion on frame structure for NR	NTT DOCOMO, INC.
R1-165178	Views on domodulation RS design for NR access technology	NTT DOCOMO, INC.
R1-165217	Consideration on frame structure for NR	Beijing Xiaomi Mobile Software
R1-165242	On Frame Structure for NR	Innovative Technology Lab Co.
R1-165285	Bidirectional frame structure for imparity CCFD scheme	III
R1-165291	Discussions on the numerology and frame structure design for NR	CATR
R1-165311	Considerations on frame structure for NR	KT Corp.
R1-165316	Scalable numerology for New RAT	Sharp
R1-165371	Discussion of Numerology for NR	Conviva Wireless LLC
R1-165431	Initial Evaluation Result for NR Numerology	LG Electronics
R1-165436	Discussions on reference signal design for NR	Samsung
R1-165811	WF on Frame Structure and Control Interference	Qualcomm
R1-165833	Mixed Numerology in an OFDM System	Ericsson
R1-165925	WF on frame structure for NR	LG Electronics, CATT
R1-166032	Way Forward on Ack/Nack feedback of DL HARQ for NR	ZTE, ZTE Microelectronics, Ericsson, Qualcomm, NTT DOCOMO

7.1.5 Channel coding and modulation for new radio interface

[R1-165945](#) **Chairman's Notes of Agenda Item 7.1.5 on Ch_Coding** Ad-hoc chair (Nokia)

The document was presented by Matthew Baker from Nokia and provides the outcomes of the session.

Decision: The document is endorsed. Contents incorporated below.

7.1.5.1 Channel coding

Comparisons

General

R1-165641	Comparison of coding schemes for NR	Intel Corporation	(R1-164182)
R1-164277	Evaluation on performance and complexity of channel coding for NR	ZTE	
R1-164704	Channel coding evaluation assumptions - performance and complexity	Qualcomm Incorporated	
R1-164564	Performance and complexity comparison of existing Turbo and LDPC codes	LG Electronics	

eMBB

R1-164812	Preliminary evaluation results on new channel coding scheme for NR - LDPC code for high throughput	Samsung	
R1-164360	Analysis of Candidate Code Types for Long Block Length	Ericsson	
R1-164377	Performance of channel coding schemes for eMBB scenario	Huawei, HiSilicon	
R1-165060	Performance Evaluation of Channel Coding for eMBB	INTERDIGITAL COMMUNICATIONS	
R1-165357	Performance of eMBB channel coding candidates	Nokia, Alcatel-Lucent Shanghai Bell	
R1-165360	Selection of the eMBB channel coding scheme	Nokia, Alcatel-Lucent Shanghai Bell	
R1-165657	WF on channel coding for eMBB	Nokia, ASB	

Proposal:

- Conclusion:
 - At least LDPC and Polar can support the high code rate and high throughput scenarios
- Further study:
 - Study further whether modified Turbo or Polar codes can satisfy the high code rate and high throughput scenarios; working assumption may be revisited if so
 - Implementation details should be provided for the decoding algorithms used in the simulation results for other eMBB coding candidates, i.e. Turbo and Polar
 - E.g. : Survey on the existing implementation efforts

[R1-165637](#) Way Forward on Channel Coding Scheme for New Radio Samsung, Nokia, Qualcomm, Intel, ZTE

Also supported by Sharp

Proposed conclusions:

- All candidate channel coding schemes for eMBB application show comparable link performance in most cases
- Observations on LTE turbo code for high code rates
 - LTE turbo code requires higher decoder computational complexity compared to LDPC code
 - LDPC code is superior to LTE turbo code in terms of latency and high data throughput

Observations:

- At least in AWGN channels:
 - For large information block sizes, all candidate channel coding schemes show comparable link performance
- Further study is required on all potential coding schemes in order to determine which coding scheme(s) should be supported, including:
 - Implementation details should be provided for the decoding algorithms used in the simulation results, e.g. survey on the existing implementation efforts

FFS:

- At least in AWGN channels:
 - [For small information block sizes, performance of Polar codes is comparable to or better than other candidate schemes depending on the Polar decoding technique and code rate]
- [At least LDPC can support the high code rate and high throughput scenarios]
- [At least Polar codes can support the high code rate and high throughput scenarios]
- Compared to LTE turbo code:
 - [At high code rates and high throughputs, LTE turbo code requires higher decoder computational complexity compared to LDPC code]
 - [Considering all code rates and all information block sizes and HARQ requirements, LTE turbo code has comparable decoder computational complexity compared to LDPC code]
- [Flexibility requirements and feasibility]

[R1-165598](#) WF on small block length Huawei, HiSilicon, Interdigital, Mediatek, Qualcomm

Proposal:

- Observation - From the evaluation results
 - TBCC and polar codes show best performance for (K=20,40)

- For K larger than 100 and lower than 1000, polar outperforms TBCC for all choices of code rate and list-size
- Proposal
 - At least for mMTC and URLLC, For small information block lengths, at least Polar codes and TBCC Codes are considered as candidate schemes.
 - FFS what is meant by “small”
 - Further evaluation of performance and complexity/latency needs to be done

R1-165726 Code type for small info block length in NR Ericsson, Nokia, ASB

Proposal:

- Observation
 - For short info block lengths and low code rate, TBCC and Turbo code perform well compared to LDPC and Polar codes
- Proposal
 - Baseline channel code type for short info block lengths (including at least: DL control channel and mMTC DL) in NR is tail-biting convolutional code (TBCC)
 - Can be revisited if problems are identified

R1-165741 WF on further study of complexity of channel code LG, Ericsson, Orange

Agreement: As one potential input to the decisions on channel coding:

- Companies are encouraged to bring evaluations of the complexity of channel coding / HARQ schemes including at least:
 - Energy efficiency (J/bit)
 - Area efficiency (Gbps/mm²)
- FEC complexity supporting the full range of info block lengths and code rates with reasonable (details FFS) granularity should be compared instead of single info block length with some code rate
 - Companies should provide details of the range of info block lengths and code rates for which their complexity evaluations are conducted

R1-165959 WF on channel coding simulation data sharing Qualcomm

Agreement:

- Include file format of results with contribution
 - Use excel file template provided in ExampleResults.xlsx
 - Multiple columns for
 - QAM, Rate, Info. Blocklength, Es/N0, Eb/N0, BLER
 - Separate tab to provide context
 - Contribution#, name of code, decoder implementation, #iterations or list size, brief details of code construction, brief details of rate matching algorithm, #CRC bits, and other parameters
 - The referenced accompanying contribution should provide enough details to enable other companies to repeat the simulations
- Companies encouraged to submit with their contribution for RAN1 #86

mMTC, URLLC

R1-164359 Performance Evaluation of Turbo Codes and LDPC Codes at Higher Code Rates Ericsson

LDPC Details and Performance

R1-164697 LDPC design overview Qualcomm Incorporated

R1-165409 Consideration on LDPC codes for NR ZTE (R1-164278)

R1-165643 WF on LDPC schemes for NR ZTE, ZTE Microelectronics, Nokia, Qualcomm, InterDigital, MediaTek, Intel, Samsung
Also supported by Sharp

Agreement:

- For the purpose of study and comparisons, quasi-cyclic like LDPC codes are defined as follows:
 - The Parity check matrix of Quasi-cyclic like LDPC Codes is defined at least by a matrix H of size $(mb \times z) \times (nb \times z)$, which consists of sub-block matrices of size $z \times z$, where each sub-block matrix is composed by circularly shifted matrices or zero matrices. Wherein, mb, nb and z are integers larger than 1.
 - The values of mb, nb and z are FFS.
- Companies providing evaluations or proposals for LDPC codes are encouraged to show how:

- Multiple code rates and multiple code sizes would be supported,
- Suitable granularity of information block size and code rate would be supported,
- How to support HARQ with/without IR.

Polar Coding Details and Performance

[R1-164039](#) **Polar codes - encoding and decoding** Huawei, HiSilicon

[R1-164184](#) **Polar code design for NR** Intel Corporation

Note that the curves for L=8 and L=32 are indicated the wrong way round in Fig 2

Turbo coding Details and Performance

[R1-164251](#) **Performance evaluation of binary turbo codes with low complexity decoding algorithm** CATT

[R1-164635](#) **Improved LTE turbo codes for NR** ORANGE

[R1-164361](#) **Turbo Code Enhancements** Ericsson

[R1-165792](#) **WF on turbo coding** LG, Ericsson, CATT, Orange

Proposed observation:

- Turbo codes in general show potential for full flexibility of all code rates and all information block sizes, e.g. from 40 bits to 8192 bits

Outer coding

[R1-165954](#) **WF on Outer Coding** ZTE

Revisit at RAN1#86.

Not treated.

[R1-164007](#) Flexibility of LDPC - Length, Rate and IR-HARQ Samsung
[R1-164008](#) Preliminary evaluation results on new channel coding scheme for NR Samsung
[R1-164009](#) Discussion on throughput, latency for new channel coding scheme for NR Samsung
[R1-164040](#) On latency and complexity Huawei, HiSilicon
[R1-164183](#) LDPC code design for NR Intel Corporation
[R1-164185](#) Polar code constructions for evaluations Intel Corporation
[R1-164186](#) Performance evaluation of coding schemes for NR Intel Corporation
[R1-164250](#) Performance evaluation of non-binary LDPC codes CATT
[R1-164252](#) Performance evaluation of non-binary turbo codes CATT
[R1-164279](#) Throughput and latency analysis on new channel coding candidates for NR ZTE
[R1-164280](#) Consideration on outer code for NR ZTE
[R1-164356](#) Performance Evaluation of TBCC and Polar Codes Ericsson
[R1-164357](#) Analysis of Candidate Code Types for Short Block Length Ericsson
[R1-164358](#) Performance Evaluation of Turbo Codes and LDPC Codes at Lower Code Rates Ericsson
[R1-164375](#) Evaluation of polar codes for eMBB scenario Huawei, HiSilicon
[R1-164378](#) Performance of channel coding schemes for mMTC and URLLC scenarios Huawei, HiSilicon
[R1-164563](#) Discussion on channel coding scheme considering NR KPIs LG Electronics
[R1-164565](#) Discussions on polar code design LG Electronics
[R1-164592](#) Simulation results of Turbo and Polar codes Spreadtrum Communications
[R1-164667](#) Outer erasure code for efficient multiplexing INTERDIGITAL COMMUNICATIONS
[R1-164698](#) LDPC - Performance evaluation Qualcomm Incorporated
[R1-164699](#) Polar code design overview Qualcomm Incorporated
[R1-164700](#) Polar - Performance evaluation Qualcomm Incorporated
[R1-164701](#) TBCC design overview Qualcomm Incorporated
[R1-164702](#) TBCC-Performance evaluation Qualcomm Incorporated
[R1-164703](#) Outer erasure code use cases and evaluation assumptions Qualcomm Incorporated
[R1-164813](#) Design of LDPC code for high throughput Samsung
[R1-165036](#) Impact of Number of Iterations in Decoding Turbo and LDPC codes Ericsson Inc.
[R1-165059](#) Performance Evaluation of Channel Coding for URLLC and mMTC INTERDIGITAL COMMUNICATIONS
[R1-165284](#) Channel Coding for NR NTT DOCOMO, INC.
[R1-165358](#) Performance of mMTC and URLLC channel coding candidates Nokia, Alcatel-Lucent Shanghai Bell
[R1-165359](#) Latency considerations for URLLC channel coding candidates Nokia, Alcatel-Lucent Shanghai Bell
[R1-165428](#) Performance evaluation of binary LDPC codes CATT
[R1-165453](#) Discussion on LDPC Code Design and Performance Evaluation MediaTek Inc.
[R1-165454](#) Discussion on Polar Code Design and Performance MediaTek Inc.
[R1-165492](#) WF on channel coding evaluation Qualcomm
[R1-165599](#) Evaluation of TBCC and polar codes for small block lengths Huawei, HiSilicon
[R1-165725](#) Turbo Code Performance Comparison Ericsson

7.1.5.2 Modulation

Not treated.

R1-164187	Modulation schemes for New RAT Intel Corporation	
R1-164566	Maximum Supported Modulation Order for above 6GHz	LG Electronics
R1-164626	On modulation schemes for NR	Ericsson
R1-164653	Considerations for non-uniform constellations for NR	Sony
R1-164705	NR modulation requirements	Qualcomm Incorporated
R1-164706	Evaluation assumptions for NR modulation schemes	Qualcomm Incorporated
R1-165061	Evaluation of Spatial Modulation for New Radio	INTERDIGITAL COMMUNICATIONS
R1-165361	Digital Modulation for 5G New Radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-165718	WF on baseline modulation schemes for NR study	LG Electronics, Intel, Nokia, ASB
R1-165919	WF on modulation for NR InterDigital	

7.1.6 Multi-antenna scheme for new radio interface

Discuss initial views on multi-antenna scheme including enhanced massive MIMO analog/digital/hybrid beam-forming

[R1-164013](#) Framework for beamformed access Samsung

- *Observation 1: Relying solely on digital precoding to compensate for the additional path-loss in higher frequencies will lead to excessive implementation burden.*
- *Proposal 1: Adopt hybrid beamforming as a baseline MIMO/beamforming scheme for higher frequencies in NR.*
- *Proposal 2: For beamformed access, introduce beam sweeping for providing basic coverage in NR.*
 - *Strive for minimizing the overhead related to the beam sweeping.*
- *Proposal 3: Study beam-sweeping based designs for initial access in NR: at least for synchronization signals, broadcast channel and random access channel.*
- *Proposal 4: Study beam-sweeping based designs for RRM measurements in NR.*

Decision: The document is noted.

[R1-164372](#) Coverage Issues of Massive MIMO in NR Huawei, HiSilicon

Observation 1: Additional gain is needed for NR to achieve similar coverage as LTE.

Observation 2: Beam based scheme outperforms repetition based scheme in terms of coverage performance.

Proposal 1: Investigate SFN as a complementary solution for coverage improvement in NR.

Proposal 2: Investigate power boosting solution to improve the coverage of NR.

Proposal 3: Investigate beam based access to improve the coverage of NR.

Proposal 4: The following principles need to be considered for the enhancements on coverage limited signals (such as synchronization and broadcast signals):

- *The signal design should take into account the performance, overhead, complexity and reliability.*
 - *Impacts from phase noise should be considered in system design for HF bands.*
- *The signal design should consider the adopted numerology and multiple access schemes.*

Decision: The document is noted.

[R1-164925](#) Considerations of digital beam forming on multi antenna scheme MTI

- *Observation#1: Clearly, DBF has the high performance, and give best operational flexibility with slightly higher cost. The DBF is put the complexity at the cell side, and minimize the complexity and power constraints at UE.*
- *Observation#2: The cost of DBF is mainly coming from parallel channels of IFP that convert signals from digital domain to IF domain. The IFP may be expensive when design with discrete components, but would be substantially lower cost when implemented with digital IC and RFIC, and when produced at high quantity.*
- *Proposal 1: Digital beamforming which adopts digital precoding to adjust the beam direction and operating sub band should be considered as well for NR.*
- *Proposal 2: RAN1 should discuss the design aspects and architecture for DBF, especially considering the maximization of orthogonality and relative blind decoding.*

Decision: The document is noted.

[R1-165179](#) Discussion on NR MIMO NTT DOCOMO, INC.

Proposal 1: Following requirements should be considered for NR MIMO design.

- *Feasible overhead for DL/UL RSs and feedback*
- *Versatile technology for different*
 - *Antenna configurations (e.g., number/arrangement of antenna elements and virtualization)*
 - *Frequency bands (e.g., low frequency to mmWave)*
 - *Duplex schemes, e.g., FDD/TDD/eTDD*

Proposal 2: Beamforming, SU-MIMO and MU-MIMO should be studied for higher frequency NR together with optimization for massive array and reciprocal systems.

Proposal 3: Following issues should be studied for higher frequency.

- *Impact of blockage effect and possible solutions*
- *Effect of multi-cell association technology*
- *Interference measurement schemes (e.g., flush-light effect and measurement for reciprocal systems)*

Proposal 4: For higher frequency, effect of beamforming on common channels/signals should be studied together with other potential technologies such as repetition, power boosting and SFN transmission.

Proposal 5: Multi-antenna technologies for NR should be applicable for hybrid beamforming (or analogue beamforming).

Proposal 6: For frequencies below 6 GHz, beamforming can be applied both for common and data-plane channels/signals, although details should be discussed together with the design for over 6 GHz.

Decision: The document is noted.

R1-164191 UL MIMO for new radio interface Intel Corporation

- Proposal 1:
 - For below 6GHz band, consider both digital and hybrid antennas at eNB and omni-directional antenna at UE in the NR design.
 - For above 6GHz band, consider multiple hybrid antennas at eNB and multiple hybrid antennas at UE, e.g. two and facing opposite direction, in the NR design.
- Proposal 2:
 - For below 6GHz band, both sub-array and fully connected virtualization for TRP can be supported by using LTE FD-MIMO framework.
 - For above 6GHz band, prioritize the 2D sub-array based virtualization for eNB/UE in the NR design.
 - It is worth to clarify whether TXRU can be connected to different antenna arrays dynamically at UE.
- Proposal 3:
 - eNB/UE vendors to state intra-array antenna calibration and inter-array antenna calibration assumption for the NR design.
 - NR system design should be flexible enough for different antenna calibration assumptions.
- Proposal 4:
 - Design UL NR MIMO assuming the listed scenarios in Figure 1. UL NR MIMO should support stand-alone operation for all possible bands, however, optimization of the capacity booster layer at middle/high band assuming a coverage layer using LTE or NR at low band can also be considered.
- Proposal 5:
 - Strive to have a unified uplink NR MIMO framework for all NR bands.
 - Have a relatively independent uplink beam management procedure to downlink
 - Have a beam management framework which can address various scenarios including inter-TRP and intra-TRP beam mobility scenarios.
 - Design uplink physical channels considering the hybrid antennas at both sides of the link.
 - Apply relevant NR MIMO scenarios for various uplink physical channels/signals.
 - Study uplink power control scheme in a beam centric environment.
 - NR at low band should target the same SU-MIMO dimension and higher MU-MIMO dimension than LTE. SRS and DMRS should be designed to be compatible with other system design aspects and better support reciprocity based operation.

Decision: The document is noted.

R1-164892 General Views on Reference Signal Design CMCC

- Proposal 1: At least NR_SS, NR_CSI-RS and NR_DMRS should be considered for downlink reference signals of NR.
- Proposal 2: A two-stage CSI feedback and corresponding CSI-RS design could be considered in NR
- Proposal 3: NR_SRS and NR_DMRS, whose functionalities are analogous to SRS and DMRS in LTE, could be considered for uplink reference signals of NR.
- Proposal 4: The design of NR_SRS should try to improve its capacity to ensure the accuracy of channel reciprocity in TDD system.

Decision: The document is noted.

R1-164116 Consideration on muti-antenna schemes for new radio Beijing Xinwei Telecom Techn.

- *Observation 1: Reduction of broadcast signal is also beneficial from perspective of large scale MIMO.*
- *Observation 2: Channel reciprocity in TDD should be carefully invoked, considering the problem of RS contamination and fewer digital chains than antenna elements.*
- *Proposal 1: A universal MIMO framework should be established in the study item for the compatibility of the two-phase standardization process.*

- *The universal framework should accommodate requirements for different scenarios, including over-6GHz and sub-6GHz deployment.*
- *Proposal 2: Antenna modelling within the NR MIMO framework should not limit the possibility of applying other types of antennas besides URPA.*
- *Proposal 3: The possibility of multiple TXRUs fully connected to the same subarray should not be precluded.*
- *Proposal 4: Novel access and data transmission procedure should be designed with as few broadcast signal as possible and facilitate the usage of spatial information.*
- *Proposal 5: Spatial sparsity of channels could be leveraged to reduce RS overhead.*
- *Proposal 6: RS for spatial information is also beneficial in TDD system.*
- *Proposal 7: Feedback based on RS measurement should be considered as the baseline for NR. Other form of feedback should be compared with the baseline on overhead, complexity and performance.*
- *Proposal 8: For antenna array besides URPA, measurement and feedback framework based on beamformed reference signal should be studied.*
- *Proposal 9: Distributed large scale MIMO should be natively supported and facilitated in the NR MIMO framework.*
- *Proposal 10: For distributed large scale MIMO, distributed MRT based scheme should be considered as the baseline for further study.*

Decision: The document is noted.

R1-164117 Overview of Massive MIMO for NR National Instruments Corp.

