**3GPP TSG RAN WG1 #122bis R1-250XXXX**

**Prague, Czech, Oct 13th – 17th, 2025**

**Source: Chair**

**Title:** **Draft Agenda**

**Document for: Decision**

**Meeting registration: The deadline is Monday, Oct 6th, 08:00 UTC**

**Tdoc request: The deadline is Friday, Oct 3rd, 15:00 UTC**

**Tdoc submission: The deadline is Friday, Oct 3rd, 23:59 UTC**

# Opening of the meeting (Day 1: 9:00 am)

## Call for IPR

*I draw your attention to your obligations under the 3GPP Partner Organizations' IPR policies. Every Individual Member organization is obliged to declare to the Partner Organization or Organizations of which it is a member any IPR owned by the Individual Member or any other organization which is or is likely to become essential to the work of 3GPP.*

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| The attention of the delegates to this meeting 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 delegates were asked to take note that they were thereby 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 Statement and the Licensing declaration forms (<http://www.etsi.org/WebSite/document/Legal/IPRForms.doc>). |

## Competition Law Statement

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| The attention of the delegates to this meeting was drawn 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 Chair and Vice Chairs. 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, delegates were reminded that timely submission of work items/contributions in advance of WG meetings is important to allow for full and fair consideration of such matters. |

## Network Usage Conditions

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| **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, port scanners) |

## Consensus Principles Reminder

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| **Decision PCG54/10**: PCG approved to incorporate the following text to the agendas of each and every TSG and Working Group on “Consensus principles reminder”:  The attention of the delegates to the meeting is drawn to the fact that 3GPP endeavours to reach consensus on all decisions and therefore depends on a cooperative spirit of the Individual Members. In particular, Individual Members are encouraged to seek a consensus-based solution and only to sustain objections as a very last resort, and where absolutely necessary and well justified. The leadership will conduct the present meeting in a manner whereby informal methods of reaching consensus are encouraged, whilst ensuring that well justified concerns are taken into account. |

## Streamlined Standards

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| **Endorsement RAN#107:** RAN endorsed the following working principle for 6G (in RP-250766):  *3GPP to create lean and streamlined standards for 6G, e.g., by dimensioning an appropriate set of functionalities, minimizing the adoption of multiple options for the same functionality, avoiding excessive configurations, etc. Any exception to the above shall be well justified.* |

## Check-in for Registered Delegates

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

# Approval of Agenda

R1-2506700 Draft Agenda of RAN1#122bis meeting RAN1 Chair

R1-2506703 RAN1#122bis Meeting Timelines, Scope, Process RAN1 Chair, ETSI MCC

# Highlights from RAN plenary

R1-2506701 Highlights from RAN#109 RAN1 Chair

# Approval of Minutes from previous meetings

R1-2506702 Report of RAN1#122 meeting ETSI MCC

# Incoming Liaison Statements

**RAN1 Secretary**

R1-2506729 LS on please take good care of Carolyn RAN4 Chair (Apple)

**Relevant Tdoc:**

R1-2507889 Draft reply LS on please take good care of Carolyn THALES

**Modernization of specification format**

R1-2507032 LS on Study on Modernization of Specification Format and Procedures for 6G SA, Nokia, Samsung, CMCC, ETSI MCC

TSG SA asks all groups to remind delegates about the ongoing Study on Modernization of Specification Format and Procedures for 6G and to encourage participation to reflect the needs and ways of working of all groups. No RAN1 immediate action is needed.

**R19 AI/ML**

R1-2506715 LS on candidate data collection RAN2, Xiaomi, Ericsson

RAN2 is requesting RAN1 to feedback if there are any concerns on its agreements for Beam management UE-side data collection, as well as to provide necessary higher layer parameters for CSI prediction and for AI/ML beam management. RAN1 response needed. To be handled in agenda item 8.1. Moderator Haewook (LGE)

**Relevant Tdocs:**

R1-2506767 Discussion on candidate data collection ZTE Corporation, Sanechips

R1-2506768 Draft LS reply on candidate data collection ZTE Corporation, Sanechips