- Observation 1: Massive MIMO beamforms to a point, conventional beamforming beamforms to a direction.
- Observation 2: Reciprocity based TDD NR MIMO is a scalable solution from CSI estimation overhead perspective, for all antenna sizes.
- Observation 3: Canonical Massive MIMO can work with many flexible antenna configuration and has relaxed antenna calibration requirements.
- Observation 4: The subframe duration of a TDD NR M-MIMO subframe should no longer than the channel coherence time for the given deployment scenario.
- Observation 5: Benefits of Massive MIMO are only apparent with 8-10x the number of transceiver chains at eNB as number of UEs in the cell where each transceiver chain is a digital beamforming element.
- Observation 6: Reciprocity Calibration is necessary. Level of calibration and optional support of over the air signaling for calibration is FFS.
- Observation 7: Reciprocity calibration can be performed within the eNB, with no necessity of signaling between eNB and UE.
- Proposal 1: Use Massive MIMO using channel reciprocity as a framework for TDD NR M-MIMO.
- Proposal 2: Adopt TDD NR M-MIMO as primary MIMO mode for larger number of antenna ports at eNB (especially for ≥ 64 antenna ports).
- Proposal 3: Study improvements in UL Sounding Pilot signaling to support at least 32 UEs in UL.
- Proposal 4: Support a flexible grant duration for TDD NR M-MIMO subframe to be smaller than the channel coherence time.
- Proposal 5: Support fully digital beamforming for up to at least 64 antenna ports at the eNB.

Decision: The document is noted.

R1-165313 Need for study on In-Band Full Duplex communication CEWiT

Proposal 1: To consider in-band full duplex communication in conjunction with massive MIMO systems.

Proposal 2: To consider and study other potential network wide applications and standardization impact of in-band full duplex communication.

Decision: The document is noted.

R1-164955 Reciprocity based MIMO in NR Ericsson

- Efficient reciprocity-based transmission schemes need to be standardized as in some use cases they will have significantly better performance compared to normal resolution closed loop schemes (as has been specified for smaller arrays, e.g. LTE)
- Coherent reciprocity allows for efficient acquisition of explicit channel knowledge even for very large arrays, thus enabling frequency-selective precoding and nullforming
- Achieving coherent reciprocity imposes several additional requirements, e.g., on antenna calibration
 - Whether there is standard impact (RAN1 or RAN4) is FFS
- Study proposals to support reciprocity based MIMO in NR:
 - RAN1 should study Sounding Reference Signal design and the necessary quality of the estimates
 - Study SRS sequences and SRS density for enabling high-quality channel estimates, to reduce the effects of channel aging and pilot contamination

- RAN1 should study Interference acquisition schemes for reciprocity based operation
 - for the purpose of scheduling and link adaptation

Decision: The document is noted.

R1-165559 WF on Supported NR Operations Samsung, Nokia, Alcatel Lucent Shanghai Bell

The document was presented by Young Han Nam from Samsung.

- RAN1 to strive for both beam-centric operation and non-beam-centric operation in a single unified framework
 - Beam-centric operation
 - In beam-centric operation, multiple beams are used for covering a DL/UL coverage area of a TRP/a UE.
 - One example of beam-centric operation is beam sweeping:
 - When beam sweeping is applied for a signal (or a channel), the signal (the channel) is transmitted on multiple beams, which are on multiple time instances in a constant time duration.
 - Non-beam-centric operation
 - In non-beam-centric operation, a single beam can be used for covering a DL/UL coverage area of a TRP/a UE, similarly as for LTE cell-specific channels/RS.
- For beam-centric operation, study the application of beam sweeping at least for:
 - Initial-access signals (synchronization signals and random access channels)
 - System-information delivery (broadcast channels)
 - RRM measurement
 - CSI measurement

Decision: The document is noted.

Possible agreements:

- Following three types of beamforming are to be studied in NR
 - Analog beamforming
 - Digital beamforming
 - Hybrid beamforming
- RAN1 studies both beamforming based approaches and non-beamforming based approaches for these channels/signals/measurement/feedback
 - Initial-access signals (synchronization signals and random access channels)
 - System-information delivery (broadcast channels)
 - RRM measurement/feedback
 - L1 control channel
 - FFS: Note: The physical layer procedure design for NR should be agnostic as much as possible to the beamforming type employed at TRP
- Beamforming based approaches
 - In beamforming based approaches, multiple beams are used for covering a DL coverage area and/or UL coverage distance of a TRP/a UE
 - One example of beamforming based approaches is beam sweeping:
 - When beam sweeping is applied for a signal (or a channel), the signal (the channel) is transmitted/received on multiple beams, which are on multiple time instances in finite time duration
 - Multiple beams can be transmitted/received in a single time instance
 - Others are FFS
- Non-beamforming based approaches
 - In non-beamforming based approaches, each time invariant beam can be used for covering a DL/UL coverage area of a TRP/a UE, similarly as for LTE cell-specific channels/RS
- For both beamforming and non-beamforming based approaches, RAN1 can consider following examples
 - Power boosting
 - SFN
 - Repetition
 - Beam diversity (only for beamforming approach)
 - Antenna diversity
 - Other approaches are not precluded
- Combinations of non-beamforming based and beamforming based approaches are not precluded

Agreements:

- Following three implementations of beamforming are to be studied in NR
 - Analog beamforming
 - Digital beamforming
 - Hybrid beamforming

- Note: The physical layer procedure design for NR can be agnostic to UE/TRP with respect to the beamforming implementations employed at TRP/UE, but it may pursue beamforming implementation specific optimization not to lose efficiency
- RAN1 studies both multi-beam based approaches and single-beam based approaches for these channels/signals/measurement/feedback
 - Initial-access signals (synchronization signals and random access channels)
 - System-information delivery
 - RRM measurement/feedback
 - L1 control channel
 - Others are FFS
 - Note: The physical layer procedure design for NR can be unified as much as possible whether multi-beam or single-beam based approaches are employed at TRP at least for synchronization signal detection in stand-alone initial access procedure
 - Note: single beam approach can be a special case of multi beam approach
 - Note: Individual optimization of single beam approach and multiple beam approach is possible
- Multi-beam based approaches
 - In Multi-beam based approaches, multiple beams are used for covering a DL coverage area and/or UL coverage distance of a TRP/a UE
 - One example of multi-beam based approaches is beam sweeping:
 - When beam sweeping is applied for a signal (or a channel), the signal (the channel) is transmitted/received on multiple beams, which are on multiple time instances in finite time duration
 - Single/multiple beam can be transmitted/received in a single time instance
 - Others are FFS
- Single-beam based approaches
 - In single-beam based approaches, the single beam can be used for covering a DL coverage area and/or UL coverage distance of a TRP/a UE, similarly as for LTE cell-specific channels/RS
- For both single-beam and multi-beam based approaches, RAN1 can consider followings in addition
 - Power boosting
 - SFN
 - Repetition
 - Beam diversity (only for multi-beam approach)
 - Antenna diversity
 - Other approaches are not precluded
- Combinations of single-beam based and multi-beam based approaches are not precluded

R1-165563 WF on NR beamforming Huawei, HiSilicon

The document was presented by ... from Huawei.

- Following three types of beamforming are to be studied in NR
 - Analog beamforming
 - Digital beamforming
 - Hybrid beamforming
- Study coverage improvement techniques for control channels / signals for NR
 - Beamforming-based coverage improvement
 - Beam sweeping and beam selection techniques
 - Non-beamforming based approaches such as
 - Power boosting
 - SFN
 - Repetition
 - Combinations of non-beamforming based and beamforming based approaches are not precluded
 - Other methods are not precluded

Note: The physical layer procedure design for NR should be agnostic as much as possible to the beamforming type employed at TRP.

Decision: The document is noted.

Possible agreements:

- For Non-beam-centric operation, RAN1 can consider following examples
 - Power boosting
 - SFN
 - Repetition
- Combinations of non-beamforming based and beamforming based approaches are not precluded

Note: The physical layer procedure design for NR should be agnostic as much as possible to the beamforming type employed at TRP.

Tuesday

R1-165564 **WF on UE beamforming and beam management** Nokia, Samsung, Intel, Interdigital, Alcatel-Lucent
Shanghai Bell
Decision: The document is noted.

Agreements:

- RAN1 to study the beamforming procedures and their system impacts at least for multi beam based approach
 - Physical layer procedures for beamforming optimizing different metrics such as overheads and latencies in multi beam and single beam based approaches
 - Physical layer procedures in multi beam based approach that require beam training, i.e. steering of transmitter and/or receiver beams
 - E.g. Periodic/Aperiodic downlink/uplink TX/RX beam sweeping signals, where periodic signals may be semi-statically or dynamically configured (FFS)
 - E.g. UL sounding signals
 - Other example is not precluded

R1-165684 **WF on beamforming procedures** Nokia
Decision: The document is noted.

Agreements:

- Both intra-TRP and inter-TRP beamforming procedures are considered.
- Beamforming procedures are considered with/without TRP beamforming/beam sweeping and with/without UE beamforming/beam sweeping, according to the following potential use cases:
 - UE movement, UE rotation, beam blocking:
 - Change of beam at TRP, same beam at UE
 - Same beam at TRP, change of beam at UE
 - Change of beam at TRP, change of beam at UE
 - Other cases are not precluded

R1-165650 **WF on the antenna port and QCL assumption study in NR** Intel, Ericsson
Decision: The document is noted.

Possible agreements:

As a starting point for NR study RAN1 assumes the following definition of antenna port and corresponding antenna port transmission assumptions:

- The antenna port in NR is used for transmission of a physical channel or signal, where 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.
- For antenna port transmitted in different time occasions (e.g. different subframes or TTIs) by default assumption the channel on the antenna port in one time occasion can't be inferred from the channel on the same antenna port in another time occasion
- For antenna port transmitted in the same time occasion on different frequency resource units (blocks), by default assumption the channel in one frequency resource unit/block on one antenna port can't be inferred from the channel on the same antenna port in another frequency resource unit/block in the same time occasion

The assumptions on antenna ports that are different from the above should be studied in RAN1 and if needed recommended for NR specification (e.g. fixed in the specification or signaled by network explicitly or implicitly)

Possible agreements:

As a starting point for NR study RAN1 assumes the following definition of QCL and corresponding QCL assumptions:

- Two antenna ports in NR are said to be quasi co-located if the large-scale 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. The large-scale properties include one or more of delay spread, Doppler spread, Doppler shift, average gain, and average delay.
- For antenna ports corresponding to different RS types (e.g. DM-RS and CSI-RS) or multiple RS of the same type (e.g. two NZP CSI-RS) by default assumption UE can't assume QCL-ion between the antenna ports wrt to delay spread, Doppler spread, Doppler shift, average gain, and average delay.
- For antenna ports corresponding to the same type (e.g. DM-RS antenna ports), by default assumption UE can't assume QCL-ion between antenna ports wrt to delay spread, Doppler spread, Doppler shift, average gain, and average delay.

The assumptions on QCL that are different from the above should be studied in RAN1 and if needed recommended for NR specification (e.g. fixed in the specification or signaled by network explicitly or implicitly)

Continue offline discussion – (Intel)

Thursday

R1-165905 **WF on the antenna port and QCL assumption study in NR**

Intel, Ericsson

Decision: The document is noted. Revised in:

R1-165947 **WF on the antenna port and QCL assumption study in NR**
Nokia, ASB, CATT

Intel, Ericsson, ZTE, LGE, Samsung,

Decision: The document is noted.

Agreement: Study the necessity of QCL and measurement assumptions for antenna ports in NR

R1-165588 **WF on hybrid UE antenna modelling** **Intel, Samsung**

Decision: The document is noted. Revised in:

R1-165712 **WF on hybrid UE antenna modelling** **Intel, Samsung**

Decision: The document is noted.

R1-165654 **WF on CSI Acquisition Framework in NR** **Huawei, HiSilicon, NTT DOCOMO, Intel, China Telecom, ZTE, China Unicom, Deutsche Telecom, Softbank, ETRI, Ericsson, Nokia**

Decision: The document is noted. Also supported by CATR, ASB.

Agreements:

- In NR multi-antenna schemes, studies on CSI acquisition framework include:
 - CSI reporting schemes
 - Implicit CSI feedback
 - Parameters indicating channel quality based on a set of transmission and receiving hypotheses associated with one particular UE, e.g. CQI, PMI, RI, CRI
 - Explicit CSI feedback: for both quantized and unquantized/analog CSI feedback
 - Parameters representing channel coefficients or some reduced-space representation thereof
 - Reciprocity-based feedback
 - For example, take into account interference and/or receiver hypothesis can be included
 - Note: including aperiodic, periodic and semi-persistent, and single/wide band and sub-band feedback
 - Mixed feedback is not precluded
 - Interference measurement
 - FFS: CSI measurement and/or reporting and/or triggering can be 'self-contained' in at least time domain

Possible agreements:

- In NR multi-antenna schemes, studies on CSI acquisition framework include
 - CSI acquisition
 - based on hybrid RS
 - E.g., hybrid non-precoded and beamformed RS
 - E.g., hybrid different types of beamformed RS
 - based on beamformed/precoded RS (e.g., CSI-RS, Demodulation RS)
 - based on non-precoded RS
 - based on reciprocity (e.g., SRS design, UL SRS Transmission in DL band)
 - Note: including measurement over aperiodic/periodic/semi-persistent RS
 - Note: Subband RS is not precluded

Continue offline discussion until Wednesday – (Huawei)

R1-165541 **WF on CSI reporting framework for NR** **Samsung, Interdigital, Ericsson**

Decision: The document is noted.

R1-165701 **WF on RS design for CSI measurements in NR** **Samsung, ZTE, ZTE Microelectronics, Intel, Ericsson**

Decision: The document is noted. Continue offline discussion until Wednesday – (Samsung)

Wednesday

R1-165843 **WF on CSI Acquisition in NR** **Huawei, HiSilicon, Samsung**

- In NR multi-antenna schemes, studies on CSI acquisition include;
 - based on RS for UE-specific use case
 - Note: multiple-stage RS is not precluded
 - e.g., beamformed CSI-RS, Demodulation RS
 - based on RS for non-UE-specific use case
 - Note: multiple-stage RS is not precluded
 - e.g., beamformed CSI-RS, Non-precoded CSI-RS
 - based on hybrid RS
 - E.g., hybrid RS for UE-specific and Non-UE-specific use cases

- based on reciprocity (e.g., SRS design, UL SRS Transmission in DL band)
- Note: including measurement over aperiodic/periodic/semi-persistent RS
- Note: Subband RS is not precluded

Decision: The document is noted, modified as follows:

Agreements:

- In NR multi-antenna schemes, studies on RS design and CSI acquisition considering following use cases
 - Non-UE-specific RS use case for CSI measurement
 - UE-specific RS use case for CSI measurement
 - Note: functionally may be analogous e.g.: to R13/14 UE-specific beamformed CSI-RS (with dynamic beamforming)
 - Note: maybe relevant to UE receiving beam sweeping
 - Use of a joint operation among multiple RS from the same or different use cases
 - RS for interference measurement use cases
 - RS for channel reciprocity use cases
 - Other use cases is not precluded
- Note: including measurement over aperiodic/periodic/semi-persistent RS
- Note: Subband RS is not precluded

R1-165590 WF on aperiodic CSI for NR ZTE, ZTE Microelectronics, ASTRI, Ericsson, Samsung

- Study aperiodic CSI reporting in conjunction with aperiodic RS (including multi-shot RS) transmission
 - UE measures/reports CSI and TRP transmits RS for CSI measurement only when needed
 - Study self-contained scheme to support CSI triggering, CSI measurement and CSI feedback in a subframe
 - Study RS design for CSI measurement e.g. CSI-RS, demodulation RS.
 - Others are not precluded

Decision: The document is noted. Also supported by Interdigital. The WF is updated as follows:

Agreements:

- Study aperiodic CSI reporting in conjunction possibly with aperiodic RS (e.g. one-shot, multi-shot RS) transmission
 - Aperiodic RS can be used for CSI measurement including channel measurement (e.g. using CSI-RS) and/or interference measurement (e.g. using IMR)
 - Study on demand UE measurement/reports and TRP RS transmission for CSI measurement only when needed
 - Study aperiodic CSI procedure to support CSI triggering, CSI measurement and CSI feedback in certain time interval(s). These three steps can happen in the same or different time interval.
 - Study aperiodic CSI procedure using RS for CSI measurement e.g. CSI-RS, demodulation RS.
 - Others are not precluded

R1-165808 WF on NR UL MIMO Intel, NTT DOCOMO, Ericsson

Decision: The document is noted.

Agreements:

- The following techniques are studied for NR UL MIMO
 - Uplink transmission/reception schemes for data channels
 - Non reciprocity based UL MIMO (e.g. PMI based)
 - Reciprocity based UL MIMO. E.g. UE derives precoder based on downlink RS measurement (including partial reciprocity)
 - Support of MU-MIMO
 - Open-loop/Close-loop single/Multi point spatial multiplexing
 - e.g. for multi point SM, multi layer is received either jointly or independently by different TRPs
 - Note: for multi point SM, multiple point may have coordination
 - Single/Multi panel spatial diversity
 - Uplink antenna/panel switching (UE side)
 - UL beamforming management for analog implementation
 - Combination of above techniques
 - UL RS design considering the below functions
 - Sounding
 - Demodulation
 - Phase noise compensation
 - UL transmit power/timing advance control in the context of UL MIMO
 - Transmission scheme(s) for carrying UL control information
 - Other UL MIMO and related techniques are not precluded

Possible agreements:

- Study beam determination procedure (e.g. TRP beam(s) and/or UE beam(s) determination)
 - Option 1: In the initial access procedure
 - Option 2: Not in the initial access procedure
- For beam change after initial beam determination, study the following two procedures:
 - Procedures different from initial beam determination procedure
 - E.g. L1 or L2 based approach
 - Procedures with the same procedure as initial beam procedure
- Note: A common procedure may be applied to initial beam determination and beam change.
- Note: Different procedures may be applied to different frequency resources
- For multi beam and single beam based approaches at TRP, companies should state the assumptions on UE beamforming for the agreed system aspects
 - E.g. how many UE beams and UE beam patterns

Continue offline discussion until Friday – Yuan (Intel)

Friday

R1-166030	WF on beam management	Intel, Ericsson, Nokia, Qualcomm, Samsung, ZTE, NTT DoCoMo, Huawei, Xinwei, CATT, MTK
R1-165915	WF on beam management	Intel, Samsung, NTT DOCOMO

[R1-165946](#) **WF on DL multi-antenna transmissions for NR** LG Electronics, CATT, Intel, Samsung

Decision: The document is noted, modified and agreed as follows:

Agreements:

- The following DL multi-antenna transmissions to be studied for NR
 - Closed-loop/(Semi)Open-loop spatial multiplexing
 - Single/Multi-point transmissions
 - SU/MU-MIMO
 - Transmit diversity,
 - e.g., Single/Multi panel spatial diversity
 - Combination of above techniques
- Other DL multi-antenna transmissions and related techniques are not precluded
- This does not imply that used transmission technique needs to be known to the UE

[R1-165929](#) **WF on beamforming for message transmission in NR** Qualcomm, Ericsson, Intel, Nokia, CATT, Samsung

Decision: The document is noted.

Possible agreements:

- RAN1 to study beamforming for transmitting control message in the multi-beam based approach for NR
 - Beamforming that is specific to a UE or group of UEs when transmitting control message (i.e. control transmission)
 - Procedures for determining (e.g., through beam training) and changing the beam used for the control transmission
 - Procedures may or may not be same as the procedure for determining/changing the beam for data transmission
 - Control transmissions may be in both UL or DL direction
 - Procedures when transmitting common control message (e.g. beam sweeping, wide beam)

Continue offline discussion until Friday – Sundar (Qualcomm)

Not treated:

R1-164010	Discussions on CSI-RS design for NR	Samsung
R1-164011	Discussions on CSI reporting for NR	Samsung
R1-164012	Discussion on advanced MIMO transceivers for NR	Samsung
R1-164014	Discussion on RS for beamformed access	Samsung
R1-164015	DL MIMO framework for NR	Samsung
R1-164016	UL MIMO framework for NR	Samsung
R1-164017	Advanced CSI feedback for NR	Samsung
R1-164018	Analog/digital/hybrid beamforming for massive MIMO	Samsung

R1-164019	Discussion on CSI acquisition for beamformed access	Samsung
R1-164027	Design of massive MIMO for New Radio	Mitsubishi Electric Co.
R1-164038	Motivations and Considerations on Massive MIMO for New RAT	Huawei, HiSilicon
R1-164188	Overview of multi-antenna schemes for new radio interface	Intel Corporation
R1-164189	On UE side beamforming	Intel Corporation
R1-164190	RSRP modeling with UE side beamforming	Intel Corporation
R1-164192	Evaluation methodology for UL MIMO	Intel Corporation
R1-164254	Views on NR MIMO design	CATT
R1-164255	Discussion on beam-based operation	CATT
R1-164256	NR MIMO based on channel reciprocity	CATT
R1-164294	Overview on NR MIMO for sub-6 GHz	ZTE
R1-164295	Overview on NR MIMO for above-6 GHz	ZTE
R1-164296	Discussion on beamforming architecture for NR MIMO	ZTE
R1-164297	Consideration on CSI measurement and feedback for NR MIMO	ZTE
R1-164334	Discussion on massive MIMO in NR	Fujitsu
R1-164349	Discussion the transmission scheme of M-MIMO for 5G system	Fiberhome Technologies Group
R1-164374	CSI Acquisition Framework for Massive MIMO in New Radio	Huawei, HiSilicon
R1-164485	Discussion on Multi-antenna scheme for NR NEC	
R1-164567	Massive MIMO for New Radio Interface	LG Electronics
R1-164624	Principles for downlink control signaling in NR	Ericsson
R1-164625	Design principles for system access in a beam-centric system	Ericsson
R1-164660	Enhanced multiple antenna transmission for NR	Sony
R1-164707	Massive MIMO architecture	Qualcomm Incorporated
R1-164708	NR Massive MIMO design considerations	Qualcomm Incorporated
R1-164872	Initial views on MIMO/Beamforming in the NR systems	ETRI
R1-164873	Use of polarized MIMO for NR	ETRI
R1-164874	Beam-based design framework for New Radio	INTERDIGITAL COMMUNICATIONS
R1-164891	On Gradual UE-specific (GUS) Beamformed Control Channel CMCC	
R1-164893	Hybrid Beamforming for Massive MIMO	CMCC
R1-164952	On CSI for multi-antenna operation in NR	Ericsson
R1-164953	Multi-antenna transmission principles for data channels in NR	Ericsson
R1-164954	SU-MIMO performance for antenna arrays with a massive number of antennas	Ericsson
R1-164956	Multi-point MIMO connectivity	Ericsson
R1-164957	On UE side beamforming in NR	Ericsson
R1-165037	Discussion on Design of Reference Signals for NR MIMO	ZTE
R1-165038	Discussion on Control Channel Design for NR MIMO	ZTE
R1-165056	Views on antenna configuration for above-6GHz NR	CATT
R1-165062	Views on Beamforming with a Large Number of Antennas	INTERDIGITAL COMMUNICATIONS
R1-165063	Views on Massive MIMO for New Radio	INTERDIGITAL COMMUNICATIONS
R1-165079	Consideration on advanced receivers for NR	Intel Corporation
R1-165166	Support of Multiuser Transmission in 5G New Radio Interface below 6GHz	MediaTek Inc.
R1-165167	Beamforming Considerations for above 6 GHz Deployment Scenarios	MediaTek Inc.
R1-165180	Discussion on Multi-Antenna Transmission of Synchronization and Reference Signals	NTT DOCOMO, INC.
R1-165181	Evaluation Methodologies for NR MIMO	NTT DOCOMO, INC.
R1-165362	Multi-antenna Architectures and Implementation Issues in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-165363	Scalability of MIMO operation across NR carrier frequencies	Nokia, Alcatel-Lucent Shanghai Bell
R1-165364	Support for Beam Based Common Control Plane	Nokia, Alcatel-Lucent Shanghai Bell
R1-165365	On the UE beamforming in new radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-165366	Channel reciprocity support in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-165586	WF on NR UL MIMO	Intel, NTT DOCOMO
R1-165721	WF on TXRU Virtualization for NR MIMO	Xinwei, NEC
R1-165832	WF on aperiodic CSI for NR	ZTE
R1-165997	WF on beamforming for control message transmission in NR	Qualcomm

7.1.7 Other

[R1-164020](#) Co-existence of LTE and NR Samsung

- *Proposal 1: LTE-NR coexistence on the same spectrum should be supported as part of NR.*
- *Proposal 2: Consider both geographically separated and co-located scenarios when designing NR specification support for LTE-NR coexistence.*
- *Proposal 3: Design TDD UL-DL configurations for NR such that at least a subset of the configurations are compatible with those of LTE.*
- *Proposal 4: Consider utilizing LTE features to efficiently support LTE-NR coexistence for co-located scenario.*

Discussion: Huawei → time domain coexistence issues are relevant to this SI.

Decision: The document is noted.

Not treated

R1-164021	Network topology and system operation for NR	Samsung
R1-164022	Discussion on interference coordination for NR	Samsung
R1-164023	Discussion on interference management based on advanced transceivers for NR	Samsung
R1-164024	Shared spectrum support for NR	Samsung
R1-164042	Wideband support for NR	Huawei, HiSilicon
R1-164043	Considerations on vehicular communications for NR	Huawei, HiSilicon
R1-164053	Support for flexible backhauling for NR	Huawei, HiSilicon
R1-164054	Support for energy efficient NR	Huawei, HiSilicon
R1-164371	Considerations on new radio access mechanisms in NR	Huawei, HiSilicon
R1-164379	Support for UE Cooperation in NR	Huawei, HiSilicon
R1-164382	Advanced Link Adaptation for NR	Huawei, HiSilicon
R1-164568	High level view on eV2X	LG Electronics
R1-164632	Flexible bandwidth in NR	Ericsson
R1-164709	Sidelink design for NR	Qualcomm Incorporated
R1-164710	Mobility considerations for NR	Qualcomm Incorporated
R1-164714	NR positioning	Qualcomm Incorporated
R1-165064	Design considerations on URLLC for New Radio systems	INTERDIGITAL COMMUNICATIONS
R1-165182	Discussion on affinity for unlicensed spectrum access in 5G new radio	NTT DOCOMO, INC.
R1-165373	On Hybrid ARQ functionality for 5G	Nokia, Alcatel-Lucent Shanghai Bell
R1-165374	On the utilization of UE Advanced Receivers in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-165375	On the cross-link interference mitigation	Nokia, Alcatel-Lucent Shanghai Bell
R1-165376	Radio resource management in NR	Nokia, Alcatel-Lucent Shanghai Bell
R1-165377	Random access principles for New Radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-165378	On network energy efficiency requirement and evaluation for the 5G new radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-165379	Network-based inter-cell interference coordination	Nokia, Alcatel-Lucent Shanghai Bell
R1-165380	Uplink power control for 5G New Radio	Nokia, Alcatel-Lucent Shanghai Bell
R1-165381	Punctured Scheduling for Latency Critical Transmissions	Nokia, Alcatel-Lucent Shanghai Bell

7.2 Study on channel model for frequency spectrum above 6 GHz - SID in RP-151606

[R1-164025](#) Chairman's Notes of Agenda Item 7.2 on Channel model for >6 GHz Nokia

The document was presented by Tuomo Säynäjäkangas from Nokia and provides the outcomes of A17.2.

Decision: The document is endorsed. Contents incorporated below.

Remaining issues

[R1-164606](#) List of open issues for channel modelling SI Nokia, Samsung

Discussion:

Decision: The document is noted

[R1-165372](#) Notation of log-normal distributed random variables Fraunhofer HHI

Proposal 1: Adopt the following notation for mean ($\mu_{\lg X} = \text{mean}\{\log_{10}(X)\}$) and standard deviation ($\sigma_{\lg X} = \text{std}\{\log_{10}(X)\}$) of logarithmized parameters.

Proposal 2: When presenting mean values of logarithmized parameters in linear scale, clarify whether $10^{\mu_{\lg X}}$ or μ_X is given.

Discussion:

Samsung: Has this been used in previous channel model work or is this a new one?

Fraunhofer: This is an old problem. We should avoid misunderstanding.

Samsung: We could agree in principle and think about the wording for a TR.

Decision: The document is **agreed**

TR update

[R1-164607](#) TP for TR38.900 on Section 7.2 Nokia, Samsung

Discussion:

Ericsson: 38.953 mention indoor car users to be reflected too.

Fraunhofer: Then we need to add more details on that model. 7.2.1 table to be corrected.

Huawei: Table 7.2.2 values are already agreed.

We should agree this TP first. It captures agreement from last meeting. Modifications can be added for the next version.

Decision: The document is **agreed**

R1-164608 TP for TR38.900 on Section 7.4 Nokia, Samsung

Discussion:

Nokia: More clarifications are needed for O2I section in this meeting.

Fraunhofer: We need to decide parameter d. PL equations are modified. It is not clear what frequencies are meant. General note of units and equations needs clarifications.

NTT DOCOMO: Rural macro scenario frequency range is not clear.

Nokia: It is up to 7 GHz.

Decision: The document is **agreed**

R1-164609 TP for TR38.900 on Section 7.5 Nokia, Samsung

Discussion:

LGE: Steps 2 and 3 should be corrected.

Fraunhofer: Some parameters needs further clarifications.

NTT DOCOMO: Table 7.5 unit of distance needs further clarifications.

Decision: The document is **agreed**

R1-164610 TP for TR38.900 on Section 7.6 Nokia, Samsung

Discussion:

Motorola: Equation and impulse response corrections are needed. Why impulse response is a function of f?

Decision: The document is **agreed**

R1-164611 TP for TR38.900 on Section 7.7 Nokia, Samsung

Discussion:

Huawei: There are couple of issues to be corrected.

Samsung: There are some errors not captured but discussed in email discussions.

Ericsson: We agreed also K-factor scaling for LOS.

Decision: The document is **agreed**

R1-164612 TP for TR38.900 on Section 7.8 Nokia, Samsung

Discussion:

Decision: The document is **agreed**

R1-164613 TP for TR38.900 on Section 8 Nokia, Samsung

Discussion:

Decision: The document is **agreed**

R1-164614 WF on TR clean up Nokia, Samsung, AT&T, Ericsson, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm

- *Proposal-1: For all the parameter values in bracket, remove the brackets (confirm the value in bracket) if no proposals of other value are received in RAN1#85.*
- *Proposal-2: Address all FFS points in the TR in RAN1#85.*
- *Proposal-3: Section 7.2, every scenario has a sentence like: "Other parameters are FFS". Remove the FFS sentences for each scenario with the understanding of "other parameters can be considered"*

Discussion:

Fraunhofer: "Other parameter can be considered" has a different meaning. Missing parameters are FFS.

Nokia: Intention is not to replace the sentence but to remove "Other parameters are FFS".

ZTE: We are OK with intention but safer way would be to mention numbers can be revised if problems are found.

Nokia: Every parameters can be revised if issues are found.

Decision: The document is **agreed**

R1-164615 Detailed parameters for RMa scenario description Nokia, Samsung, AT&T, Ericsson, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm
Use below table in section 7.2 for RMa scenario description

Discussion:

LGE: Is BS-UT distance 2d or 3d?

Nokia: 2d

Fraunhofer: In car users are mentioned but why are we not considering pedestrians at all?

Nokia: This is in line with NR SI

Huawei: Other scenarios mention also UE mobility. Should that be considered also for RMa?

Nokia: 3D CM mention reasonable UE speed. Our proposal is to remove that from all scenarios.

Fraunhofer: How to do simulations then?

Nokia: That can be done in separate WI like FD-MIMO.

Motorola: Range of speed could be add on assumption.

Ericsson: It is not mandated for simulations but meant for calibration purposes.

Huawei: We need to clarify the speed for the in car users.

Decision: The document is **agreed**

R1-165465 **TP for TR38.900** **Nokia, Samsung**

Discussion:

Decision: The document is **agreed**

R1-165757 **Applicability of TR38.900 channel models** **Huawei, HiSilicon**

Discussion:

Samsung: Some of these are already understood. There is no confusion to correct.

Fraunhofer: RMa scenario should be applicable to up to 7 GHz.

Nokia: We should not this document. RMa is a new and special scenario.

LGE: No need to approve.

Huawei: Don't we need to evaluate whether the model fulfil the requirements?

Samsung: Additional features are already specified in TR.

Decision: The document is noted

R1-165758 **Discussion on the channel model names and abbreviations** **Huawei, HiSilicon**

Discussion:

Samsung: We don't support HF. E.g. NR could be better.

Ericsson: We support NR

LGE: 5G or NR.

Nokia: NR is OK even it is a technology.

Rapporteur could implement the name change by using some acronym in TR abbreviations. Discuss by Friday lunch time. If no agreement then the current names are used.

Decision: The document is noted.

Friday: Current names are used for >6GHz channel model study (TR38.900)

R1-165478 **Corrections for CIR Equations** **Fraunhofer HHI, Motorola Mobility, Lenovo**

Discussion:

LGE: No strong concerns but clarifications needed for proposals 1 and 2. Why we have to change?

Fraunhofer: To avoid misunderstandings. Sometimes people don't realize if we are in time domain or not.

Samsung: Everybody know these models used in the past so need to change. What is actually proposal 3?

Fraunhofer: Change from + to – sign. Lambda f is not defined anywhere. We want to make clear what is coefficient and what is CIR.

Samsung: Rapporteur can do the editorial changes.

Huawei: This is not only editorial change. Equations are different.

Motorola: Errors has to be corrected.

Decision: The document is revised in 5774

R1-165774 **Corrections for CIR Equations** **Fraunhofer HHI, Motorola Mobility, Lenovo, CATT, Huawei, HiSilicon**

Discussion:

Samsung cannot agree. Equations and been used for long time, also in 3D CM. There is no strong reason to change.

Samsung: As compromise delay correction in Proposal 3 can be agreed in principle

ZTE has concerns on proposal 3. Same should be done also for hybrid model.

Delay correction in Proposal 3 can be agreed

Decision: The document is noted

Friday

R1-165775 **WF for TR clean-up** **Nokia, Samsung, Huawei, HiSilicon, Intel, NTT DOCOMO, Qualcomm, AT&T, KT Corporation, Alcatel-Lucent Shanghai Bell, ZTE, Interdigital**

- Remove all brackets in the TR38.900

Discussion:

Decision: The document is noted as working assumption

Agreement: Use 3D distance in RMa path loss

[R1-165768](#) TR38.900 v0.4.0 Samsung, Nokia

Discussion:

Decision: The document is return.

Friday: The document is agreed in principle, and email approval to check the consistency with the agreements reached in RAN1#84bis and RAN1#85 meetings until June 2nd – (Samsung)

Offline session notes

[R1-165457](#) Minutes of offline session on Tue Nokia

Discussion:

Decision: The document is noted

[R1-165467](#) Minutes of offline session on Wed Samsung

Discussion:

Decision: The document is noted

Friday

Email discussions

Email discussion until the next meeting for full calibration – [R1-165770](#)

[85-19] Email discussion until June 10th for updating results for large scale calibration (Samsung)

[85-20] Email discussion until June 25th for full calibration results (Samsung)

[85-21] Email discussion until June 25th for additional feature calibration (Samsung)

[85-22] Email discussion until August 10th for approval of the summary related to all the calibration results and updated TP (Samsung)

7.2.1 Remaining details on large scale modelling for >6GHz

Path loss modeling

[R1-164729](#) WF on Pathloss clean up Huawei, HiSilicon, Nokia, Samsung, AT&T, Ericsson, Intel, KT Corporation, NTT DOCOMO, Qualcomm, ETRI

- For UMa, UMi Street Canyon, Indoor office and RMa, limit the NLOS pathloss by LOS pathloss. (same as 36.873)
- NLOS Pathloss is defined as the Max(PL_{LOS}, PL_{NLOS}):
where PL_{NLOS} and PL_{LOS} are LOS and NLOS PL formula in current TR

Discussion:

ZTE: We are OK but do we need to redo calibration?

Samsung: We don't need to redo calibration as we have good enough match between companies already.

Fraunhofer: What about RMa calibration? It would be important to include also that.

Samsung: That is different scenario discussed in NR session. No need for that calibration.

Nokia: No need to have another calibration campaign but companies can update their results if they want.

ZTE: This propose max for all scenarios.

Decision: The document is agreed

Penetration loss

[R1-164569](#) Remaining issues on large scale modeling LG Electronics

Proposal 1: Whether to use high or low loss model should be UE-specific.

Proposal 2: The 2D indoor distance, d_{in} , should be common for sectors of an eNB but differently generated for different (non-collocated) eNBs.

Proposal 3: O-to-I penetration loss deviation should be common for 3 sectors of an eNB but different one for different eNB, and it should replace shadow fading of path loss.

Proposal 4: The clarifications on (1) high vs. low loss model, (2) d_{in} , and (3) O-to-I penetration loss deviation should be included into large scale modeling section of the TR rather than calibration assumption section.

Discussion:

Decision: The document is not treated

[R1-164617](#) Clarifications on O-I implementation Corporation, NTT DOCOMO, Qualcomm, Samsung

Nokia, AT&T, Ericsson, ETRI, Huawei, HiSilicon, Intel, KT

- Clarify the implementation of O-I in TR38.900 as following:
 - The selection of high loss or low loss O-I model is UE specific
 - O-I deviation is an add-on term to SF.
 - Change the standard deviation to 4.4 and 6.5 for low loss and high loss penetration model separately (see below table from [R1-163256](#))
 - O-I deviation is UE specific random variable.
 - d_{in} is an UE specific random variable

Discussion:

LGE: We have prepared another WF on this issue.

Decision: The document is revised in 5458

[R1-165458](#) **Clarifications on O-I implementation**
Corporation, NTT DOCOMO, Qualcomm, Samsung

Nokia, AT&T, Ericsson, ETRI, Huawei, HiSilicon, Intel, KT

Discussion:

Decision: The document is withdrawn.

[R1-165451](#) **WF on O-to-I penetration modeling**

LG Electronics, CATT, CHTTL, Intel, ITRI

Discussion:

Straight Path: Modeling should be site specific. UE specific is not a good approximation e.g. what comes to correlation. Deviations are depended to angle.

Nokia: Site specific was our original proposal but after discussing with other companies we believe US specific is more close to reality.

Straight Path: There are penetration coming from the 4 side of the UE. Those should be site specific.

Ericsson: Propagation is typically coming from the closest wall. This increases the correlation. Shadow fading is link specific and should be accounted for also.

Samsung: Can we agree Proposal 1 Option 2 and proposal 2.

LGE prefers option 1.

CATT: We prefer option 1.

Straight Path: We prefer option 1.

Decision: The document is revised in 5464

[R1-165464](#) **WF on O-to-I penetration modeling**

LG Electronics, Straight Path, Ericsson, Samsung, Nokia,

Alcatel-Lucent Shanghai Bell, ETRI, CHTTL, NTT DOCOMO, Huawei, HiSilicon

Discussion:

Decision: The document is **agreed**

[R1-165463](#)

WF on O2I Penetration Loss Model Mix for Urban Scenarios

Huawei, HiSilicon, CATT

Discussion:

Decision: The document is **agreed**

[R1-165849](#)

WF on clarification on O2I penetration modeling for RMa

LG Electronics, Ericsson, ETRI,

Samsung, Straight Path, NTT DOCOMO, Intel, Nokia, Alcatel-Lucent Shanghai Bell, CHTTL

- For RMa scenario, the indoor 2D distance (d_{2D-in}) for indoor UE is generated in the same manner agreed in [R1-165464](#).
 - d_{2D-in} is UE-specific and generated as the minimum of two independent uniform RVs between 0 and 25 m.
 - Other channel modeling steps that should utilize d_{2D-in} follow the same calculation for d_{2D-in} .
- The correlation distance for cluster/ray specific random variables for RMa O2I scenario is 15m.
 - Note that this value is the same as one for UMa/UMi-Street Canyon O2I.

Discussion:

Intel: Also correlation distance for the indoor-outdoor stage should be added with the value of 50 m.

Agreed with the addition: For the RMa scenario correlation distance for the indoor-outdoor state should be added with the value of 50 m.

Decision: The document is **agreed**

[R1-164804](#)

Discussion on recommended split of low and high penetration loss for NR

Samsung

Proposal: For UMi, the low-loss model is used 80% probability and the high-loss model is used 20% probability; for UMa, the low-loss model is used 90% probability and the high-loss model is used 10% probability.

Discussion:

Ericsson: Having different probabilities in UMa and UMi is not in line with NR work.

Samsung: NR scenario don't have UMa and UMi mix. We should make suggestion to NR delegates.

Ericsson: BS above rooftop is UMa, below rooftop it is UMi.

Huawei: We are confused why we are discussing this. Channel model task is not to decide high or low loss.

Nokia: We sympathize the intention of this proposal but we should not have different probabilities for UMa and UMi.

CATT: We have similar view than Huawei.

Ericsson: We also agree with Huawei and CATT. One way could be to capture the recommendation. In the end this is simulation assumption.

Straight Path: There are reasons for the loss numbers in reality.

Decision: The document is revised in 5459

R1-165459 Discussion on recommended split of low and high penetration loss for NR Samsung

Discussion:

Decision: The document is withdrawn.

R1-165398 Additional Considerations on Building Penetration Loss Modeling for 5G System Performance
Evaluation Straight Path Communications

Two options to model the mix of high-loss and low-loss building penetration models:

Proposal 1: The low loss model should be used with 80% probability, the high loss model should be used with 10% probability, and a medial loss model (the average of the high-loss and the low-loss model) should be used for 10% of the probability.

Proposal 2: The low loss model should be used with 80% probability and the high loss model should be used with 20% probability for Urban Micro; the low loss model should be used with 90% probability and the high loss model should be used with 10% probability for Urban Macro.

We request RAN1 to select one of these two proposals for New Radio (NR) system performance evaluation purposes.