R1-2506851 Draft reply LS on candidate data collection vivo

R1-2506852 Discussion on candidate data collection vivo

R1-2506999 Discussion on LS on candidate data collection CMCC

R1-2507081 Draft reply LS on candidate data collection CATT

R1-2507157 Reply on LS on candidate data collection OPPO

R1-2507220 Discussion on RAN2 LS on candidate data collection Samsung

R1-2507306 Discussion on LS on candidate data collection NEC

R1-2507384 Discussion for LS on candidate data collection Nokia

R1-2507385 Draft LS reply on candidate data collection Nokia

R1-2507393 Draft reply LS on candidate data collection LG Electronics

R1-2507431 Discussion on the RAN2 LS on candidate data collection Ericsson

R1-2507439 Draft Reply LS on candidate data collection Lenovo

R1-2507523 Draft Reply LS on Candidate Data Collection Google

R1-2507647 Discussion on RAN2 LS on candidate data collection Apple

R1-2507691 Discussion for LS reply on candidate data collection Qualcomm Incorporated

R1-2507773 Discussion on RAN2 LS on candidate data collection Sharp

R1-2507928 Discussion on the LS reply to RAN2 on candidate data collection Huawei, HiSilicon

R1-2506722 LS to RAN1 and RAN3 on NW side data collection RAN2, ZTE

RAN2 is requesting RAN1 to feedback if there are any concerns on its agreements NW side data collection, as well as to necessary feedback. RAN1 discussion is needed. To be handled in agenda item 8.1. Moderator Zhe (Samsung)

**Relevant Tdocs:**

R1-2506765 Discussion on NW side data collection ZTE Corporation, Sanechips

R1-2506766 Draft LS reply on NW side data collection ZTE Corporation, Sanechips

R1-2506998 Discussion on RAN2’s LS to RAN1 and RAN3 on NW side data collection CMCC

R1-2507226 Discussion on RAN2 LS to RAN1 and RAN3 on NW side data collection Samsung

R1-2507420 Discussion on the RAN2 LS on NW side data collection Ericsson

R1-2507581 Discussion for LS reply on NW side data collection Nokia

R1-2507690 Discussion for LS reply on NW side data collection Qualcomm Incorporated

R1-2507930 Discussion on the LS reply to RAN2 on NW side data collection Huawei, HiSilicon

R1-2506720 LS on when RRC layer submits periodic CSI inference configuration to lower layer RAN2, Apple

RAN2 is requesting RAN1 to reply which option (i.e. Option 1 or Option 2) of their context is best. RAN1 response is needed. To be handled in agenda item 8.1. Moderator Zhe (Samsung)

**Relevant Tdocs:**

R1-2506769 Draft LS reply on when RRC layer submits periodic CSI inference configuration to lower layer ZTE Corporation, Sanechips

R1-2506853 Draft reply LS on when RRC layer submits periodic CSI inference configuration to lower layer vivo

R1-2506854 Discussion on when RRC layer submits periodic CSI inference configuration to lower layer vivo

R1-2506956 Draft reply LS on when RRC layer submits periodic CSI inference configuration to lower layer Xiaomi

R1-2506997 Discussion on LS on when RRC layer submits periodic CSI inference configuration to lower layer CMCC

R1-2507088 Draft reply LS on when RRC layer submits periodic CSI inference configuration to lower layer CATT

R1-2507158 Reply on LS on when RRC layer submits periodic CSI inference configuration to lower layer OPPO

R1-2507221 Discussion on RAN2 LS on periodic CSI inference configuration to lower layer Samsung

R1-2507222 Draft LS reply on RAN2 LS on periodic CSI inference configuration to lower layer Samsung

R1-2507307 Discussion on LS on when RRC layer submits periodic CSI inference configuration to lower layer NEC

R1-2507386 Discussion on when RRC layer submits periodic CSI inference configuration to lower layer Nokia

R1-2507387 Draft LS reply on when RRC layer submits periodic CSI inference configuration to lower layer Nokia

R1-2507392 Draft reply LS on when RRC layers submits inference configuration to lower layer LG Electronics

R1-2507441 Draft Reply LS on when RRC layer submits periodic CSI inference configuration to lower layer Lenovo

R1-2507524 Draft Reply LS on when RRC layer submits periodic CSI inference configuration to lower layer Google

R1-2507645 Discussion on RAN2 LS on when RRC layer submits periodic CSI inference configuration to lower layer Apple

R1-2507646 Draft reply on RAN2 LS on when RRC layer submits periodic CSI inference configuration to lower layer Apple

R1-2507689 Discussion for LS reply on when RRC layer submits periodic CSI inference configuration to lower layer Qualcomm Incorporated