Discussion:

Decision: The document is **not treated**

Rural Macro model

R1-164712 Penetration loss measurements for RMa settings Qualcomm Incorporated

Proposal: Adopt the low-loss model from [R1-161636](#) [4] to capture the shadow fading standard deviation for building penetration in an RMa setting, as suggested in [R1-163909](#) [1].

Discussion:

Decision: The document is **not treated**

R1-164975 New measurements at 24 GHz in a rural macro environment Telstra Corporation Limited,
Ericsson

*Proposal: Extend the applicability of the new RMa path loss model in [R1-163909](#) **Error! Reference source not found.** to 24 GHz*

*Proposal: Consider extending the applicability of the new RMa fast fading model in [R1-163909](#) **Error! Reference source not found.** to 24 GHz*

Discussion:

Fraunhofer: Lot of parameters are not investigated for this frequency range. This proposal is based on single measurements only.

Huawei: Scope of RMa is below 7 GHz.

Telstra: We want to challenge that approach.

Straight Path: We agree with Telstra. In the end the channel model does not matter. You need to design your system up to 100 GHz.

Huawei: ITU considered above 24 GHz.

Telstra: We did measurement on 24 GHz but that can be updated also to higher frequencies.

Fraunhofer: We don't have not enough data to conclude this.

Nokia: Figure 2, what is the difference between rural and suburban areas?

Ericsson: This is single measurement campaign but not much less than others like urban macro model.

CMCC: It is good to see results. We should match with practical deployments.

Decision: The document is revised in 5732

R1-165732 Way Forward for RMa model frequency range Telstra Corporation Limited, Ericsson

Discussion:

CMCC: This is not good way to extend the model based on only one measurement results.

Ericsson: Urban macro has been changed based on 2 measurements. This is more reasonable than UMa.

Huawei: How well the measurement results correlate with the low frequency of the IMT-A?

Ericsson: Parameters are the same than < 7 GHz.

Huawei: IMT-A was defined based on one measurements in Tyrnävä near to Oulu, Finland which is the flat terrain.

Telstra: We are surprised with this discussion.

Ericsson: If IMT-A was based on single measurement could we do the same also for this.

CMCC: There were lot of measurements for IMT-A e.g. in Winner.

Nokia: Do we intend to add a note to PL model?

Ericsson: Model is valid up to 30 GHz. It is only for the PL model.

Decision: The document is revised in 5769

R1-165769 **Way Forward for RMa model frequency range** Telstra Corporation Limited, Ericsson

Proposal: Extend the applicability of the RMa model to 30 GHz for pathloss, noting that:

- *All fast fading aspects remain applicable to 7 GHz*
- *Pathloss model validation above 7 GHz is based on a single measurement campaign conducted at 24 GHz*
 - *This sentence will be captured as a footnote to the pathloss table in the TR*

Discussion:

Huawei: This version is better now.

Decision: The document is **agreed**.

R1-165244 **WF on O2I penetration for the RMa scenario** Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

Proposal 1: Adopt a car penetration loss of 9 dB on average with a 5 dB standard deviation

Note: This model is valid for at least 0.6-60 GHz

Proposal 2: Include an optional car penetration loss model for metallized windows with 20 dB on average with a 5 dB standard deviation

Proposal 3: Adopt the low loss model for building penetration in the RMa scenario

Discussion:

LGE: Proposal 2. When the option would apply?

Ericsson: Optional in the future SI/WIs.

Huawei: Why frequency range upper limit is 60 GHz? Is this frequency dependent?

Ericsson: It mean at least 60 GHz.

Qualcomm: We also have measurement results in our document.

Straight Path: Optional model is a good idea but situation may change with mixed windows.

CMCC: It is good to have optional model.

Fraunhofer: In car penetration model up to 60 GHz are specific to RMa.

Decision: The document is **agreed**

Correlations

R1-165243 **Clarifications on channel model correlations** Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

Proposal 1: UEs on different floors have uncorrelated LSPs

Proposal 2: LSPs for links from different sites to same UE are uncorrelated

– *Clarify this directly in the TR rather than by reference*

– *Applies also to LOS/NLOS state but not indoor/outdoor state*

Proposal 3: LSPs for links from co-sited sectors to same UE are fully correlated

– *Clarify this directly in TR rather than by reference*

– *The outcome of steps 1-9 should be identical for all sectors*

Discussion:

Decision: The document is **agreed**

R1-165350 **Clarifications on frequency correlation** Ericsson, AT&T, ETRI, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

Proposal: Cluster delays and angles are frequency-independent

Discussion:

Huawei: In many cases you can see similar delays but they are not always frequency independent. This is important topic but maybe too simplified approach.

Nokia: We don't have procedure to address this proposal in TR.

Ericsson: This may be simplification but pretty close to reality.

Samsung: We need to see what parameters are meant to be frequency-independent.

LGE: We agree with Samsung. This is too high level.

Fraunhofer: Cluster delay could vary over frequency.

Ericsson: Delay spread is in a way a dispersion of the channel.

Straight Path: We understand the intention but also agree with Samsung.

Decision: The document is noted

R1-165481 **WF on frequency correlation** Ericsson, ETRI, Telstra Corporation Limited

- › Proposal 1: Step 1 is identical for all frequencies, except:
 - 1d Antenna patterns and array geometries
 - 1g System centre frequency and bandwidth
- › Proposal 2: Step 2 is identical for all frequencies,
 - *Note: Soft LOS states may be different due to frequency dependent function*
- › Proposal 3: If blocking is modeled, the positions of blockers are the same for all frequencies
 - *Note: The blocking loss may be different*
- › Proposal 4: Step 4 is identical for all frequencies, except for possibly frequency-dependent scaling of e.g. delay spread and angular spreads according to the LSP tables
- › Proposal 5: The cluster delays and angles resulting from steps 5-7 are same for all frequency bands
- › Proposal 6: Per-cluster shadowing (Z_n in step 6) is independent for different frequency bands
- › Proposal 7: Cluster powers in step 6 ~~are derived from the delay and angle spreads and~~ may be frequency-dependent
- › Proposal 8: Steps 8-11 are independent for different frequency bands

Discussion:

ZTE: WE are basically fine except with proposal 7.

Ericsson: We could change the wording like shown above in these minutes

Samsung: We need more time to look this late contribution.

Decision: The document is **agreed with the modifications by red text above.**

7.2.2 Remaining details on fast fading modelling for >6 GHz

Rural macro channel model

R1-164386 **Discussion on Rma channel model** Huawei, HiSilicon

The following problems are necessary to be further investigated:

Problem1: the difference on the surrounding may bring difference on the ZSA for RMa.

Problem2: the difference between the RMa and UMa environment may bring disorder on the inside correlation when combine the RMa azimuth and UMa zenith cross-correlation parameters together.

Problem3: the difference on the surrounding may bring difference on the cluster ZSA for RMa.

Problem4: the difference between RMa and UMi and UMa may bring difference on the correlation distance in zenith domain for RMa.

Discussion:

Decision: The document is **not treated**

Large scale parameters

R1-164049 **Discussion on removal of square bracket for LSP** Huawei, HiSilicon, Samsung

*Proposal1: the square bracket on the frequency dependent LSP in **Error! Reference source not found.** except K-factor can be removed.*

Proposal2: Modify the K-factor parameters to reuse the values from M.2135 as in Table 1 and remove the square bracket.

Discussion:

ZTE: K-factor change is not only frequency dependent. This is fundamental change. Motivation is not clear.

Huawei: In some cases K-factor can be negative. Most of the cases the K-factor shall be positive.

Ericsson: We don't agree with having frequency dependent parameters.

Decision: The document is noted

R1-164730 **Cross-correlation on LSP for Indoor office** Huawei, HiSilicon, AT&T, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

Alternative 1: the cross-correlation on LSP for indoor office in Table 2 will be adopted.

Alternative 2: the cross-correlation on LSP for indoor office in Table 3 will be adopted.

Proposal 1: Adopt Alternative 1 or Alternative 2 for cross-correlation on LSP for indoor office.

Discussion:

Huawei prefers alternative 1.

LGE prefers alternative 1.

Ericsson prefer alt 2 but also OK with alt 1.

Samsung prefer alt 2 but also OK with alt 1.

Agreement: Alternative 1: the cross-correlation on LSP for indoor office in Table 2 will be adopted.

Decision: The document is noted.

R1-164570 Remaining issues on fast fading modeling LG Electronics

Proposal 1: Choose either approach 1 or 2 for the cross-correlation matrix in UMa and UMi-Street canyon O-to-I scenarios. In case approach 1 is preferred, the table in Appendix A can be used for revising the current cross-correlation matrix.

Approach 1: Adjusting cross-correlation values to ensure that the cross-correlation matrix is positive definite.

Approach 2: Reusing the cross-correlation matrix from TR 36.873 [2].

Proposal 2: Reuse the ZSD and ZoD offset parameters from TR 36.873 for necessary parameters above 6 GHz.

Proposal 3: After determination of the ZSD and ZoD offset parameters, the scaling factor should be defined based on the determination.

Proposal 4: Reuse the mean and standard deviation of XPR from TR 36.873 for necessary parameters above 6 GHz.

Discussion:

Decision: The document is **not treated**

R1-164805 Remaining issues on UMi/UMa large-scale parameters Samsung, AT&T, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, ETRI

Proposal 1: Reuse the mean and standard deviation of XPR parameters from TR36.873 model

Proposal 2: Adopt the cluster DS as fixed number, 5 for LoS and 11 for O2I

Proposal 3: Modify the per-cluster SF parameters to 3 dB for both UMi LoS and NLoS adopting from TR36.873

Proposal 4: Reuse ZoD spread and ZoD offset for UMi O2I and UMa O2I from UMi O2O and UMa O2O, respectively

Proposal 5: Adopt the revised cross-correlation parameters for O2I scenarios in Table 4

Proposal 6: Remove square brackets in Table 1 UMi channel parameters, if there is no other proposal to update

Discussion:

Ericsson: Proposal 6 means other proposals in this meeting.

Decision: The document is **agreed**

R1-165345 WF on RMa LSPs Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

Proposal 1: For in-car and indoor users, reuse LSPs for outdoor users according to the working assumption

– Note: These parameters are in Appendix A in [R1-163909](#)

– Note: Car and building penetration loss should be added for these users

Proposal 2: Adopt the following revised cross-correlation entries for LOS

– ZSD vs DS: 0

– ZSD vs ASA: 0

– ZSA vs ASA: 0

Discussion:

LGE: Parameters for indoor UEs?

Ericsson: We use outdoor parameters.

Decision: The document is **agreed**

R1-165366 WF on ZoD offset for Indoor office Huawei, HiSilicon, Ericsson, Nokia, NTT DOCOMO, NTT, Samsung

The ZoD offset for indoor office can be set as 0 for both LOS and NLOS cases

Discussion:

Decision: The document is **agreed**

Small scale parameters

R1-164388 Discussion on removal of square bracket for cluster level SSP Huawei, HiSilicon, AT&T, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

*Proposal 1: the square bracket on the cluster level SSP in **Error! Reference source not found.** can be removed.*

Proposal 2: the scaling factors for AOA, AOD generation in TR 36.837 can be reused for InH.

*Proposal 3: the scaling factors for ZOA, ZOD generation in InH can be adopted as in **Error! Reference source not found.***

Discussion:

Ericsson: 4 clusters are far too low.

Huawei: This value is based on results from different companies.

Samsung: What is alternative?

Ericsson: Clusters as in IMT-A, 15 clusters. We have tdoc 5353.

ZTE: We support Ericsson proposal. Number of 4 do not match with link level simulations.

Huawei: IMT-A values are based on below 6 GHz.

Samsung: We don't have all parameters in place in IMT-A.

Decision: The document is revised in 5460

R1-165460

Discussion on removal of square bracket for cluster level SSP

Huawei, HiSilicon

Discussion:

NTT DOCOMO: We have measurement results supporting this.

Decision: The document is **agreed**

Frequency dependency

R1-164732

**Discussion on frequency dependent channel characteristics for InH and UMi
CMCC, ETRI, Intel, Samsung, Nokia**

Huawei, HiSilicon,

Proposal: Frequency dependent channel characteristics should be included in the model of this SI, e.g. for delay spread and angular spread.

Discussion:

Decision: The document is revised in 5570

R1-165570

**Discussion on frequency dependent channel characteristics for InH and UMi
CMCC, ETRI, Intel, Samsung, Nokia**

Huawei, HiSilicon,

Proposal: Frequency dependent channel characteristics should be included in the model of this SI, e.g. for delay spread and angular spread.

Discussion:

Ericsson: All measurements are not fully comparable.

Decision: The document is revised in 5461

R1-165351

Frequency-dependence of LSPs Ericsson, Telstra

Proposal: Use frequency-independent or weakly frequency-dependent functions for modeling LSPs

Discussion:

Huawei: We compared from different data sources independently. Those are comparable.

Ericsson: We and Fraunhofer gave reasoning in last meeting on the comparability of the measurement.

Huawei: Ericsson showed in other contribution that delays and angles are quite similar with different power levels.

Ericsson: There may be some sort of dependency but it is not linear.

Huawei: Even with same measurement campaign seems to lead to different findings.

Decision: The document is revised in 5480

R1-165461

WF on frequency dependent LSP

Huawei, HiSilicon, Samsung, NTT DOCOMO

Discussion:

Ericsson: This is only for indoor. What about other scenarios?

Huawei: In this we address only indoor. We have agreement for other scenarios.

Ericsson: We have brackets in other scenarios. We are fine in principle with this but we should apply the same also for other scenarios.

Huawei: Other scenarios can be modified in other contributions.

Ericsson: We would prefer linear domain instead, not logarithmic. It would be easier to compare plots.

Decision: The document is revised in 5475

R1-165475

WF on frequency dependent LSP for indoor office

Huawei, HiSilicon, Samsung, NTT DOCOMO

Discussion:

Ericsson: It is not only the slope change but also average value change. We do have a solution for this in 5480.

Nokia: We could remove all the brackets from LSP values in TR.

Ericsson don't agree with that approach.

Samsung: We need to solve this issue. Only 2 companies (Ericsson, Telstra) object.

Chair: How many companies can agree on removing the brackets from LSP for indoor and UMi? => Nokia, Samsung, Huawei, KT, LGE, ETRI, Alcatel Lucent Shanghai Bell, NTT DOCOMO (8 companies)

Ericsson could agree to remove brackets from indoor.

Nokia: UMi still in brackets?

Ericsson: Half dependency for UMi

Samsung: Apply Ericsson proposal for indoor and remove brackets from UMi.

Nokia: We can compromise with Samsung proposal.

Ericsson: As compromise we could take half the dependency for all the parameters.

Decision: The document is noted

R1-165480 **WF on frequency-dependent LSPs** Ericsson, Telstra

Proposal 1: Use the compromise solution between frequency-dependent and frequency-independent for all scenarios

Proposal 2: Change the frequency-dependent LSPs such that the value at 6 GHz equals the legacy value, and mandate that the LSP value is constant below 6 GHz

Proposal 3: Change frequency-independent LSPs to the legacy values

Discussion:

Nokia: proposal 1 say all the scenario but we already have agreements for UMa. This reopen parameters for some scenarios. We don't support to change agreements at this late phase. We should focus on parameters in brackets now.

Ericsson: We are open to change only some of the parameters. Proposal 3 also apply to all scenarios and parameters, not just one with brackets.

Huawei: We share the Nokia concerns on re-opening the parameters which are based on measurements.

Samsung: We have similar view than Nokia and Huawei.

Ericsson: Huawei have raised concern that models are inconsistent but not willing to change those.

Huawei: We agree there are inconsistencies but we have measurements results for high frequencies what is the focus on this SI.

We agree with the problem but not with the solution.

Ericsson: This is only solution propose to this issue. If we don't agree we will stuck with this.

Huawei: This is a new approach making parameters for <6GHz based on higher frequency measurements.

Nokia: We share the Huawei view. Target is to make realistic CM for >6 GHz.

Ericsson: This is not a new feature. It is already included in the white paper and done also earlier.

KT: We agree with Huawei, Nokia and Samsung.

Telstra: This is pragmatic approach to make model consistent.

Decision: The document is noted

Time varying parameters

R1-165218 **Time-Varying Delays and Angles** Keysight

Proposal 1: Replace the factor $\exp(j2\pi v_{n,m} \cdot t)$ with $\exp(j2\pi \sum_{k=0}^K (v_{n,m}(k\Delta T) \cdot \Delta T))$ in the channel coefficient equation

– where $t = k\Delta T$, ΔT is the time sampling interval and k is a positive integer

Proposal 2: Proposal 1 needs only to be considered in case the Doppler frequencies are time-varying. This could be due to:

- Non-linear UE movement
- Time-varying angles of arrival due to spatial consistency modeling

Discussion:

Ericsson: This is almost identical with our proposal. This is more complex. Does it also mean delta T need to be updated?

Decision: The document is noted

R1-165246 **WF on modifying channel coefficient equation for time-varying Doppler frequencies** Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

- *Proposal 1: Replace the factor $\exp j2\pi v_{n,m} \cdot t$ with $\exp j2\pi v_{n,m} t \cdot t - ti \exp j2\pi v_{n,m} ti \cdot ti$ in the channel coefficient equation*

– The phase shift at time ti is established as an anchor point and an incremental phase shift is applied

– The anchor point should be updated sufficiently often so that $v_{n,m} ti+1 - v_{n,m} ti \ll 1$

- *Proposal 2: Proposal 1 needs only to be considered in case the Doppler frequencies are time-varying. This could be due to:*

- Non-linear UE movement
- Time-varying angles of arrival due to spatial consistency modeling

Discussion:

Decision: The document is **agreed**

Clusters

R1-165352 **On number of clusters and paths within clusters** Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

Proposal: The observations in this contribution should be taken into account when deciding on the number of clusters and paths within clusters

Discussion:

Samsung: Do you have a specific proposal for the number? This is high level proposal.

Ericsson: We should have at least 400. For the high resolution maybe 1000 or 10000 would be required.

Samsung: We already agreed numbers for the other cases.

Huawei: Is this proposal for all scenarios?

Ericsson: Yes.

Huawei: Changing the number of clusters now is a major change. Proposed numbers are based on only these measurements. What kind of post processing was used in these measurements? Do you measure 10000 rays at the same time? Is the environment fixed?
Ericsson: 2 GHz BW with large antenna array was used.
Decision: The document is noted

R1-165474 WF on number of MPCs Ericsson, NTT DOCOMO

Discussion:

Huawei: There are many good aspects but we have also concerns. E.g. equation for AoD leads easily less than 1. It should never go below 3GPP 3D CM. Equations may also lead to very high number which means more complicated simulations.

Ericsson: We say the minimum value is 20. It may be good to have maximum value as well.

Huawei: There are 3 dimensions, how to spread those to delay, azimuth and elevation?

Ericsson: This WF is only for the number of paths.

Huawei: Some upper limit should be defined to reduce the simulation complexity.

Decision: The document is noted

R1-165476 WF on number of MPCs Huawei, HiSilicon

Discussion:

Samsung: Regarding the number we need to consider also simulation complexity.

Huawei: We think it is good to add some upper limit to reduce complexity.

Nokia: We could leave the number as simulation parameter. Companies could decide the value they use.

Huawei: No strong opinion on that but we need to remind the complexity.

Ericsson: We could give guideline on simulation parameter.

Decision: The document is revised in 5771

R1-165771 WF on number of MPCs Huawei, HiSilicon

Discussion:

Nokia: Will this be in addition feature section?

Huawei: This is additional text to DCM for large BW and large array.

LGE: How about calibration?

Decision: The document is **agreed with the addition: For calibration Nmax is 40.**

7.2.3 Remaining details on modelling of additional features for >6GHz channel model

7.2.3.1 Remaining details on blockage modelling

R1-164193 Remaining details for blockage modeling Intel Corporation

Discussion:

Decision: The document is revised in 5405

R1-165405 Remaining details for blockage modeling Intel Corporation

Proposal 1: The additional shadowing of one blocker should consider the link between the transmitter and the blocker for indoor scenario as in equation (2-1).

Proposal 2: When calculating the additional shadowing on the LoS channel cluster, the blocker model including center and span, can still be built in the receiver's polar coordinate system. Then the blocker model in the transmitter's coordinate system can be derived by center $(\varphi_{Rx} - \pi, \pi - \theta_{Rx}, r_{Tx})$, azimuth angular span $A_{Rx} r_{Tx} / r_{Rx}$, zenith angular span $Z_{Rx} r_{Tx} / r_{Rx}$.

Proposal 3: For NLoS channel cluster, a virtual transmitter can be assumed at the extension line of AoA/ZoA.

Proposal 4: The additional shadowing on the NLoS channel cluster can be calculated based on the link between virtual transmitter and receiver in the same way as LoS channel cluster.

Proposal 5: The distance between the virtual transmitter and the blocker can be randomly generated in the range of $[r_{Rx} d_{Tx \rightarrow Rx} - r_{Rx}]$.

Proposal 6: The definition of LoS/Shadow region can be clarified, e.g. using figure 3, for knife edge model.