R1-2507866 Discussion on LS on when RRC layer submits periodic CSI inference configuration to lower layer Ericsson

R1-2507929 Discussion on the LS reply to RAN2 on periodic CSI inference configuration to lower layer Huawei, HiSilicon

R1-2506737 LS on the implicit indication of TRP location coordinates via "Associated ID" RAN2, Qualcomm

RAN2 is requesting RAN1 to provide answers to a list of questions. RAN1 response is needed. To be handled in agenda item 8.1. Moderator Yufei (Ericsson)

**Relevant Tdocs:**

R1-2506763 Discussion on the implicit indication of TRP location coordinates via "Associated ID" ZTE Corporation, Sanechips

R1-2506764 Draft LS reply on the implicit indication of TRP location coordinates via "Associated ID" ZTE Corporation, Sanechips

R1-2506855 Draft reply LS on the implicit indication of TRP location coordinates via "Associated ID" vivo

R1-2506856 Discussion on the implicit indication of TRP location coordinates via "Associated ID" vivo

R1-2507087 Draft reply LS on the implicit indication of TRP location coordinates via associated ID CATT

R1-2507223 Discussion on RAN2 LS on LS on the implicit indication of TRP location coordinates via "Associated ID" Samsung

R1-2507224 Draft LS reply on RAN2 LS on the implicit indication of TRP location coordinates via "Associated ID" Samsung

R1-2507338 Discussion on the implicit indication of TRP location coordinates via "Associated ID" Ericsson

R1-2507692 Discussion on LS reply for the implicit indication of TRP location coordinates via "Associated ID" Qualcomm Incorporated

R1-2507345 Proposals for reply for RAN2 LS: on the implicit indication of TRP location coordinates via "Associated ID" InterDigital, Inc.

R1-2507388 Draft LS reply on the implicit indication of TRP location coordinates via "Associated ID" Nokia

R1-2507644 Discussion on RAN2 LS on the implicit indication of TRP location coordinates via "Associated ID" Apple

R1-2507927 Discussion on the LS reply to RAN2 on the implicit indication of TRP location coordinates via Associated ID Huawei, HiSilicon

**R19 MIMO**

R1-2506721 LS on two-TA configuration and UE-initiated CSI reporting RAN2, Samsung

RAN2 is requesting RAN1 to take its agreement into account. RAN1 discussion is needed. To be handled in agenda item 8.2. Moderator Li (OPPO)

**Relevant Tdoc:**

R1-2507847 Discussion on LS on two-TA configuration and UE-initiated CSI reporting Ericsson

R1-2506730 LS on event triggered L1-RSRP reporting if eventDetectionTimeWindowLength-r19 is configured RAN4, Qualcomm

RAN4 is requesting RAN1 to take its agreement into account. No RAN1 discussion needed.

**Relevant Tdoc:**

R1-2507736 Reply to LS on event triggered L1-RSRP reporting if eventDetectionTimeWindowLength-r19 is configured Nokia

R1-2506727 LS on event triggered L1-RSRP reporting RAN4, ZTE

RAN4 is requesting RAN1 to take its agreement into account and provide feedback if there is any issue with the agreement. RAN1 discussion is needed. To be handled in agenda item 8.2. Moderator Bo (ZTE)

**Relevant Tdocs**

R1-2507046 Draft reply LS to RAN4 on event triggered L1-RSRP reporting ZTE Corporation, Sanechips

R1-2507435 Draft Reply LS on event triggered L1-RSRP reporting Lenovo

R1-2507576 Draft reply of LS on event triggered L1-RSRP reporting Google

R1-2507735 Reply to LS on event-triggered L1-RSRP reporting Nokia

R1-2506728 Reply LS on maximum transmission power for STxMP RAN4, vivo

RAN4 informs RAN1 about its spec change on receiving corresponding RAN1 LS. No RAN1 action is needed.

R1-2506724 LS on per band and per BC capability RAN2, Samsung, Xiaomi

RAN2 is requesting RAN1 to provide answer to a list of questions, and further requesting RAN1 to capture how to handle relationship between per band and per BC capabilities and pre-requisite in the feature list If there is no common rule for all per band and per BC capabilities or there is exception for a certain feature group. RAN1 discussion is needed. To be handled in Agenda 9.2. Moderator to be decided by Ralf.

**Relevant Tdocs**

R1-2506867 Draft reply LS on per band and per BC capability vivo

R1-2506955 Discussion on RAN2 LS on per band and per BC capability Xiaomi

R1-2507045 Draft reply LS to RAN2 on per band and per BC capability ZTE Corporation, Sanechips

R1-2507071 Draft reply LS on per band and per BC capability Spreadtrum, UNISOC

R1-2507161 Discussion on LS on per band and per BC capability OPPO

R1-2507225 Draft reply LS on per band and per BC capability Samsung

R1-2507339 Discussion on RAN2 LS on per band and per BC capability Nokia

R1-2507440 Draft Reply LS on per band and per BC capability Lenovo

R1-2507869 Discussion on LS on per band and per BC capability Ericsson

R1-2507933 Discussion on per band and per BC capability Huawei, HiSilicon

**R19 SBFD**

R1-2506719 Reply LS on simultaneous configuration of SBFD and DC RAN2, ZTE

RAN2 is requesting RAN1 to take its conclusion that simultaneous configuration of SBFD and DC can be supported with limited specification impact. No RAN1 immediate action is needed.

**R19 NES**

R1-2506714 LS on RAN2 agreement on SUL support for SIB1 request RAN2, Samsung

RAN2 is requesting RAN1 to inform if there is any concern on the SUL support for SIB1 request. RAN1 discussion is needed. To be handled in agenda item 8.5. Moderator James (MediaTek).

**Relevant Tdocs:**

R1-2507089 Draft reply LS on RAN2 agreement on SUL support for SIB1 request CATT

R1-2507188 Draft reply LS on RAN2 agreement on SUL support for SIB1 request ZTE Corporation, Sanechips

R1-2507266 Discussion on RAN2 agreement on SUL support for SIB1 request ZTE Corporation, Sanechips

R1-2507350 Discussion on RAN2 LS on SUL support for SIB1 request LG Electronics

**R19 LP-WUS**

R1-2506723 LS on not supporting simultaneous LR and MR operation RAN2, Apple

RAN2 is requesting RAN1 to take its agreement into account, as well as sharing its understanding on RAN1 agreement. RAN1 discussion is needed. To be handled in Agenda 8.6. Moderator Xin (vivo)

**Relevant Tdoc**

R1-2506868 Draft reply LS on not supporting simultaneous LR and MR operation vivo

**R19 NR/IoT-NTN**

R1-2506732 Reply LS on requirements for phase continuity and power consistency for OCC with PUSCH in NR NTN Ph3 RAN4, vivo

RAN4 is requesting RAN1 to take its agreement into account. RAN1 was CC-ed. RAN1 discussion is needed. To be handled in agenda item 8.7.1. Moderator Gilles (MediaTek)

**Relevant Tdoc:**

R1-2507688 Requirements for phase continuity and power consistency for OCC Qualcomm Incorporated

R1-2506717 LS on power ramping and RRC configuration for CB-Msg3-EDT RAN2, Nokia

RAN2 is requesting RAN1 to take the above information into account, and providing confirmation regarding RAN1’s questions indicated in the LS R1-2504959. RAN discussion is needed. To be handled in agenda item 8.7.2. Moderator Gilles (MediaTek).

**Relevant Tdocs:**

R1-2506857 Draft reply LS on the support of CB-msg3 vivo

R1-2506858 Discussion on the support of CB-msg3 vivo

R1-2506907 Discussion on the LS on power ramping and RRC configuration for CB-Msg3-EDT ZTE Corporation, Sanechips

R1-2506958 Discussion on RAN2 LS on power ramping and RRC configuration for CB-Msg3-EDT Xiaomi

R1-2507083 Discussion on LS on power ramping and RRC configuration for CB-Msg3-EDT CATT

R1-2507143 Discussion on LS on power ramping and RRC configuration for CB-Msg3-EDT OPPO

R1-2507144 Draft reply LS on power ramping and RRC configuration for CB-Msg3-EDT OPPO

R1-2507261 On RAN2 LS on CB Msg3 EDT for IoT NTN Ph3 Ericsson

R1-2507295 Discussion on RAN2 LS on power ramping and RRC configuration for CB-Msg3-EDT Nokia, Nokia Shanghai Bell

R1-2507626 LS on power ramping and RRC configuration for CB-Msg3-EDT MediaTek Inc.