Proposal 7: The existent period of hand-held blockage can be modelled as a random variable with exponential distribution or uniform distribution. Or for simplicity, the existence/absence of hand-held blockage can be modelled as a discrete event for a given UE during the whole traffic transmission of this UE.

Proposal 8: The coherent distance to generate spatially consistent blockers need to be defined. It can be generated as the scenario dependent value, e.g. [5] meter for indoor scenario, and [10] meter for UMi/UMa/RMa.

Discussion:

Qualcomm: Proposal 1 is fine in principle. Simulations support shorter distances.

Samsung: In principle we agree with proposal 1. We have slightly different calculation method.

Ericsson: On proposal 7, how would we parametrise such a model?

Decision: The document is noted

R1-164713 Advantages of stochastic blockage model Qualcomm Incorporated

Document highlight the main advantages of the stochastic approach and provide a text proposal

Discussion:

Fraunhofer: Reasoning for K-values is confusing.

Samsung: Step c is FFS in TP. Do you have any specific proposal? This method may require too many parameters.

Qualcomm: We could modify the attenuation loss.

Decision: The document is noted

R1-164808 Remaining details on blockage modelling for above 6 GHz channel model Samsung

Proposal 1: Proposal B3 is preferred.

Proposal 2: Azimuth angles of blocking screens should be generated with spatial consistency, i.e. interpolation using correlated random variables. Elevation angles of blocking screens should be computed according to geometry.

Proposal 3: Sizes of angular blocking regions should be determined by Eq. (2)-(6).

Proposal 4: The number of blockage regions is modelled by a Poisson distributed random variable as Eq. (7).

Proposal 5: Proposal B5, i.e., knife edge based model should be used to compute attenuation of blockage.

Proposal 6: Proposal A7 is preferred.

Proposal 7: The blockage attenuation is constant during the blockage period. Linear transition periods of 0.01s are introduced at both sides of the blockage period. The average blocking period should be used in the simulation. The average blocking period is determined by Eq. (9)

Discussion:

Ericsson: We don't agree with the complexity. We can use the same approach for blockers as for users.

Qualcomm: We need to consider also other parameters which increase the complexity.

Decision: The document is noted

R1-165347 WF on Blockage modeling Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

- Both approaches have their use cases
 - A (stochastic model) when a generic and computationally efficient blocking scenario is needed
 - B (geometric model) when a specific and more realistic blocking scenario is needed
- Proposal: Adopt both A and B as optional blocking models

Discussion:

ZTE: Approach A still has some parameters as FFS.

Nokia: We had to address all FFS points in this meeting so we propose this to be **conditionally agreed**

Ericsson: What is we can agree points only for one model?

Samsung agrees with Nokia.

Decision: The document is **agreed**

R1-165462 WF on dynamic blockage Qualcomm Incorporated, Intel, Samsung, Ericsson

Discussion:

Ericsson: We can agree but we need to note that parameter values on stochastic approach need further clarifications.

ZTE: We prefer the single solution but also OK with this approach. Companies should provide a TP in this meeting.

Qualcomm: We are working on that.

LGE: You just generate random distance. We are in general fine with option A.

Nokia: It is difficult to find different with already agreed WF. We could go directly for the TPs.

Decision: The document is noted.

7.2.3.2 Remaining details on spatial consistency modelling

Remaining issues

R1-164809 Remaining details on spatial consistency for above 6 GHz channels Samsung

Proposal 1: Use the proposed channel generation steps for user dropping.

Observation 1: The modelling of spatial consistency in the user mobility case may require recalculation of antenna patterns, which increases the complexity of channel simulation.

Proposal 2: If spatial consistency in mobility is considered, Method 1 or Method 2 should be used. Also, Method 2 is slightly preferred.

Under the working assumption of interpolation with correlated random variables, a method was proposed in [7], which is denoted as Method 1

Propose a new method (denoted as Method 2) to update channel parameters over time.

Discussion:

Ericsson: Proposal 1, companies may implement this differently. Method 2 is problematic approach.

Huawei: How about angle spreads in Method 1? Is it possible to merge these proposals?

Samsung: No

Decision: The document is noted

Time evolution

R1-164050 Dynamic modeling for time evolution Huawei, HiSilicon

Proposal 1: Adopt the model of time-variant angles given by equations (1)~(5) under the framework of spatial consistency model in [3].

Discussion:

Decision: The document is **not treated**

R1-164389 Cluster delay with time evolution Huawei, HiSilicon

Proposal 1: Adopt the correlation matrix method in (1) to slow down the varying rate of cluster delay

Discussion:

Decision: The document is **not treated**

R1-164726 Discussion on spatial consistency in 5G channel model in time variant case Huawei, HiSilicon

Proposal 1: Considering these results we may define a maximum distance of movement for the time evolution before a new spatially consistent realization is drawn. The max. movement maybe in the range of a few meters, e.g. 5m. This distance however may depend on the distance d_{2D} .

Proposal 2: Consider an asymmetric behaviour for the angular changes to model local cluster angular change rates.

Discussion:

Decision: The document is **not treated**

Calibration

R1-164194 Calibration methodology for spatial consistency Intel Corporation

- Proposal 1: Spatial consistency can be calibrated as:
 - For each dropped UE, create one pair of positions according to **Error! Reference source not found.**. The first position is the dropped UE's position. The second position has fixed distance, e.g. 1 meter, from the first position.
 - Collect statistics from channel realization on each pair of positions.
 - For LOS/NLOS state spatial consistency, collect CDF of the LOS/NLOS state delta.
 - For cluster level spatial consistency, collect CDF of the mean channel angle difference using equation (1-2) for AOD/ZOD/AOA/ZOA.
- Proposal 2: For drop based MU-MIMO simulation, use the baseline model for spatial consistency.
- Proposal 3: If improvement of mobility based simulation is needed, use baseline model for initial UE dropping, followed by updating cluster delay using equation (5-1) and updating cluster angle with the limit of equation (5-2).
- Proposal 4: If moving between different channel states is modelled, define soft LOS/NLOS and indoor/outdoor states, and then path loss and fast fading channel are defined as a function of soft LOS/NLOS and indoor/outdoor states as in equation (7-1) and (7-2).

Discussion:

Huawei: The scope of this document is not clear. Only proposal 1 is for calibration. Is mobility also considered?

Intel: This propose also other details than calibration. Mobility relation is not agreed yet.

Nokia: We are OK in principle with dropping part for calibration.

Samsung is also OK with dropping part.

Huawei: WE have joint contribution in different agenda item

Decision: The document is noted

Further enhancements

R1-165233 WF on correlation distance for spatial consistency in RMa Intel, Ericsson, AT&T, ETRI, Huawei, HiSilicon, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

- The correlation distance for cluster/ray specific random variables for RMa is according to the table below
- The correlation distance for LoS state is [60m] for RMa

	RMa	
	LOS	NLOS

Correlation distance (m) for cluster/ray specific random variables	[50]	[60]
--	------	------

Discussion:

Nokia: We should remove the brackets.

Samsung: Same comment.

Chair: Brackets can be removed when implementing text into TR.

Decision: The document is **agreed**

R1-165234 **WF on mobility enhancement for spatial consistency** Intel, Ericsson, AT&T, ETRI, Huawei, HiSilicon, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

Proposal 1: Both alternatives are captured in TR 38.900

- *Alternative 1: based on [R1-163480](#), details described in the following slides*
- *Alternative 2: based on [R1-163248](#), details described in the following slides*

Proposal 2: Modify the below text by adding the red text into the current TP

- *The cluster specific random variables include:*
 - » *Cluster specific random delay in step 5;*
 - » *Cluster specific shadowing in step 6; and*
 - » *Cluster specific offset for AoD/AoA/ZoD/ZoA in step 7.*
 - » *Cluster specific sign for AoD/AoA/ZoD/ZoA in step 7*
- *The procedure shall apply to each cluster before sorting the delay. Cluster specific sign for AoD/AoA/ZoD/ZoA in step 7 shall be generated once kept unchanged per simulation drop if UE position changes during simulation. The ray specific random variables include:*

Discussion:

Samsung: Alternative 1, would it be possible to update cluster angles?

Ericsson: Alternatives are different in scope. We are fine with capturing both in TR but we need to consider how to do that.

Decision: The document is **agreed**

R1-165248 **WF on O2I spatial consistency** Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

- *Proposal 1: Determine the “building type” using a spatially consistent random variable with correlation distance [50 m]*
 - *The building type is determined by comparing the random variable with P1 and P2*
- *Proposal 2: Determine the indoor distance from a spatially consistent uniform random variable in the interval 0-25 m, with correlation distance [25 m]*
- *Proposal 3: Make the penetration loss variability sP a spatially consistent random variable with correlation distance [10m]*

Discussion:

Fraunhofer: What is the value in proposal 3?

Ericsson: Same as the Shadow fading.

Decision: The document is **agreed**

R1-165354 **WF on further enhancements for spatial consistency** Ericsson, Intel, AT&T, ETRI, Huawei, HiSilicon, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

- *Proposal 1: Soft LoS states are modeled in spatial consistency modeling*
 - *Soft LoS state is a float number between 0 (NLoS) and 1 (LoS)*
 - *Soft LoS state generating method is according to the appendix*
 - *dLoS is [20]*
 - *Define path loss and channel matrix to be a function of soft LoS state*
 - *$PLLOS_{soft} = PLLOS \cdot LOS_{soft} + PLNLOS \cdot (1 - LOS_{soft})$*
 - *$HLOS_{soft} = HLOS \cdot LOS_{soft} + HNLOS \cdot (1 - LOS_{soft})$*
 - *Note: Not restricted to mobility simulations only*
- *Proposal 2: Soft indoor/outdoor states are not modeled in spatial consistency modeling*
 - *Note: The model thus doesn't support move between indoor/outdoor states in mobility simulation*

Discussion:

LGE: Agreement from last meeting was different.

Ericsson: This is a shared view from sourcing companies.

Samsung: We shall remove the brackets when implementing this in TR.

Decision: The document is **agreed**

R1-165773 **TP for blockage** Qualcomm, Intel, Samsung, Ericsson

Discussion:

Fraunhofer: have you considered if you move the screen and elevation change?

Straight Path: Situation is different in NLOS case.

Decision: The document is noted.

7.2.3.3 Remaining details on large antenna array modelling

R1-164727 Discussion on remaining details on large antenna array modeling Huawei, HiSilicon

Proposal 1: The following aspects on large array support should be discussed in the channel model SI: spherical wave, high angular resolution, 3D correlation issue, and non-stationarity.

Proposal 2: The spherical wave modeling introduced in this document should be taken into account in the channel model SI.

Discussion:

Ericsson: What do you mean by 3D correlation issue?

Huawei: Contribution [6] discuss that.

Samsung: Do you have concrete proposals?

Huawei: Spherical way proposal is in this document. Other issues are ongoing except non-stationary. That can be discussed this week further.

Ericsson: Would it be in space domain?

Huawei: Yes.

Ericsson not comfort able with proposal 2.

Decision: The document is noted

R1-165183 Implementation of cluster delay and angle spread NTT DOCOMO, INC., AT&T, Ericsson, Huawei, HiSilicon, Intel, KT Corporation, Nokia, Qualcomm, Samsung

Alternative 1: Implementation for narrow BW based on sub-cluster information of 3GPP 3D model

Alternative 2: Implementation for large BW and/or large antenna arrays using generating step of cluster delays and angles in the 3GPP 3D channel model

Alternative 2a: Method using generating step of cluster delays and angles in the 3GPP 3D channel model

Alternative 2b: New method

Proposals 1: Adopt Alternative 1 for low complexity simulations where narrow BW

Proposals 2: Down select from Alternative 2a and Alternative 2b for large BW and/or large arrays

Discussion:

NTT DOCOMO support 2a.

Ericsson support 2b.

ZTE support 2b.

Decision: The document is revised in 5466

R1-165466 WF on implementation of cluster delay and angle spread NTT DOCOMO, Huawei, HiSilicon, Intel, Nokia, Qualcomm, Samsung

Proposal 1: Alternative 1 is adopt for low complexity simulations where narrow BW

Proposal 2: Alternative 2a is adopt for large BW and/or large arrays

Discussion:

Ericsson: Alternative 2a is based on number of paths not in line with other WF. We like to see the scaling.

ZTE: Proposal is quite high level. It would be better to provide TP.

Decision: The document is revised in 5477

R1-165477 TP for implementation of cluster delay and angle spread in TR38.900 on Clause 7.5 NTT DOCOMO, Huawei, HiSilicon, Intel, Nokia, Qualcomm, Samsung

Discussion:

LGE: Comments on 3 issues. How to use scaling factor? How to implement cluster delays in section 7.5? This is a new feature for large antenna array. How RAN1 us this new feature?

NTT DOCOMO: We will assume arrays. Clause belongs for rapporteur to handle.

Samsung: We prefer to capture in 7.6 instead.

LGE: New delay offset for narrow BWs.

ZTE: 2 values are not defined yet. Who will provide those definitions? Scaling factor is non-linear optimisation factor. Companies are not sure about realization.

Fraunhofer: What to do with sub path powers?

Ericsson: Which agreement in Busan this is referring to? We could re-use agreed TP for the hybrid model.

NTT DOCOMO: WF in this meeting.

Decision: The document is revised in 5772

Friday

R1-165772 WF on implementation of cluster delay and angle spread Ericsson, NTT DOCOMO, ZTE Corp, ZTE Microelectronics
Discussion:
Decision: The document is agreed.

R1-166025 WF on AoA, ZoA, ZoD Angular Scaling Huawei, HiSilicon, NTT DOCOMO
• Agree the following example values for scaling:

- AoA spread (ASA) for each CDL model: {30, 45, 60} degrees.
- ZoA spread (ZSA) for each CDL model: {5, 10, 15} degrees.
- ZoD spread (ZSD) for each CDL model: {1, 3, 5} degrees.

Decision: The document is agreed.

R1-165353 Indoor Highly Resolved Channel Measurements at 60 GHz Ericsson, Telstra
Observation 1: 1000-10000 MPCs needed to account for 95% of power
Observation 2: 100 strongest MPCs account for 10-70% of power
Observation 3: Number of observed clusters are at the order of 10-20
Observation 4: More clusters and MPCs needed in NLOS than in LOS

Proposal: The observations in this contribution are taken into account when deciding on the number of clusters and paths within clusters

Discussion:
Huawei: BW is 2 GHz with very large array. How did you consider the impact of that?
Ericsson: Broadening the clusters.
Decision: The document is noted.

7.2.3.4 Remaining details on modelling of other additional features

R1-164353 Text proposal to update oxygen absorption loss ZTE
Discussion:
Decision: The document is agreed

7.2.4 Remaining details on link-level channel models

Remaining issues

R1-164724 Discussion on the link level channel models Huawei, HiSilicon
Proposal 1: CDL-A/TDL-A two last tap powers adjusted 19.0 to -19.9 and -33.1 to -29.7.
Proposal 2: CDL-D/CDL-E/TLD-D/TDL-E delay spread is adjusted by multiplying all delays by a constant value to obtain 1.0000 rms delay spread.
Proposal 3: Correct the editorial error of CDL-D.
Discussion:
Decision: The document is agreed

TPs and WFs

R1-164051 Text proposal to TR 38.900 to add link level channel model for LoS scenario Huawei, HiSilicon
Discussion:
Decision: The document is agreed

R1-164052 Text proposal to TR 38.900 to add antenna filtering for link level channel model Huawei, HiSilicon
Discussion:
Fraunhofer: We had email discussions where we said there is something wrong in this. Filter has to be changed.
Huawei: This is a copy of agreed WF from Busan.
Decision: The document is revised in 5468

R1-165468 Text proposal to TR 38.900 to add antenna filtering for link level channel model Huawei, HiSilicon
Discussion:
Samsung: We have not got time to check.
Decision: The document is return.
Friday: The proposed TP is just noted.

R1-164257 Text Proposal on the purpose of link-level channel modes for 38.900

CATT

Discussion:

Samsung: This is more a guideline for NR, not for channel model work.

CATT: WE have used similar statement also earlier SCM channel model work.

LGE: We are not sure why we have to capture this in a TR.

Huawei: This is not necessary text in a TR. It is up to RAN1 to decide which model to use.

Ericsson: This is not something we should mandate. We could have recommendation or guideline.

Decision: The document is noted

[R1-164725](#) **Text proposal to TR 38.900, corrections and clarifications to the link level channel models** Huawei, HiSilicon

Discussion:

LGE: Comment on CDL table delay.

Huawei: Delay is normalised to 1 s.

CMCC: Do we have to align the numbers with system simulation parameters?

Huawei: These are different models agreed before system simulation model due to time pressure.

Decision: The document is **agreed**

[R1-164731](#) **Scaling of the K-factor of the link level channel models** Huawei, HiSilicon, Nokia, Samsung, AT&T, CMCC, Ericsson, Intel, KT Corporation, NTT DOCOMO, Qualcomm

Discussion:

Decision: The document is revised in 5440

[R1-165440](#) **Scaling of the K-factor of the link level channel models** Huawei, HiSilicon, Ericsson, Nokia, Samsung, Intel, Qualcomm, NTT DOCOMO, AT&T, KT Corporation

Proposal: The above procedure for K factor scaling and example K-factor values is added into the TR 38.900.

Discussion:

Decision: The document is **agreed**

[R1-165349](#) **WF on link level models for MIMO simulations** Ericsson, AT&T, CMCC, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

Discussion:

Decision: The document is revised in 5402

[R1-165402](#) **WF on link level models for MIMO simulations** Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung

- Proposal 1: Introduce angular translation and angular spread scaling to the agreed CDLs
 - A method for scaling and translation to be described in the TR
 - Guidelines on selecting scaling and translation parameters to be captured in the TR
 - Note: This can be done with a similar approach as the delay scaling
- Proposal 2: Introduce correlation matrices to be used together with the TDLs
 - The correlation matrix construction method from 36.101/36.104 can be reused
 - Guidelines on selecting correlation parameters to be captured in the TR
 - Note: This approach can be applied to TDLs derived from spatially filtered CDLs according to [R1-163490](#) to emulate hybrid BF

Discussion:

Samsung: Are we going to capture the content in the TR? Angular spread need to be modified.

Ericsson: Typo need to be fixed.

Huawei: There should be example scaling factor values in proposal 1. We are preparing WF for that. Proposal 2 for channel or cluster correlation matrix? How it is defined for very large array? 4x4 MIMO leads to 16x16 correlation matrix. We could have 256x256 MIMO and the matrix will be huge.

Ericsson: It can be used for both. Per channel may be better but we are open for both. We don't need to write out the matrices.

Samsung: Proposal 2 2nd bullet needs clarification.

Ericsson: It is defined in the 3rd bullet.

Decision: The document is revised in 5470

[R1-165470](#) **WF on link level models for MIMO simulations** Ericsson, AT&T, ETRI, Huawei, HiSilicon, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung, InterDigital

Discussion:

Decision: The document is **agreed**

R1-165756 **WF on Angular Scaling** Huawei, HiSilicon, Ericsson

Agree the Proposal 1 of R1-165402.

Agree the following example values for AoD spread (ASD) for each CDL model: {5, 10, 15, 25} degrees.

Scaling of other angular parameters (ZSD, ASA, ZSA) are FFS.

Discussion:

Samsung: Did you address the zenith angle?

Huawei: That is quite limited case. The scalability of that is not important.

Samsung: We should define the upper limit. We should not have FFS anymore.

ZTE: Is the scaled number already normalized.

Huawei: Proposal was to first normalise, then scale.

Samsung: We should complete FFS and zenith angle during this week.

Decision: The document is **agreed**.

7.2.5 Channel modelling calibration results

R1-165184 **Further Discussion on O-to-I Parameters** NTT DOCOMO, INC.

Discussion:

Decision: The document is revised in 5427

R1-165427 **Further Discussion on O-to-I Parameters** NTT DOCOMO, INC.

Proposal 1: Use the UE-specific in d_{in} , i.e. UE to all the sectors has the same d_{in} .

Proposal 2: Replace the O-to-I shadow fading with O-to-I standard deviation.

Discussion:

Decision: The document is noted

R1-165770 **WF on calibration** Nokia, Samsung

- Setup 3 email threads for collecting calibration results
 - For updating results for large scale calibration: Until June 10th
 - For full calibration results: Until June 25th
 - For additional feature calibration: Until July 25th
- Companies can decide which option(s) to calibrate for those additional features with multiple options
 - Rapporteur will provide separate excel templates for different options
- Capture the [reference tdoc # containing the excel sheet(s)] into TR38.900 similarly to 3D channel model calibration process
 - TP for capturing the results can be approved in the email discussion

Discussion:

Decision: The document is **agreed**.

7.2.5.1 Large-scale calibration

Email discussion summary

R1-164802 **E-mail discussion summary of the large scale calibration** Samsung, Nokia

Large-scale calibration is completed, and the calibration results in the latest version of the excel sheet in the ftp folder are captured in the TR.