R1-2507685 Power ramping and RRC configuration for CB-Msg3-EDT Qualcomm Incorporated

R1-2507917 Discussion on CB-Msg3-EDT Huawei, HiSilicon

R1-2507918 Draft LS reply on CB-Msg3-EDT Huawei, HiSilicon

R1-2506718 LS on OCC for IoT-NTN TDD mode RAN2, Huawei

RAN2 respectfully asks RAN1 to provide feedback if OCC defined for IoT NTN Rel-19 can be supported for IoT NTN TDD mode. RAN1 discussion is needed while keeping in mind that Internet of Things (IoT) Phase 3 and IoT-NTN TDD mode belong to different items, the outputs from one item can’t be simply applied to another one even when it is feasible according to MCC procedure. To be handled in agenda item 8.7.2 Moderator Shin (Huawei).

**Relevant Tdocs**

R1-2506859 Draft reply LS on OCC support for IoT NTN TDD vivo

R1-2506860 Discussion on OCC support for IoT NTN TDD vivo

R1-2506908 Discussion on the LS on OCC for IoT-NTN TDD mode ZTE Corporation, Sanechips

R1-2506954 Discussion on the LS on OCC for IoT-NTN TDD mode xiaomi

R1-2507084 Discussion on LS on OCC for IoT-NTN TDD mode CATT

R1-2507145 Discussion on LS on OCC for IoT-NTN TDD mode OPPO

R1-2507146 Draft reply LS on OCC for IoT-NTN TDD mode OPPO

R1-2507262 On RAN2 LS on OCC for IoT-NTN TDD mode Ericsson

R1-2507296 Discussion on RAN2 LS on OCC for IoT-NTN TDD mode Nokia, Nokia Shanghai Bell

R1-2507686 OCC for IoT-NTN TDD mode Qualcomm Incorporated

R1-2507915 Discussion on OCC for IoT-NTN TDD mode Huawei, HiSilicon

R1-2507916 Draft LS reply on OCC for IoT-NTN TDD mode Huawei, HiSilicon

R1-2506731 LS Reply on precompensation for NB-IoT NTN TDD mode RAN4, Iridium Satellite LLC

RAN4 asks RAN1 if the included TS change is in accordance with the RAN1 agreement; if it is, no action is needed from RAN1. If it is not, RAN4 respectfully asks for further guidance from RAN1. RAN1 discussion is needed. To be handled in agenda item 8.7. Moderator Alberto (Qualcomm).

**Relevant Tdocs:**

R1-2506864 Draft reply LS on pre-compensation for IoT TDD mode vivo

R1-2506865 Discussion on pre-compensation for IoT TDD mode vivo

R1-2506909 Discussion on the LS Reply on precompensation for NB-IoT NTN TDD mode ZTE Corporation, Sanechips

R1-2507086 Discussion on LS Reply on precompensation for NB-IoT NTN TDD mode CATT

R1-2507147 Discussion on LS Reply on precompensation for NB-IoT NTN TDD mode OPPO

R1-2507148 Draft reply on LS on precompensation for NB-IoT NTN TDD mode OPPO

R1-2507684 Precompensation for IoT-NTN TDD mode Qualcomm Incorporated

**Release 18 NR-NTN and Mobile-IAB**

R1-2505120 LS on RACH-less handover RAN2, NEC

In RAN1#122, RAN2 is requesting RAN1 to take its decision made in TEI into consideration that RACH-less handover applies to NTN UEs and TN UEs (including UEs on mobile IAB), the discussion was postponed to this meeting. To be handled in agenda item 7. Moderator Yingchao(NEC).

**Relevant Tdoc(s)**

R1-2506861 Discussion on the support of RACH-less handover vivo

R1-2507309 Discussion on RAN2 LS on RACH-less handover NEC

R1-2507890 On RAN2 LS on RACH-less handover Ericsson

**R19 TEI**

R1-2506716 LS on early CSI acquisition for L3 handover RAN2, Huawei

RAN2 is requesting RAN1 to check if it is OK to support early CSI acquisition for L3 handover by re-using the early CSI acquisition framework for LTM and update the RAN1 spec if needed. RAN1 discussion is needed. To be handled in LTM of Agenda 8.8. Moderator Hong (Apple)

**Relevant Tdocs**

R1-2506866 Discussion on early CSI acquisition for L3 handover vivo

R1-2507043 Draft reply LS to RAN2 on early CSI acquisition for L3 handover ZTE Corporation, Sanechips

R1-2507044 Discussion on early CSI acquisition for L3 handover ZTE Corporation, Sanechips

R1-2507069 Discussion on LS on support for early CSI acquisition for L3 handover Nokia

R1-2507070 Draft reply LS on early CSI acquisition for L3 handover Spreadtrum, UNISOC

R1-2507082 Draft reply LS on early CSI acquisition for L3 handover CATT

R1-2507219 Discussion on RAN2 LS on early CSI acquisition for L3 handover Samsung

R1-2507348 Discussion on LS on early CSI acquisition for L3 handover Ericsson

R1-2507403 Introduction of Rel-19 early CSI acquisition for L3 handover to TS 38.214 [EarlyCSI\_L3HO] Huawei, HiSilicon, Ericsson

R1-2507404 Introduction of Rel-19 early CSI acquisition for L3 handover to TS 38.212 [EarlyCSI\_L3HO] Huawei, HiSilicon, Ericsson

R1-2507924 Discussion on the RAN2 LS on early CSI acquisition for L3 handover [EarlyCSI\_L3HO] Huawei, HiSilicon

R1-2507925 Draft reply LS on early CSI acquisition for L3 handover [EarlyCSI\_L3HO] Huawei, HiSilicon

**Incoming LSs where RAN1 was cc-ed**

R1-2506706 Reply LS on signalling feasibility of dataset and parameter sharing SA5, Huawei

R1-2506711 Reply LS on signalling feasibility of dataset and parameter sharing SA2, Samsung

R1-2506712 LS on UE data collection and data transfer SA2, Nokia

R1-2506726 Reply LS on AI/ML functionality activation RAN2, Apple

R1-2506735 LS on definition of CSI-RS based L1 intra/inter-frequency measurement RAN4, Apple

R1-2506713 LS on allocation of CN assigned subgroup ID for LP-WUS RAN3, NTT DOCOMO

R1-2506704 Reply LS to SA4 on the RAN simulation assumptions for ULBC CT1, Qualcomm

R1-2506708 Reply LS on the RAN simulation assumptions for ULBC SA2, Qualcomm

R1-2506736 Response LS on the RAN simulation assumptions for ULBC RAN4, Xiaomi

R1-2507035 LS on bundling period and SPS for ULBC SA4, Qualcomm

R1-2506733 LS on Rel-19 RAN4 UE feature list for NR (version 2) RAN4, CMCC

R1-2506734 LS on Release Independence of 6Rx RAN4, T-Mobile USA

R1-2506725 LS on CQI reporting for CB-Msg3-EDT RAN2, Samsung

R1-2506705 LS on the maximum supported AIoT NAS container length CT1, Lenovo

R1-2506709 Reply LS to Reply LS on the removal of service type information SA2, LG Electronics

R1-2506710 LS on AIoT Device Permanent ID Length SA2, Huawei

**R20 IoT-NTN**

R1-2506707 LS on issues related to support of IMS voice over NB-IoT NTN connected to EPC SA2, Qualcomm

SA2 is checking if RAN1 can provide answer to question 2. To be handled in agenda item 5 because corresponding item is not started yet in RAN1. Moderator Alberto (Qualcomm).

**Relevant Tdocs:**

Agreement

Reply to Q2 of R1-2506707 as the following:

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| Assuming line-of-sight condition for the duration of the call, no change in large scale parameters (e.g. fixed shadowing), and using an NTN TDL-C channel model (which is a channel model previously used by RAN1 and SA4 evaluations), the probability of having 16 or 64 packets consecutively lost is negligible under typical operating conditions (e.g. up to 10% packet error rate)  For the case of line-of-sight not being guaranteed for the duration of the call, an intermittent blockage (e.g. according to the land mobile satellite channel model in TR 38.811) may still occur in practice, in which case the probability of having 16 or 64 packets consecutively lost may not be negligible. RAN1 has not reached consensus on whether to consider this case. |

Agreement

Draft LS R1-2508095 is endorsed in principle.