- *In the TR, average cdf plots will be provided for the calibration parameters with citing rapporteur's calibration summary tdoc similarly as done for TR36.873.*
- *In the rapporteur's calibration summary tdoc, the below table on the O2I parameters is included.*

For the full calibration, companies continue discuss how to align the three O2I parameters in [84b-17].

Discussion:

Decision: The document is **agreed**

Calibration results

R1-164195 **Large scale calibration results** Intel Corporation

Discussion:

Decision: The document is **not treated**

R1-164258 **Large scale calibration results** CATT

Discussion:

Decision: The document is **not treated**

[R1-164384](#) Discussion on large-scale calibration Huawei, HiSilicon

Discussion:

Decision: The document is not treated

[R1-164571](#) Large scale calibration results LG Electronics

Discussion:

Decision: The document is not treated

[R1-164810](#) Results of large-scale channel model calibration Samsung

Discussion:

Decision: The document is not treated

[R1-164899](#) Large Scale Calibration Results Beijing Xinwei Telecom Techn.

Discussion:

Decision: The document is not treated

[R1-165286](#) Large scale calibration results of channel model for frequency spectrum above 6 GHz CATR

Discussion:

Decision: The document is not treated

[R1-165404](#) Large scale calibration results Lenovo, Motorola Mobility

Discussion:

Decision: The document is not treated

Calibration discussions

[R1-164715](#) Initial results on large scale calibration and concerns on calibration specifications Qualcomm

Incorporated

Proposal 1: Baselines on which large and full scale calibration are to be made need to be specified completely and in as much detail as possible in the TP to avoid ambiguities and mismatches in calibration curves.

Proposal 2: UE-specific, link-specific, eNB-specific and sector-specific quantities need to be appropriately defined.

Proposal 3: Quantities that are to be correlated across sectors, across eNBs and across links need to be specified. In particular, assumptions on the following quantities need to be specified: Outdoor/indoor determination random variable, penetration loss determination random variable, d_{In} , shadow fading factors for LOS/NLOS, and shadow fading factors for penetration loss.

Discussion:

Decision: The document is noted

[R1-164894](#) Discussion on large-scale calibration results CHTTL

Proposal 1: RAN1 should clarify whether it's UE-specific or link-specific for Building penetration loss through external wall, O-to-I penetration loss standard deviation, and Indoor distance d_{2D-in} to improve the convergence of calibration results.

Discussion:

Decision: The document is noted

7.2.5.2 Full calibration

Email discussion summary

[R1-164803](#) E-mail discussion summary of the full calibration Samsung

Discussion:

Decision: The document is noted

Calibration results

[R1-164259](#) Full scale calibration results CATT

Discussion:

Decision: The document is **not treated**

R1-164385 **Discussion on fast fading calibration** **Huawei, HiSilicon**

Discussion:

Decision: The document is **not treated**

R1-164811 **Results of full channel model calibration** **Samsung**

Discussion:

Decision: The document is **not treated**

Calibration discussions

R1-164048 **Discussion on additional feature calibration** **Huawei, HiSilicon, AT&T, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung**

Discussion:

Decision: The document is revised in 5441

R1-165441 **Discussion on additional feature calibration** **Huawei, HiSilicon, AT&T, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung**

Proposal 1: adopt assumptions in Table 1 for calibration of oxygen absorption.

Proposal 2: adopt assumptions in Table 2 for calibration of large bandwidth and large antenna array.

Proposal 3: adopt assumptions in Table 3 for calibration of spatial consistency.

Proposal 4: adopt assumptions in Table 4 for calibration of blockage.

Discussion:

Decision: The document is revised in 5469

R1-165469 **Discussion on additional feature calibration** **Huawei, HiSilicon, AT&T, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung**

Proposal 1: adopt assumptions in Table 1 for calibration of oxygen absorption.

Proposal 2: adopt assumptions in Table 2 for calibration of large bandwidth and large antenna array.

Proposal 3: adopt assumptions in Table 3 for calibration of spatial consistency.

Proposal 4: adopt assumptions in Table 4 for calibration of blockage.

Discussion:

Nokia: There are quite many scenarios to calibrate. We should try to down select the scenarios and metrics.

LGE: Which spatial consistency dropping method is intended? Large antenna array have 64 elements. Distance of the panels will be more than 3.5 lambda. We have too many metrics to calibrate.

Huawei: In stationary case we drop multiple users at the same time. We could consider down selection.

Decision: The document is revised in 5471

R1-164900 **Discussion on full calibration** **Beijing Xinwei Telecom Techn.**

Proposal 1: Companies are encouraged to adjust cross correlation values based on measurement data to make the cross correlation matrix positive definite.

Proposal 2: Reuse the same ZSD and ZoD offset parameters for UMa and UMi-Street Canyon LOS O-I scenarios as those values for UMa and UMi-Street Canyon LOS scenarios, as listed in Table 1 and Table 2 .

Proposal 3: Reuse the same ZSD and ZoD offset parameters for UMa and UMi-Street Canyon NLOS O-I scenarios as those values for UMa and UMi-Street Canyon NLOS scenarios, as listed in Table 1 and Table 2 .

Proposal 3: For indoor-office scenario, ZoD offset in LOS condition can be zero, and in NLOS condition, it should be a function that takes d2D or d3D as a variable.

Proposal 4: Constant C for the number of clusters equals to 4, 10 or 11 should be defined based on measurement data.

Proposal 5: For calibration purpose, whether O-I penetration loss is high or low is UE-specific, indoor distance is UE-specific, and replace shadow fading term by standard deviation which is link-specific and the same for three sectors of an eNodeB and different for different eNodeBs.

Discussion:

Decision: The document is noted

R1-165471 **Discussion on additional feature calibration** **Huawei, HiSilicon, AT&T, Ericsson, Intel, KT Corporation, Nokia, NTT DOCOMO, Qualcomm, Samsung**

Discussion:

Decision: The document is **agreed**

7.2.6 Consistent extension of the additional features to < 6GHz

[R1-164716](#) Considerations on link and system model extension to < 6GHz Qualcomm Incorporated

Observation 1: Typically, when a UE is close to the base station it is more likely to experience a relatively lower delay spread, compared to that of a UE that is in the cell-edge.

Proposal 1: Perform link-level evaluations of different numerology proposals under a geometry-based scaled multi-path channel model.

Discussion:

Decision: The document is **not treated**

[R1-164728](#) Discussion on the extensions of the channel model to below 6GHz Huawei, HiSilicon, Intel, Qualcomm

Proposal: TR38.900 is applicable to 6 - 100 GHz only.

Discussion:

Ericsson: RMa would then be valid only between 6 – 7 GHz.

Huawei: It would be valid for lower frequencies too. One way would be to include RMa in 3D CM.

Nokia: RMa is anyway exceptions as it is only for up to 7 GHz.

Samsung: How can solve the discrepancy between models at 6 GHz?

Huawei: We can adjust higher frequency PL or modify 3D CM PL. We prefer option 1 to modify 5G CM PL.

Ericsson: Observation 4 shows additional features are important also for < 6 GHz.

Nokia: We don't think the PL discontinuity is a critical issue.

Ericsson: NR evaluation has such scenario combining both frequency ranges. Having different models is not a good solution.

Telstra: <6GHz range is important. 2 models is not a good approach.

Huawei: Basically we agree it would be good to have only 1 model but we have very limited time schedule. We would need more time to study all implications.

Decision: The document is noted

[R1-164806](#) Discussion on using new channel model also below 6 GHz Samsung, AT&T, Ericsson, KT Corporation, ETRI

Discussion:

Decision: The document is revised in 5400

[R1-165400](#) Discussion on using new channel model also below 6 GHz Samsung, Ericsson, ETRI, KT Corporation, Telstra

This contribution made the following observations:

- *If two incompatible pathloss models are adopted according to Alt 1, pathloss discontinuities occur at 6 GHz.*
- *Alt 1 can introduce another problem of how to handle the range of 3.5-6GHz frequency band.*
- *The new channel models are proposed based on the dataset including both below and above 6 GHz measurement/ray-tracing.*
- *Following Alt 1, there is no 3D channel model for InH and RMa scenarios below 6 GHz; With Alt 2, 3D channel model is available for all prioritized scenarios and frequency bands.*
- *There was a precedence to make a full transition from one channel model to another – TR 25.996 SCM to ITU channel models during 3GPP RAN1 LTE advanced SI.*
- *Alt 2 can improve the accuracy of MU-MIMO simulations below 6 GHz.*
- *Alt 2 may be more attractive from the point of view of ITU-R*

Discussion:

Huawei: PL model is shown as reasoning but the same can be used also another way around. Do we need to redo all the simulations?

Samsung: Interference limited scenario was considered in 3D CM work. PL change doesn't affect the results so much. We saw in calibration results that we have Interference limited scenario in NR as well.

Huawei: We should consider different levels in NR study. The impact on PL will be more significant.

Decision: The document is noted

[R1-164807](#) Discussion on consistent pathloss model between below 6GHz and above 6GHz Samsung

Proposal 1:

- *Considering the simplicity and the consistency in pathloss models, Solution #2 should be taken into TR38.900*

Proposal 2:

- *Alt 2 : New channel model in TR38.900 is applicable to 0.5 - 100 GHz in [R1-164616](#) should be down-selected*

Discussion:

Decision: The document is **not treated**

R1-164616 **On the applicability range of new channel model** **Nokia, AT&T, Ericsson, ETRI, Huawei, HiSilicon, Intel, KT Corporation, NTT DOCOMO, Qualcomm, Samsung**

RAN1 should down-select between the two alternatives

- *Alt.1: New channel model in TR38.900 is applicable to 6 - 100 Ghz*
- *Alt.2: New channel model in TR38.900 is applicable to 0.5 - 100 Ghz*

Discussion:

ZTE: There is also 3rd alternative.

Decision: The document is noted

R1-165472 **WF on the applicability range of new channel model** **Nokia**

Discussion:

Decision: The document is withdrawn

R1-165479 **WF on the applicability range of the new channel model** **Ericsson, Samsung, Telstra, ETRI, KT, LGE, Straight Path**

Proposal: New channel model in TR38.900 is applicable to 0.5 - 100 GHz

Discussion:

Nokia: It is hard to find a compromise for the question yes or no. We could capture the new CM is applicable to at least 6-100 GHz.

Ericsson: There are colleagues in NR session planning to use this model for < 6GHz.

Huawei: We checked NR colleagues. If model is stable they can use it also, otherwise they use something else.

Ericsson: What is Huawei view? Is the model valid for <6 GHz or not?

Huawei: It is not valid for < 6 GHz.

CATT: Model is not valid for < 6 GHz. NR evaluations will start in the next meeting.

Nokia: There is no consensus for the values < 6GHz. We capture now what we have in a TR and add a sentence in the TR and close the SI.

Ericsson: That would be extremely confusing for NR evaluations. We need to solve this before closing the SI.

Huawei: NR assumption says also 3D model can be used. Title of the SI is > 6 GHz so this is very clear.

Ericsson: Why do you draft WF for link level which is mandatory for < 6 GHz?

Samsung: Current TR have different description for different features and applicability range. Link level is OK. It would be much nicer to use the 5G CM for the whole range of NR.

CMCC: We have not got enough time to evaluate parameters for < 6 GHz. If to cover also that then extension of the SI should be further discussed.

Samsung: There is no issue to use this for < 6GHz. There is no CM agreed for all NR simulation cases.

Telstra: This is important issue to solve.

Samsung: What is Huawei solution for indoor?

Huawei: Using 3D CM or ITU model.

Samsung: ITU model is not 3D.

Ericsson: Partial solution would be to agree extension to UMa and RMa.

Huawei: What is the reason to extend if UMa is according to 3D CM and RMa according to ITU?

Ericsson: We have re-used parameters and added some more parameters.

Samsung: Compromise could be to have applicability range in brackets and let NR to decide.

Huawei: RAN plenary discussed this range. We proposed then to cover the full range but it was objected by many companies. The whole SI focus have been >6 GHz only.

Samsung: We are not changing any opinion but consider extending to <6GHz as discussed in the plenary.

Ericsson: There are many issues to solve for <6GHz.

Ericsson: We have proposed solution to solve this issue. Blocking is not constructive.

CATT: We have not seen solution for extension.

Conclusion: 2 alternatives were discussed on the applicability frequency range either 0.5-100 GHz or 6-100 GHz but consensus was not reached.

Decision: The document is noted.

7.2.7 Map-based methodology

R1-164331 **Evaluations of map-based hybrid channel model** **ZTE, Keysight**

Proposal 1: RAN1 confirms the working assumption on map-based hybrid model in TR38.900

Discussion:

Huawei: Did you verify the spatial consistency between 2 closely located users? It seems to be good match between parameters. Why the SF is lower?

ZTE: Not in this document but we have done that earlier.

NTT DOCOMO: Question on Figure 2 calibrated PL decrease.

Ericsson: Do you think table 2 shows a good correspondence?

ZTE: On reason for the difference is the layout. Ray tracing results will be smaller than stochastic model. Hybrid model works with different maps.

Ericsson: Is the different from the map only?

ZTE: Yes. There are differences in results also in stochastic model.

Decision: The document is **agreed**.

R1-164352 **Text proposal for remaining issues in map-based hybrid model** **ZTE, Keysight**

Discussion:

Decision: The document is revised in 5667

R1-165667 **Text proposal for remaining issues in map-based hybrid model** **ZTE, Keysight**

Proposal 1: The modeling of large bandwidth and large antenna array in map-based hybrid channel model is based on the splitting of whole bandwidth into multiple frequency bins, and has channel coefficients per bin given by (1) and corresponding delays given by (2).

Proposal 2: The modeling of blockage and UT rotation in map-based hybrid channel model obeys maximum similarity to those determined in stochastic-only model.

Proposal 3: To update the section 8 of TR38.900 with the attached TP.

Discussion:

Ericsson: Dividing the BW. Is this applicable to both models?

ZTE: In theory yes but the intention is to have that only in hybrid model.

Ericsson: If to have it in both models then more time is needed to evaluate.

Decision: The document is **agreed**.

8 Closing of the meeting

Thanks to the Chinese Friends of 3GPP for hosting and organizing such big meeting. High attendance will surely becomes an issue for the upcoming meetings in Europe.

Mr Chair thanked all the chair persons who help managing the number of parallel sessions during the course of the week. Good progress was achieved with the closing of NB-IoT work and other WI/SI as well.

Mr Chair then wished all a relaxing summer break.

Meeting was closed at 17:10.

See you all in Göteborg.

**3GPP TSG RAN WG1 Meeting #86
Göteborg, Sweden, 22nd – 26th August 2016**

R1-166056

Annex A: List of Tdocs at RAN1 #85

Please see excel file attached to this report

3GPP TSG RAN WG1 Meeting #86
Göteborg, Sweden, 22nd – 26th August 2016

R1-166056

Annex B: List of CRs agreed at RAN1 #85

TDoc #	Title	Source	Release	Spec #	Version	Related WIs	CR #	CR revision #	CR category
R1-164926	Correction on citations to a DAI bits table	ITRI	Rel-13	36.212	13.1.0	LTE_CA_enh_b5C-Core	0205		F
R1-164927	Some corrections for eMTC	ITRI	Rel-13	36.211	13.1.0	LTE_MTCe2_L1-Core	0245		F
R1-165093	Correction on search space to decode the PDCCH configured by the SC-N-RNTI	TD Tech Ltd, Huawei	Rel-13	36.213	13.1.1	LTE_SC_PTM-Core	0654		F
R1-165387	Starting OFDM symbol for SIB1-BR for BL/CE UE	Ericsson	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0657		F
R1-165388	Collision between SIB1-BR and SI message for BL/CE UE	Ericsson	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0658		F
R1-165392	Definition of number of MPDCCH repetitions for BL/CE UE	Ericsson	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0662		F
R1-165393	PRB locations for Type0 MPDCCH search space for BL/CE UE	Ericsson	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0663		F
R1-165396	36.201CR0014r1 Introduction of NB-IoT	Nokia, Alcatel-Lucent Shanghai Bell	Rel-13	36.201	13.1.0	NB_IOT-Core	0014	1	B
R1-165515	Clarifications on DCH enhancements feature	Qualcomm Incorporated, Ericsson, Huawei, Nokia Networks, HiSilicon	Rel-12	25.212	12.1.0	UTRA_DCHenh-Core	0339		F
R1-165516	Clarifications on DCH enhancements feature (Mirror Rel-13)	Qualcomm Incorporated, Ericsson, Huawei, Nokia Networks, HiSilicon	Rel-13	25.212	13.0.0	UTRA_DCHenh-Core	0340		A
R1-165528	CR on FD-MIMO codebooks	Samsung	Rel-13	36.213	13.1.1	LTE_EBF_FDMIMO-Core	0666		F
R1-165529	CR on CSI-Reporting-Type	Samsung	Rel-13	36.213	13.1.1	LTE_EBF_FDMIMO-Core	0667		F
R1-165530	Introduction of 60ms periodicity for wideband CQI/PMI reporting	Nokia, Alcatel-Lucent Shanghai Bell, Apple, Broadcom, Ericsson, Intel, Mediatek	Rel-13	36.213	13.1.1	TEI13	0668		B
R1-165531	Correction on the usage of CEModeA and CEModeB for eMTC in TS 36.213	Huawei, HiSilicon	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0669		F
R1-165532	CR for clarification of MPDCCH over empty CRS tones in PBCH repetition	Qualcomm Incorporated	Rel-13	36.211	13.1.0	LTE_MTCe2_L1-Core	0247		F
R1-165533	Correction on the DCI payload size for eMTC in TS 36.212	Huawei, HiSilicon	Rel-13	36.212	13.1.0	LTE_MTCe2_L1-Core	0207		F

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TDoc #	Title	Source	Release	Spec #	Version	Related WIs	CR #	CR revision #	CR category
R1-165534	CR for scrambling sequence initialization	Qualcomm Incorporated	Rel-13	36.211	13.1.0	LTE_MTCe2_L1-Core	0248		F
R1-165536	On MPDCCH AL and search space for 8 EREGs per ECCE in TS 36.213.	Huawei, HiSilicon	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0670		F
R1-165537	CR on MPDCCH quasi co-location	Panasonic	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0671		F
R1-165538	Correction on UE assumption on DMRS ports	ZTE Corporation, ZTE Microelectronics	Rel-13	36.213	13.1.1	LTE_EBF_FDMIMO-Core	0672		F
R1-165540	Frequency hopping flag definition in DCI formats for BL/CE UE	Ericsson, Samsung	Rel-13	36.212	13.1.0	LTE_MTCe2_L1-Core	0206	1	F
R1-165568	Correction on collision of dynamically scheduled data and semi-statically scheduled data for Rel-13 eMTC	Ericsson, LG Electronics	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0637	2	F
R1-165621	A-CSI reporting for TM6	Samsung	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0673		F
R1-165622	Corrections on CSI Reporting	Samsung	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0674		F
R1-165623	On MPDCCH AL for 8 EREGs per ECCE in TS 36.211	Huawei, HiSilicon	Rel-13	36.211	13.1.0	LTE_MTCe2_L1-Core	0249		F
R1-165624	Correction on RV determination for PUSCH in TS 36.213	Huawei, HiSilicon	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0675		F
R1-165626	Clarification on Msg3 PUSCH repetition level in TS 36.213	Huawei, HiSilicon	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0677		F
R1-165627	Correction on SRS frequency location in TS 36.213	Huawei, HiSilicon	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0678		F
R1-165635	Channel interleaver correction for eMTC	Nokia, Alcatel-Lucent Shanghai Bell	Rel-13	36.212	13.1.0	LTE_MTCe2_L1-Core	0208		F
R1-165636	Correction on PDSCH reception timing for eMTC	Nokia, Alcatel-Lucent Shanghai Bell	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0679		F
R1-165672	Clarification on starting subframe for MPDCCH	Qualcomm	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0681		F
R1-165673	Overriding of valid-invalid subframes for R=1	Qualcomm	Rel-13	36.211	13.1.0	LTE_MTCe2_L1-Core	0250		F
R1-165682	Correcting configuration parameter for number of PRB-pairs	Sequans Communications	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0680	1	F
R1-165686	Scrambling Sequence for paging MPDCCH and PDSCH	Nokia, Alcatel-Lucent Shanghai Bell, Intel, Ericsson	Rel-13	36.211	13.1.0	LTE_MTCe2_L1-Core	0251		F
R1-165687	MCS for Random Access Response Grant	Nokia, Alcatel-Lucent Shanghai Bell	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0682		F
R1-165703	Scrambling sequence initialization for PDSCH	Qualcomm, NTT DOCOMO	Rel-13	36.211	13.1.0	LTE_MTCe2_L1-Core	0252		F