Agreement

Final LS R1-2508096 is endorsed

**R1-2508050**

R1-2507992 Feature lead summary #1 for IMS voice over NB-IoT NTN Moderator (Qualcomm Incorporated)

R1-2506862 Draft reply LS on issues related to support of IMS voice over NB-IoT NTN connected to EPC vivo

R1-2506863 Discussion on issues related to support of IMS voice over NB-IoT NTN connected to EPC vivo, Spreadtrum

R1-2506906 Discussion on the LS on issues related to support of IMS voice over NB-IoT NTN connected to EPC ZTE Corporation, Sanechips

R1-2506957 Discussion on SA2 LS on the support of IMS voice over NB-IoT NTN connected to EPC Xiaomi

R1-2507085 Discussion on LS on issues related to support of IMS voice over NB-IoT NTN connected to EPC CATT

R1-2507141 Discussion on LS on issues related to support of IMS voice over NB-IoT NTN connected to EPC OPPO

R1-2507142 Draft reply LS on issues related to support of IMS voice over NB-IoT NTN connected to EPC OPPO

R1-2507218 Discussion on SA2 LS for issues related to support of IMS voice over NB-IoT NTN connected to EPC Samsung

R1-2507297 Discussion on SA2 LS on issues related to support of IMS voice over NB-IoT NTN connected to EPC Nokia, Nokia Shanghai Bell

R1-2507320 Discussion on SA2 LS on issues related to support of IMS voice over NB-IoT NTN connected to EPC NEC

R1-2507687 IMS voice over NB-IoT NTN Qualcomm Incorporated

R1-2507919 Discussion on issues related to support of IMS voice over NB-IoT NTN connected to EPC Huawei, HiSilicon

R1-2507920 Draft LS reply on issues related to support of IMS voice over NB-IoT NTN connected to EPC Huawei, HiSilicon

R1-2507263 On SA2 LS on IMS voice over NB-IoT NTN Ericsson

# Pre-Rel-19 E-UTRA Maintenance

***Only essential corrections*** *– a rejected draft CR will be marked in red*

***For maintenance on RAN1 specifications, individual draft CRs are to be submitted. Final endorsed CR will be sourced by “Moderator (company name)” and other co-sourcing companies (if any).***

**Maintenance issues on Pre-Rel-19 E-UTRA will be discussed in RAN1 adhoc1 session (chaired by Sorour).**

**R1-2508146** Session notes for AI 6 Ad-Hoc Chair (Ericsson)

Session notes are endorsed and incorporated the session notes below.

R1-2507365 On TA command adjust timing for NB-IoT NTN Ericsson

R1-2507622 Alignment CR for MAC-CE TA command in IoT NTN MediaTek Inc.

R1-2507623 Discussion on interference randomnization for non-anchor carrier MediaTek Inc.

# Pre-Rel-19 NR Maintenance

***Only essential corrections*** *– a rejected draft CR will be marked in red*

***For maintenance on RAN1 specifications, individual draft CRs are to be submitted. For more efficient review, please use/fill the release and WI code fields when requesting tdoc numbers for draft CRs. Final endorsed CR will be sourced by “Moderator (company name)” and other co-sourcing companies (if any).***

**Maintenance issues on Pre-Rel-19 NR will be discussed in RAN1 adhoc1 session (chaired by Sorour).**

**R1-2508147** Session notes for AI 7 Ad-Hoc Chair (Ericsson)

Session notes are endorsed and incorporated the session notes below.

**POS SRS FH**

[R1-2507194](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507194.zip) UE features for positioning SRS frequency hopping for RedCap UE ZTE Corporation, Sanechips

[R1-2507914](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507914.zip) Discussion on UE capabilities for UTW Huawei, HiSilicon

Agreement:

The draft LS captured in R1-2507194 is endorsed in principle with the following update (addition of 37.355):

“As this agreement is related to RAN2 specification (38.306, 38.331, 37.355), this liaison informs RAN2 about this agreement.

The final LS in R1-2508188 is endorsed.

**LTM**

[**R1-2507349**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507349.zip) On per-band capabilities for inter-frequency LTM Ericsson

Related to the issue raised in R1-2507349, RAN1 will send an LS to RAN2.

Agreement:

The draft LS in R1-2508123 in endorsed in principle. The final LS in R1-2508124 is endorsed.

[**R1-2507870**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507870.zip) Draft CR on simultaneous BWP operation for LTM PRACH and legacy BWP operation MediaTek Inc.

**Conclusion:**

It is RAN1 common understanding that LTM PRACH triggered by PDCCH order outside active BWP and legacy BWP change operation do not run simultaneously in the same band.

[**R1-2507921**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507921.zip) Correction to L1-RSRP reporting in UCI for LTM in TS38.212 Huawei, HiSilicon

Agreement:

The TP in R1-2507921 for TS38.212 is endorsed in principle as **Alignment CR**.