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TDoc #	Title	Source	Release	Spec #	Version	Related WIs	CR #	CR revision #	CR category
R1-165724	Correction on RLM for PSCell in dual connectivity	Intel Corporation, panasonic	Rel-13	36.213	13.1.1	LTE_SC_enh_dualC-Core, TEI13	0684		F
R1-165737	Correction on PDSCH transmission scheme assumed for TM9 CSI reference resource in TS 36.213	Huawei, HiSilicon	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0685		F
R1-165746	eMTC MPDCCH corrections for 36.213	Sequans Communications	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0653	1	F
R1-165791	Correction on UCI multiplexing on PUSCH	Ericsson	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0683	2	F
R1-165862	Clarifications on DCH enhancements feature	Qualcomm Incorporated	Rel-12	25.214	12.3.0	UTRA_DCHenh-Core	0747		F
R1-165863	Clarifications on DCH enhancements feature (Mirror Rel-13)	Qualcomm Incorporated	Rel-13	25.214	13.2.0	UTRA_DCHenh-Core	0748		A
R1-165969	MPDCCH search space for random access in connected mode for BL/CE UE	Ericsson, Panasonic, Samsung	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0660	3	F
R1-165971	Introduction of NB-IoT	Ericsson	Rel-13	36.211	13.1.0	NB_IOT-Core	0224	8	B
R1-165972	Introduction of NB-IoT	Motorola Mobility	Rel-13	36.213	13.1.1	NB_IOT-Core	0656	1	B
R1-165973	Introduction of NB-IoT	Ericsson	Rel-13	36.214	13.1.0	NB_IOT-Core	0033	2	B
R1-166022	CR on clarification for channel sensing	Qualcomm Incorporated	Rel-13	36.213	13.1.1	LTE_LAA-Core	0686		F
R1-166039	CR on CWp adjustment	Qualcomm Incorporated	Rel-13	36.213	13.1.1	LTE_LAA-Core	0687		F
R1-166045	Introduction of Rel-13 feature of NB-IoT in 36.212	Huawei, HiSilicon	Rel-13	36.212	13.1.0	NB_IOT-Core	0192	3	B
R1-166048	Clarification of CSI measurements	Qualcomm Incorporated, Ericsson, Samsung, Panasonic	Rel-13	36.213	13.1.1	LTE_MTCe2_L1-Core	0688		F

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Annex C-1: List of Outgoing LSs from RAN1 #85

TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-165511	LS on RAN1 multi-carrier enhancements for UMTS agreements	RAN1, Huawei	Rel-14	FS_UTRA_Mce		RAN2, RAN3			
R1-165512	LS on HS-SCCH DRx Design in Cell Fach	RAN1, Qualcomm	Rel-14	FACH_DTXDRX-Core		RAN2, RAN3			
R1-165710	Reply LS on TBS sizes for SI-messages for NB-IoT	RAN1, Huawei	Rel-13	NB_IoT-Core	R2-163294	RAN2			
R1-165711	Reply LS on updated TS 36.300 section 5 for NB-IoT	RAN1, Huawei	Rel-13	NB_IoT-Core	R2-161885	RAN2			
R1-165748	LS on MPDCCH configuration for BL/CE UE	RAN1, Ericsson	Rel-13	LTE_MTCe2_L1-Core		RAN2			
R1-165814	LS to RAN2 on Priority for V2V	RAN1, Qualcomm	Rel-14	LTE_SL_V2V-Core		RAN2	SA2		
R1-165820	Reply LS on Parameters for WP5D Sharing and compatibility studies	RAN1, NTT DOCOMO	Rel-15	FS_NR_newRAT	R4-162880	RAN4			
R1-165853	LS on OTDOA for the same PCI	RAN1, Huawei	Rel-14	UTRA_LTE_iPos_enh2-Core		RAN2, RAN3	RAN4		
R1-165906	LS on RRC parameter list for NB-IoT	RAN1, Huawei	Rel-13	NB_IoT-Core		RAN2			
R1-165913	LS on TR update for latency reduction	RAN1, Ericsson	Rel-14	FS_LTE_LATRED		RAN2			
R1-165984	LS on RAN1 Agreements in MUST	RAN1, MediaTek	Rel-14	LTE_MUST-Core		RAN4			
R1-165996	Reply LS on the feasibility of mobility enhancement solutions	RAN1, ZTE	Rel-14	LTE_eMob-Core	R2-163135	RAN2	RAN4, RAN3		
R1-166029	LS on Rel.14 eFD-MIMO WID update	RAN1, Nokia	Rel-14	LTE_eFDMIMO-Core		RAN			
R1-166033	LS on high level coexistence approaches between PC5 transport for V2V services and DSRC/IEEE 802.11p services in the same channel	RAN1, Ericsson	Rel-14	FS_LTE_V2X		RAN			
R1-166044	LS on Uplink Capacity Enhancements for LTE	RAN1, Ericsson	Rel-14	LTE_UL_CAP_enh-Core		RAN2	RAN4		
R1-166037	LS on NB-IoT performance	RAN1, Huawei	Rel-13	NB_IoT-Core		RAN	RAN2, RAN4		
R1-166038	LS on DRX and Reception of PDCCH scrambled by CC-RNTI	RAN1, Panasonic	Rel-13	LTE_LAA-Core		RAN2			
R1-166040	Response LS to 802dot11 regarding LAA	RAN1, Qualcomm Incorporated	Rel-13	LTE_LAA-Core		IEEE 802 LAN/MAN Standards Committee	Wi-Fi Alliance, The City of New York Office of the Mayor, RAN, RAN2, RAN4		
R1-166041	Response LS to WFA regarding LAA	RAN1, Qualcomm Incorporated	Rel-13	LTE_LAA-Core		Wi-Fi Alliance	IEEE 802 LAN/MAN Standards Committee,		

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TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
							The City of New York Office of the Mayor, RAN, RAN2, RAN4		
R1-166042	Reply LS on continuous uplink transmission in eMTC	RAN1, Intel	Rel-13	LTE_MTCe2_L1-Core		RAN4, RAN2	RAN		
R1-165965	LS on RAN1 agreements potentially related to RAN2 in sidelink-based V2V	RAN1, LGE	Rel-14	LTE_SL_V2V-Core		RAN2, RAN4			
R1-166043	LS on UL DM-RS for NPUSCH format 1	RAN1, Huawei	Rel-13	NB_IoT-Core		RAN4			
R1-166044	LS on Uplink Capacity Enhancements for LTE	RAN1, Ericsson	Rel-14	LTE_UL_CAP_enh-Core		RAN2	RAN4		
R1-166050	LS on Enhanced LAA for LTE	RAN1, Ericsson, Huawei	Rel-14	LTE_eLAA-Core		RAN2			
R1-166051	LS on L1 parameters for Enhanced LAA	RAN1, Ericsson, Huawei	Rel-14	LTE_eLAA-Core		RAN2	RAN4		
R1-166052	LS on RRC Parameters and PRACH for Enhanced LAA for LTE	RAN1, Ericsson	Rel-14	LTE_eLAA-Core		RAN2	RAN4		
R1-166053	Reply LS on the feasibility of mobility enhancement solutions	RAN1, ZTE	Rel-14	LTE_eMob-Core	R1-163968	RAN2	RAN4, RAN3		

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Annex C-2: List of Incoming LSs from RAN1 #85

TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
R1-163962	Reply LS on Cell FACH DTx/DRx Enhancements signalling	RAN2, Qualcomm	Rel-14	FACH_DTDXRX-Core	R1-161187	RAN1		R2-162986	
R1-163963	LS on NB-IoT RRM requirements	RAN2, Huawei	Rel-13	NB_IOT-Core		RAN4	RAN1	R2-163046	
R1-163964	Reply LS on per-UE configuration to allow exception reporting	RAN2, Qualcomm	Rel-13	NB_IOT-Core		CT1, SA2	RAN1, CT4	R2-163048	
R1-163965	Reply LS on direct SI update indication for NB-IoT	RAN2, Ericsson	Rel-13	NB_IOT-Core	R1-162068	RAN1		R2-163049	
R1-163966	Response to LS on questions on CIoT	RAN2, Vodafone	Rel-13	NB_IOT-Core		SA2, CT1	CT4, RAN1, SA3, RAN3	R2-163064	
R1-163967	Reply LS on NB-IoT	RAN2, Huawei	Rel-13	NB_IOT-Core	R1-161566 , R1-162065	RAN1		R2-163125	
R1-163968	LS on the feasibility of mobility enhancement solutions	RAN2, ZTE	Rel-14	LTE_eMob-Core		RAN1, RAN3, RAN4		R2-163135	
R1-163969	LS on RLM for PSCell in dual connectivity	RAN2, Intel	Rel-12	LTE_SC_enh_dualC-Core		RAN1, RAN4		R2-163137	
R1-163970	LS on RAN2 agreements on eLAA	RAN2, Huawei	Rel-14	LTE_eLAA-Core		RAN1		R2-163146	
R1-163971	Response LS on Reply LS on questions on NB-IOT	RAN3, Nokia	Rel-13	NB_IOT-Core, CIoT		SA2, CT1, RAN2	RAN1, CT4	R3-161032	
R1-163972	LS on Parameters for WP5D Sharing and compatibility studies	RAN4, Ericsson	Rel-15	FS_NR_newRAT		RAN1		R4-162880	
R1-163973	LS to RAN on new RAN4 TR for documenting multi-node tests for LAA	RAN4, Ericsson	Rel-13	LTE_LAA-Perf		RAN	RAN1	R4-163134	
R1-163974	LS on continuous uplink transmission in eMTC	RAN4, Intel	Rel-13	LTE_MTCe2_L1-Core		RAN1, RAN2		R4-163150	
R1-163975	LS on EPC procedures for providing eNB with V2X authorization information	SA2, LGE	Rel-14	FS_V2XARC		RAN2, RAN3, SA1	RAN1	S2-162248	
R1-164114	LS regarding 3GPP LTE based technologies operating in the unlicensed bands	City of New York (Counsel to the Mayor of)	Rel-13	LTE_LAA-Core		RAN, RAN1	FCC Office of Engineering & Technology, FCC Wireless Telecommunications Bureau, WiFi Alliance, IEEE 802	Flore nagata May 2 2016	
R1-164119	Reply LS on questions on NB-IOT	RAN2, Nokia	Rel-13	NB_IOT-Core	R3-161032	RAN3, SA2, CT1	RAN1, CT4	R2-163290	
R1-164120	LS on direct indication DCI bits for NB-IoT	RAN2, Huawei	Rel-13	NB_IOT-Core		RAN1		R2-163292	
R1-164260	Formation of IEEE 1914 Next Generation Fronthaul Interface Working Group	IEEE 1914 Next Generation Fronthaul				RAN1, RAN2, RAN3		201604 LS IEEE1914 to 3GPP	

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TDoc #	Title	Source	Release	Related WIs	Reply to	To	Cc	Original LS	Reply in
		Interface (NGFI) Working Group							
R1-164286	LS on Remaining Issues on Path Loss Scenarios	New York University Wireless	Rel-14	FS_6GHz_CH_model		RAN1			
R1-165414	Reply LS on EPC procedures for providing eNB with V2X authorization information	SA1, LGE	Rel-14	V2XLTE	S2-162248	SA2	RAN1, RAN2, RAN3	S1-161587	
R1-165415	Reply LS on V2X message characteristics	SA3, TNO	Rel-14	V2XLTE	S1-154509	RAN2, SA1	SA2, RAN1	S3-160777	
R1-165417	LS on TB sizes for SI-messages for NB-IoT	RAN2, Ericsson	Rel-13	NB_IOT-Core		RAN1		R2-163294	
R1-165449	Review of 3GPP LAA Specification Rel. 13	IEEE 802 LAN/MAN SC	Rel-13	LTE_LAA-Core		RAN1	RAN, IEEE 802.19 Coexistence	802 to 3GPP 22 May 2016 Liaison r00.pdf	
R1-165655	LS to RAN1 on RAN2 agreements related to V2X	RAN2, LGE	Rel-14	FS_LTE_V2X		RAN1		R2-164373	
R1-165722	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	
R1-165723	LS to RAN1 on SPS	RAN2, LGE	Rel-14	LTE_SL_V2V-Core		RAN1		R2-164359	
R1-165727	LS on V2V transmission path selection	RAN2, Huawei	Rel-14	LTE_SL_V2V-Core		SA2, RAN1, RAN3		R2-164356	
R1-165753	Reply LS on NB-IoT RRM requirements	RAN4, Huawei	Rel-13	NB_IoT-Core	R2-163046	RAN2	RAN1	R4-164085	
R1-165754	LS on RRM measurement for NB-IOT	RAN4, Ericsson	Rel-13	NB_IoT-Core		RAN1, RAN2		R4-164454	
R1-165817	Response LS on PUSCH transmission for eLAA	RAN4, Nokia	Rel-14	LTE_eLAA-Core		RAN1		R4-164678	
R1-165838	LS to RAN1 on RAN2 agreement on eLAA	RAN4, Nokia	Rel-14	LTE_eLAA-Core		RAN1		R2-164489	
R1-165894	Response to LS on uplink transmission gap in NB-IoT	RAN4, Sony	Rel-13	NB_IoT-Core	R1-162069	RAN1	RAN2	R4-164459	
R1-165895	LS on Tx Gaps for Frequency Error Correction	RAN4, Qualcomm	Rel-13	NB_IoT-Core		RAN2	RAN1	R4-164532	
R1-166004	Response LS on realistic power amplifier model for NR waveform evaluation	RAN4, Nokia	Rel-14	FS_NR_newRAT		RAN1		R4-164542	

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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 #85

Tdoc Number	Title	Source	Conclusion/Decision
<u>R1-164298</u>	TR Skeleton for Study on FeCoMP	ZTE, Intel	endorsed
<u>R1-165216</u>	Draft TR 38.802 Study on New Radio (NR) Access Technology - Physical Layer Aspects	NTT DOCOMO, INC.	endorsed
<u>R1-165465</u>	TR38.900 v0.3.0	Nokia, Samsung	agreed
<u>R1-165514</u>	TR 25.707 v0.3.0 on Multi-Carrier Enhancements for UMTS	Huawei	agreed
<u>R1-165866</u>	TR 25.707 v1.0.0 on Multi-Carrier Enhancements for UMTS	Huawei	agreed
<u>R1-165889</u>	TR 38.802 Study on New Radio (NR) Access Technology - Physical Layer Aspects	NTT DOCOMO	agreed
<u>R1-165966</u>	TR38.900 v0.4.0	Samsung, Nokia	agreed
<u>R1-165967</u>	3GPP TR 36.885 v.2.0.0 Study on LTE-based V2X Services	LG Electronics	agreed
<u>R1-165970</u>	TR38.900 v1.0.0	Samsung, Nokia	agreed

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Annex F: List of actions

- Outgoing LS.

[85-07] Hanbyul (LGE)

V2V LS (summarizing all the agreements/working assumptions made during the week) to RAN2/4 for email approval until June 2nd

Done: Final LS is agreed, according to Mr Chair's email posted on June 3rd, as follows:

[R1-165965](#) LS on RAN1 agreements potentially related to RAN2 in sidelink-based V2V RAN1, LGE

[85-26] Matthew (Huawei)

LS to RAN4 about UL DM-RS for NB-IoT for email approval until June 2nd

During the meeting, we agreed to to send LS to RAN 2 and cc-RAN 4 on UL DMRS hopping, but agreed LS did not include RAN4

Done: Final LS is agreed, according to Mr Chair's email posted on June 3rd, as follows:

[R1-166043](#) LS on UL DM-RS for NPUSCH format 1 RAN1, Huawei

[85-27] Sorour (Ericsson)

UL category for UL capacity enhancement for email approval until June 2nd

There was a typo that UL Category 15 instead of 17 in the RAN1 agreements as well as the LS [R1-166034](#) to RAN2.

Done: Final LS is agreed, according to Mr Chair's email posted on June 3rd, as follows:

[R1-166044](#) LS on Uplink Capacity Enhancements for LTE RAN1, Ericsson

[R1-166044](#) supersedes the former agreed LS in [R1-166034](#).

[85-24] Hanbyul (LGE)

RRC parameter lists for V2V for email approval until 2nd June

Done: Final LS is agreed, according to Mr Chair's email posted on June 4th, as follows:

[R1-165963](#) LS on L1 parameters for sidelink-based V2V RAN1, LGE

[85-29] Havish (Ericsson)

LS to RAN2 about PRACH inclusion in eLAA

Further to RAN2's request to understand whether RAN1 intends introducing PRACH in eLAA, for email approval until August 8th.

Done: Final LS is agreed, according to Mr Chair's email posted on August 10th, as follows:

[R1-166052](#) LS on Enhanced LAA for LTE RAN1, Ericsson

[85-28] Zhongda/Zhisong (ZTE)

Reply LS for mobility enhancement (RAN2-led item – reply to [R1-163968](#) (R2-163135) for email approval until August 8th.

Done: Final LS is agreed, according to Mr Chair's email posted on August 11th, as follows:

[R1-166053](#) Reply LS on the feasibility of mobility enhancement solutions RAN1, ZTE

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- CR approval

[85-02] Johan (Ericsson)

[R1-165958](#) MPDCCH search space for random access in connected mode for BL/CE UE Ericsson
Email approval until June 3rd

Done: According to Mr Chair's email posted on June 9th, rev 3 of CR0660 to 36.213 is agreed in:

[R1-165969](#) MPDCCH search space for random access in connected mode for BL/CE UE Ericsson, Panasonic, Samsung

[85-03] Alberto (Qualcomm)

Clarification on CSI measurements for eMTC
Email discussion on the issue raised in [R1-164399](#) and [R1-165542](#) till June 10th

Done: According to Mr Chair's email posted on June 10th, CR is agreed in:

[R1-166049](#) Clarification of CSI measurements Qualcomm Incorporated, Ericsson, Samsung, Panasonic Rel-13 36.213 13.1.1 LTE_MTCe2_L1-Core CR0688 F

[85-04] Editors/Rapporteur

NB-IoT CRs - Editors should provide updated CRs to 36.211, 36.212, 36.213, 36.214 by June 3rd, for approval by June 7th
Rapporteur shall submit a summary of all agreements by May 30th

Done: Summary available for information in [R1-165977](#). The following are agreed:

R1-165971	Introduction of NB-IoT	Ericsson	36.211	13.1.0	NB_IOT-Core	CR0224r8	B
R1-166045	Introduction of NB-IoT	Huawei	36.212	13.1.0	NB_IOT-Core	CR0192r3	B
R1-165973	Introduction of NB-IoT	Ericsson	36.214	13.1.0	NB_IOT-Core	CR0033r2	B
R1-165972	Introduction of NB-IoT	Motorola Mobility	36.213	13.1.1	NB_IOT-Core	CR0656r1	B

[85-06] Editors/Rapporteur

eLAA CRs. Editors should provide draft CRs to 36.211, 36.212, 36.213, 36.214 by August 18th based on the list provided by rapporteur (regarding all agreements/WA), list to be submitted by June 30th

Done: Summary available for information in [R1-166049](#).

[85-08] Editors/Rapporteur

V2V CRs. Editors should provide draft CRs to 36.211, 36.212, 36.213, 36.214 by August 18th based on the list provided by rapporteur (regarding all agreements/WA), list to be submitted by June 30th

Done: Summary available for information in [R1-165978](#).

[85-31] Gerardo (Ericsson)

[R1-165336](#) Clarification on UL DPCH 10ms Mode Ericsson
Email approval until June 8, 2016

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R1-166056

Done: According to Mr Chair's email posted on June 10th, there was still no consensus on rev 1 of CR0337 to 25.212 (rel-12, F) in [R1-166046](#) and rev 1 of CR0338 to 25.212 (rel-13, A) in [R1-166047](#). Finally revision 2 of both CRs were agreed (Mr Chair's email posted on June 15th), submitted to RAN#72 and approved as company's contributions.

- Text proposal for TS and TR

[85-32] Peter (Huawei)

TR25.707 for email discussion on updated TR25.707 until Monday June 6, 2016.

Done: According to Mr Chair's email dated on June 7th, TR is agreed as:

[R1-165514](#) TR 25.707 v0.3.0 on Multi-Carrier Enhancements for UMTS ETSI

Endorsed as v1.0.0 in [R1-165866](#) for one step approval by plenary.

[85-23] Young-Han (Samsung)

TR38.900 for channel model for email approval to check the consistency with the agreements in this meeting and the previous meeting until June 2nd

Done: According to Mr Chair's email dated on June 4th, TR is agreed as:

[R1-165966](#) TR38.900 v0.4.0 Samsung, Nokia

Endorsed as v1.0.0 in [R1-165970](#) for one step approval by plenary.

- Miscellaneous

[85-30] Harish (Qualcomm)

Clarifications to DCH enhancements feature

Email discussion on proposals 2/4/7/8 from [R1-164364](#) until June 8, 2016

Done: Postponed to next meeting.

[85-01] Aris (Samsung)

[R1-164733](#) HARQ-ACK Codebook on PUSCH for TDD Samsung

Email discussion until June 30th

Done: The text that was removed from the first version of 36.213 on eCA was later added through the approved CR in [R1-161517](#) and is incorporated in the current specification. Therefore, there is no need to further discuss the proposal in [R1-164733](#).

[85-5-1] Scheduling aspects for eLAA, Joon (LGE)

Scheduling aspects including BD reduction and working assumptions on some fields for email approval until 6th June

Done: As per final decision posted by Mr Chair on June 14th, the conclusions are as follows:

Agreements on PDCCH BD allocation

- DCI format 0A and 4A (when TM2 is configured) are default DCI formats for UL scheduling for LAA SCell
- DCI format 0A and 4A can be disabled for each LAA SCell by RRC signaling independently

- Note: It was already agreed that usage of DCI format 0B and 4B (when TM2 is configured) is configurable for each LAA SCell by RRC signaling
- A new RRC signaling *pdcch-candidateAdjustment* can adjust number of BDs on UE specific search space independently for each AL (CCE aggregation level) for each of the DCI formats 0A, 4A, 0B and 4B for each scheduled carrier. The applicable values for BD adjustment for each DCI format are as follows.
 - (0, 33, 66, 100)% BD adjustment
 - Applicable to DCI Format 0A
 - FFS: applicability to DCI Formats 0B and/or 4A
 - (0, 33, 66, 100)% for 1st and 2nd AL and (0, [50 or 66], 100, [150 or 200])% for 3rd to 5th AL
 - Applicable to DCI Format 4B
 - FFS: applicability to DCI Formats 0B and/or 4A
 - Re-13 *pdcch-candidateReductions* applies (if configured) to the other DCIs
 - If *pdcch-candidateAdjustment* is not configured, Re-13 *pdcch-candidateReductions* applies (if configured) to all the DCIs
- FFS: Special handling of potential (E)PDCCH blocking issue due to the possibility of transmitting multiple UL scheduling DCIs for a UE.

Agreements on scheduling aspects for eLAA

- Confirm the WA: For LAA uplink with single codeword, maximum number of HARQ processes = 16 are supported
- Timing offset is counted from subframe N+4+k, and k is signalled with 4 bits ([0....15] SFs) (FFS in case of 2-step scheduling)
- DCI format 0B/4B can schedule PUSCH transmission in a single subframe
- For DCI format 0B/4B, bit width of number of scheduled subframes is 1 bit when N_{sf} is configured as 2 and 2 bits when N_{sf} is configured as larger than 2
- CSI request in DCI format 0B/4B applies to last subframe if number of scheduled subframes is smaller than 3, and otherwise to the second last scheduled subframe
- Rel-14 eLAA UE is required to decode UL grant PDCCHs as well as the common PDCCH in the ending partial subframe even if the number of occupied OFDM symbols for the ending partial subframe is not indicated from the previous subframe
- FFS special handling of MCS/TBS for PUSCH containing UCI and/or SRS and/or blanked symbol(s)
 - Note: Common MCS value for all the scheduled subframes is already agreed
- The UE is not expected to process a DCI format 0B/4B indicating scheduling in a single subframe and triggering SRS in a different subframe

Notes as basis for further discussion: FFS on the indication of starting PUSCH DFT-S-OFDM symbol

- option 1) Starting PUSCH DFT-S-OFDM symbol in a DCI format 0B/4B applies only to the first scheduled subframe.
 - A single UL grant for an LAA SCell can only schedule subframes which composes a same UL transmission burst of a same UE
- option 2) DCI format 0B/4B indicates starting PUSCH DFS-S-OFDM symbol in one or multiples of the scheduled subframes
 - option 2-1) 2-bit joint indication for the starting PUSCH DFT-S-OFDM symbol, the 4 states define the starting in symbol #1 as: {in none of SFs, in all SFs, only in the 1st subframe, in 1st and 3rd subframe}
 - option 2-2) N_{sf} size bitmap to indicate the starting PUSCH DFT-S-OFDM symbol position for multiple scheduled subframes. The bitmap size changes according to the configuration of N_{sf} for MSF, i.e., 2~4.
 - option 2-3) One bit to indicate the starting PUSCH DFT-S-OFDM symbol for the 1st subframe, x bit to indicate starting PUSCH DFT-S-OFDM symbol position in one of the following subframes if N_{max} >=2. The size of x changes according to the configuration of N_{max} for MSF.

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[85-5-2] Resource allocation aspects for eLAA, Srinivas (Qualcomm)

Resource allocation aspects including resource allocation type alternatives and applicability of fields for legacy vs. interlaced resource allocation

Email approval until 6th June

Done: As per final decision posted by Mr Chair on June 7th, the conclusion is as follows:

Agreements

- **Enhanced LAA can operate without the introduction of legacy resource allocation for UL PUSCH on an LAA SCell.**
- **Introduction of optional legacy resource allocation is not precluded for future work items (if agreed).**

No consensus about the resource allocation type. Discussion will continue at next meeting.

[85-5-3] PUSCH structure, Havish (Ericsson)

Start times of PUSCH transmission including within first OFDM symbol and means to achieve this

Email approval until 6th June

Done: As per final decision posted by Mr Chair on June 9th, the conclusion is as follows:

Agreements

- **Transmission on UL is allowed to start at the following times in a UL subframe**
 - **Start of DFTS-OFDM symbol 0**
 - **Start of DFTS-OFDM symbol 1**
 - **25 us after start of DFTS-OFDM symbol 0**
 - **25 us + TA value after start of DFTS-OFDM symbol 0**
- **FFS: Choose between the following options to enable the start times within the first DFTS-OFDM symbol**
 - **Option 1: Extension of cyclic prefix of the next DFTS-OFDM symbol to occupy part of the first DFTS-OFDM symbol**
 - **Option 2: Rate matching around the modulation symbols corresponding to the first 25 μs of DFTS-OFDM symbol 0 and also around the modulation symbols at the end of DFTS-OFDM symbol 0 corresponding to the cyclic prefix length**
 - **FFS: Whether windowing at the beginning of the UL transmission is necessary to reduce the impact on out of band emissions.**

[85-5-4] SRS aspects, Xia Yuan (Huawei)

SRS aspects including triggering of SRS without PUSCH with DL grants and common/group DCI

Email approval until June 6th

Done: As per final decision posted by Mr Chair on June 7th, the conclusion is as follows:

Agreements

- **If the triggering for SRS without PUSCH is received in subframe n, the UE should send SRS without PUSCH in subframe n+k (not considering the LBT failure).**
- **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+11 respectively.**

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In addition, there is no consensus to introduce common/group DCI to trigger SRS without PUSCH for a group of UEs in this WI.

- **Support of this feature in future LAA enhancement item(s) is not precluded.**

[85-5-5] UCI on an LAA SCell, Havish (Ericsson)

Further discussion on transmission of HARQ-ACKs on an LAA SCell

Email approval until 6th June

Done: According to Mr Chair's email dated June 8th, RAN1 reached the following conclusion:

- **Enhanced LAA can operate without the introduction of HARQ-ACK transmission on an LAA SCell**
- **Support for transmission of HARQ-ACK on an LAA SCell can be beneficial and it is recommended to include it in future enhancements for LAA.**

[85-5-6] Channel access framework, Sorour (Ericsson)

Channel access aspects including Cat. 4 LBT parameters, CW adjustments for Cat. 4 LBT, Signaling of LBT type, ED threshold, DL-UL traffic multiplexing and LBT parameters for SRS

Email approval until 6th June

Done: The conclusions are as follows:

Agreements (based on the WF on LBT Priority Class for UL Transmission in [R1-165715](#)):

- **Rel-14 supports four LBT priority classes for UL transmissions as in the following table.**
 - **Note: CWmin, CWmax, n refer to the minimum CW, maximum CW and the number of consecutive CCA slots in the defer period, respectively.**
 - **Note: the smaller the LBT priority class number, the higher the priority.**
- **FFS: additional set of LBT parameters for the LBT priority classes that can be chosen by the eNB**

LBT priority class	n	CWmin	CWmax	MCOT	Set of CW sizes
1	2	3	7	2 ms	{3,7}
2	2	7	15	4 ms	{7,15}
3	3	15	1023	6ms (see note 1) or 10 ms (see note 2)	{15,31,63,127,255,511,1023}

4	7	15	1023	6ms (see note 1) or 10 ms (see note 2)	{15,31,63,127,255,511,1023}
NOTE 1: The MCOT of 6 ms may be increased to 8 ms by inserting one or more gaps. The minimum duration of a pause shall be 100 μs. The maximum duration (Channel Occupancy) before including any such gap shall be 6 ms. The gap duration is not included in the channel occupancy time. NOTE 2: If the absence of any other technology sharing the carrier can be guaranteed on a long term basis (e.g. by level of regulation), the maximum channel occupancy time (MCOT) for LBT priority classes 3 and 4 is for 10 ms, otherwise, the MCOT for LBT priority classes 3 and 4 is 6ms as in note 1.					

Agreements:

- When the UE performs 25 microsecond LBT on an LAA SCell,
 - There is no additional restriction at the UE (other than the multiplexing rules defined in RAN2) on the type of the traffic that can be carried in the scheduled subframes.
 - eNB shall not schedule the UE more subframes than the minimum necessary to transmit all the traffic corresponding to the same LBT priority class or lower (i.e., with a lower number in the LBT priority class table) than the LBT priority class used by the eNB based on the DL traffic and the latest BSR and received UL traffic from the UE.
 - The eNB is responsible for making sure that the mapping between QCI and LBT priority class is consistent with section 5.7.1 in TS 36.300.
 - The eNB is expected to take the QCI with the lowest priority in the logical channel group into account when defining the LBT priority class for a logical channel group
- Send an LS to RAN2 informing them of above agreement. **Done in R1-166050.**

Agreement: LBT type (i.e. Cat.4 LBT or LBT based on 25us CCA) is signaled via UL grant.

Agreements:

- UE is not expected to be signaled different LBT types for all consecutively scheduled subframes when there is no gap between the consecutive subframes.
- 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.
- For a set of consecutive scheduled subframes without any gaps that are subject to LBT, if LBT fails for a subframe in that set, the UE continues the LBT according to the signaled LBT type for the next subframe in the set.

Agreement:

- For an aperiodic SRS that is not multiplexed with PUSCH in the same subframe,
 - If the aperiodic SRS is followed by PUSCH without a gap between SRS and following PUSCH,

- UE performs LBT indicated for the following PUSCH.
- If the aperiodic SRS is followed by PUSCH with gap between SRS and following PUSCH,
 - Within eNB's channel occupancy, UE performs 25 usec one shot LBT
 - Outside of eNB's channel occupancy, UE performs random backoff based on LBT priority Class 1.
 - Choose one of the following options:
 - Option 1: UE performs Cat 3 LBT with fixed CWS values. The value is chosen from [3,7].
 - Option 2: UE performs Cat 3 LBT with CWS 7.
 - Option 3: UE performs Cat 4 LBT.
- FFS: SRS transmission if the gap between SRS and following PUSCH is smaller than X_{us} .
 - FFS the exact value of $X > 25us$

Agreement: The absence/presence on a long term basis (e.g. by level of regulation) of any other technology sharing the carrier is indicated by RRC signaling

[85-5-7] RRC parameters, Havish (Ericsson), Xia Yuan (Huawei)
RRC parameter list for eLAA for email approval until June 6th

Done: RRC parameter excel sheet sent in [LS R1-166051](#) – then updated in [LS R1-166052](#).

[85-09] Hanbyul (LGE)

Semi-persistent transmission for mode 2 for V2V. Email approval about FFSs until June 9th

Done: According to Mr Chair's email dated June 14th, RAN1 agreed the following:

- UE skips sensing at least on the subframes used for its own transmissions.
 - FFS how this is reflected in the resource (re)selection, e.g., whether/how to exclude the subframes for which sensing result (including information gathered from both energy measurement and SA decoding) is not available at least in case of SA and data are transmitted in the same subframe.
- Discuss in RAN1#86 whether the following is needed.
 - UE is not required to transmit PSCCH at TTI $n+c$ with $c < c_{min}$.
 - FFS the exact value of c_{min} .
- $c \leq d \leq d_{max}$
 - FFS how d_{max} is determined to fulfil the latency requirement of the packet to transmit, e.g., whether d_{max} is dependent of the priority level.
- Discuss in RAN1#86 whether further clarification is needed on the time reference of resource reselection, e.g., including the proposal in [R1-165909](#).
- Continue discussion in RAN1#86 on “e,” including the following proposal discussed in this email discussion:
 - A receiver UE decoded an SA assumes that the same frequency resource is reserved by the SA transmitter UE at TTI $n + d + P*j$ for $j=i, 2*i, \dots, J*i$.
 - $P=100$
 - FFS details of J , e.g., whether it is explicitly signalled in the SA, J is fixed in the specification (including fixed to 1).
 - FFS details of i , e.g., whether it is explicitly signalled in the SA, (pre)configuration can be used to restrict the selection of i , i is fixed in the specification, or it is an integer between 0 and 10.

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[85-10] Joerg (Ericsson)

[R1-165438](#) Link level simulation assumptions for evaluation of longer CP for MBSFN subframes Ericsson

Email approval until June 30th

Done: Still pending... status to be checked at RAN1#86.

[85-11] Alberto (Qualcomm)

eMBMS proposal

Email approval about above proposed agreements and proposed working assumptions until 30th June

Done: Still pending... status to be checked at RAN1#86.

[85-12] Hanbyul (LGE)

TP for V2V

Email approval of TP for TR including approval of next version of TR and updated simulation results by June 2nd

Done: Final TP (for capturing V2X evaluation results in TR) is agreed in [R1-165967](#), according to Mr Chair's email posted on June 4th.

[85-13] Alexei (Intel)

Antenna model for NR for email approval (w.r.t brackets in [R1-166026](#)) until June 9th

Done: According to Mr Chair's email dated June 10th, the following is agreed:

- **Reduce the gain (directivity) to 4dBi and keep HPBW = 40 deg in Option 1 (outdoor micro cell TRP antenna element model - omni in horizontal, directional in vertical)**

[85-14] Hasegawa (Mitsubishi)

[R1-166001](#) Proposal for email discussion on evaluation assumptions for high speed train scenario: Macro + relay around 30GHz Mitsubishi Electric, ETRI

Email approval until June 8th about brackets and FFS parts

Done: According to Mr Chair's email dated June 28th, the evaluation assumptions for the high speed train scenario for around 30GHz (RRH + relay) for NR are agreed in [R1-165979](#).

[85-15] Youngtae (LGE)

Performance metrics for NR for email discussion, starting from the ones in [R1-165612](#), till June 8th

Done: According to Mr Chair's email dated June 10th, the following performance metric is agreed:

CAR (Communication Availability and Resilience) = $(1-X) \cdot (1-Y)$

- **CAR metric is used for 1) sidelink only, 2) downlink only, or 3) uplink only simulation.**
 - For the other case, the equation can be modified.
- **1-X represents the availability of the communication connection, where X is the time portion during which the communication is interrupted by handover failure or link failure.**
 - X is simulated like mobility management similar to HetNet mobility in TR36.839.
 - Depending on application, X can be prefixed without evaluation of X, e.g., X=0 for sidelink.

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- **1-Y represents the resilience of the communication scheme:**
 - **Alt. 1: (1-Y) is simulated as PRR (packet reception ratio) within a specific range as defined in TR36.885.**
 - **Alt. 2: (1-Y) is simulated as a function of packet reception ratio per link.**
 - **Detailed method for Alt. 2 is further studied in RAN1#86.**
 - **Depending on the application, choose Alt. 1 and/or Alt.2.**
- **X and Y are simulated each. And those are used to calculate $(1-X)*(1-Y)$.**
- **The packet which is correctly received within D ms is regarded as successfully received packet. (NOTE: re-transmission is allowed within the latency bound.)**
 - **The requirement for the reliability and the latency depends on the targeting use cases.**
 - **The reliability and latency requirement is defined based on single communication pair**

[85-16] Frank (Huawei)

Calibration for NR waveform for email discussion until June 30th

Done: According to Mr Chair's email dated July 1st , a summary on calibration for NR waveform will be submitted to the RAN1#86 meeting.

[85-17] Frank (Huawei)

Collect information for NR waveform for email discussion until August 4th

Done: According to Mr Chair's email dated August 8th , a summary on NR waveform will be submitted to the RAN1#86 meeting.

[85-18] Mihai (Nokia)

PA assumption for NR for email discussion and approval about power amplifier assumptions for NR DL waveform evaluations by utilizing [R1-166004](#) and [R1-166010](#) and also email approval to confirm WA until June 9th

Done: According to Mr Chair's email dated June 17th , the following is agreed:

[UL part]

The following working assumption was decided in the previous RAN1 meeting and is subject for confirmation: “ RAN1 adopts the models provided in RAN4 LS ([R1-166004](#)) to the NR UL waveform evaluations”

- **Confirm the working assumption. For below 6GHz UL use the model as given in RAN4 LS in [R1-166004](#), for above 6GHz UL continue the discussion for polynomial model parametrization considering also potential impact from memory effects (consider the below 6GHz parametrization as a starting point).**

[DL part]

- **For below 6 GHz DL, consider as a starting point the below Rapp model parametrization assuming 46 dBm total output power and 57.6 dBm saturation power (this model considers DPD and CFR) .**

Parameter for Rapp model < 6GHz DL	
Target output power [dBm]	46
Saturation output power [dBm]	57.6
Smoothness factor p	3

Smoothness factor q	5
Fitting parameter A	-0.14
Fitting parameter B	1.2

Note that the gain of the model can be chosen freely, as it depends on the input signal reference level. The expected output for LTE10 DL 64-QAM signal is 46 dBm, with ACLR 45 dB and meeting respective spectrum emission masks.

- For above 6GHz DL, consider as a starting point a suitable Rapp model parametrization.

[General]

- **Proposal 4:** The PA operating point shall be set considering the
 - spectrum mask for BS
 - 36.104 clause 6.6.3.2.2 (Table 6.6.3.2.2-1) for WA BS when TX power is 46 dBm
 - spectrum mask for UE
 - 36.101 clause 6.6.2.1.1 (Table 6.6.2.1.1-1) for UE when TX power is 22 dBm
 - ACLR for BS => 45 dB (Table 6.6.2.1-1 of 36.104)
 - ACLR for UE => 30 dB (Table 6.6.2.3.1-1 of 36.101)
 - EVM requirement for BS according to Table 6.5.2-1 of 36.104
 - EVM requirement for UE according to Table 6.5.2.1.1-1 of 36.101
- **Proposal 5:** Provided that spectrum mask, ACLR, and EVM are met, companies are reporting the PA operating point. In addition, companies may provide waveform evaluations with same PA operating point and fulfilling the spectrum mask, ACLR, and EVM.
- **Proposal 6:** The potential impact from memory effects should be considered at least for above 6GHz operation and DL/UL wideband allocations.
- **Proposal 7:** Further refinement on the above DL and UL PA models and parameters is not precluded, like for example considering the indoor hotspot BS with target out power of 24 dBm.
- **Proposal 8:** Strive for a single model for each of UL and DL PA respectively which parameters does not depend on the TX power.

Note1: the 22 dBm UL power level is according to the RAN4 utilized power level in PA model investigation.

Note2: The common output phase shift due to the polynomial PA model for UL is compensated and is not included in the Tx EVM calculation for waveform evaluation.

[85-19] Young-Han Nam (Samsung)

Large scale calibration for channel model

For updating results for large scale calibration: Until June 10th

Done: Summary capturing the large scale calibration results available in [R1-165974](#).

[85-20] Young-Han Nam (Samsung)

Full calibration for channel model

For full calibration results: Until June 25th

Done: Summary capturing full calibration results available in [R1-165975](#).

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[85-21] Young-Han Nam (Samsung)

Additional feature calibration for channel model for discussion until July 25th

Done: According to Mr Chair's email dated August 8th , a summary on additional feature calibration will be submitted to the RAN1#86 meeting.

[85-22] Young-Han Nam (Samsung)

TP for channel model

For approval of the summary for all the calibration results and updated TP: Until August 10th

Done: According to Mr Chair's email dated August 11th , a draftCR to TR38.900 (now under change control) is agreeable and should be submitted to the RAN1#86 meeting.

[85-25] Taeyoung (Samsung)

UE noise figure for NR for email approval until 2nd June

Done: As per Mr chair's email decision posted on June 3rd, the following clarification is agreed:

- **The agreed noise figures (baseline performance: 13dB, high performance: 10dB) for evaluation of NR above 6GHz apply for both “Dense urban” and “Urban macro”.**

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Annex G: List of participants at RAN1 #85

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#86</u>	<u>WG</u>	22 – 26 Aug 2016	Goteborg	Sweden
<u>3GPPRAN1#86bis</u>	<u>WG</u>	10 – 14 Oct 2016	Lisbon	Portugal
<u>3GPPRAN1#87</u>	<u>WG</u>	14 – 18 Nov 2016	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#90</u>	<u>WG</u>	21 – 25 Aug 2017	Berlin (TBC)	Germany
<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