**RACH-less handover (Consider corresponding LS – Moderated by NEC Yingchao)**

[R1-2507133](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507133.zip) Draft CR for RACH-less handover OPPO

[R1-2507310](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507310.zip) Draft CR for TS 38.213 on RACH-less handover LS NEC

[R1-2507893](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507893.zip) Draft Rel-18 CR for RACH-less handover Ericsson

[R1-2507894](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507894.zip) Draft Rel-19 CR for RACH-less handover Ericsson

R1-2507891 Draft Rel-18 CR for RACH-less handover Ericsson

(Withdrawn)

R1-2507892 Draft Rel-19 CR for RACH-less handover Ericsson

(Withdrawn)

**R1-2508059 Summary for RACH-less HO Moderator (NEC)**

**R1-2508120 Summary #2 on discussion for PRACH-less HO Moderator (NEC)**

Continue the discussion next meeting.

[**R1-2507450**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507450.zip) Sequence generation for uplink DM-RS in NTN RACH-less HO or RACH-less LTM in TS 38.211 Ofinno

**DFT-s-OFDM with PTRS**

[**R1-2506779**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2506779.zip) Draft CR on DFT operation for a PUSCH with PTRS ZTE Corporation, Sanechips

**Agreement:**

The draft CR R1-2506779 is endorsed in principle as **Alignment CR** for 38.211.

Note: In R1-2506779, in third line of the equation, “PUSCH” should be used instead of “layer” in .

**HARQ**

[**R1-2507200**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507200.zip) Draft CR on Type-2 HARQ-ACK codebook for sidelink ZTE Corporation, Sanechips

Agreement:

The draft CR in R1-2507200 is endorsed in principle for Rel-17 as **Alignment CR** for TS38.213 , clause 16.5.2.2 with the following update “, and sets”. Mirror CRs are needed for Rel-18 and Rel-19.

- For the pseudo-code for the HARQ-ACK codebook generation in clause 16.5.2.1, after the completion of the loop, the UE sets if , and sets , where is the value of the SAI field in the DCI format according to Table 16.5.2.2-1.

[**R1-2507314**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507314.zip) Corrections on Type-2 HARQ-ACK codebook in Rel-17 NEC

[**R1-2507351**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507351.zip) Draft CR on HARQ-ACK bit ordering for multi-PDSCH scheduling LG Electronics, Xiaomi

**R1-2508134 Summary of draft CR discussion on HARQ-ACK bit ordering for multi-PDSCH scheduling Moderator (LG Electronics)**

**Conclusion:**

When a UE is provided *pdsch-TimeDomainAllocationListForMultiPDSCH* and the value of *maxNrofCodeWordsScheduledByDCI* equals 2 for a serving cell,

* If *nrofHARQ-BundlingGroups* is configured and *harq-ACK-SpatialBundlingPUCCH* is NOT configured for the serving cell,
  + HARQ-ACK bits are ordered in TBG first and then TB index second.
* If neither *nrofHARQ-BundlingGroups* nor *harq-ACK-SpatialBundlingPUCCH* is configured for the serving cell,
  + HARQ-ACK bits are ordered in PDSCH first and then TB index second.
* No spec change is necessary

[**R1-2507923**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507923.zip) Correction on HARQ process for Rel-17 52\_71GHz spectrum Huawei, HiSilicon

Agreement:

The draft CR in R1-2507923 is endorsed in principle as **Alignment CR** for TS38.214 for Rel-17.

**UE Power saving**

[**R1-2506959**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2506959.zip) Discussion on PDCCH monitoring behaviours for SSSG switching Xiaomi

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**R1-2508119 Discussion on PDCCH monitoring behaviors for SSSG switching Xiaomi**

**Conclusion:**

When a UE is provided a timer value by *searchSpaceSwitchTimer-r17* and the timer expires in a first slot, if PDCCH monitoring is required during PDCCH skipping duration, the UE monitors PDCCH on the serving cell according to search space sets with group index 0 starting in a second slot that

-    is not earlier than symbols after the first slot when ,

-    is a first slot in a slot group of slots that is not earlier than symbols after the first slot when

No specification impact

[**R1-2507693**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507693.zip) Determination of SSSG index in a newly activated SCell Qualcomm Incorporated

Agreement:

The draft CR in R1-2508145 is endorsed in principle for Rel-18 with the following change in cover page for the consequences:

“Ambiguity in applied SSSG switching”

The final CRs for Rel-18 and Rel-19 (mirror of Rel-18) in R1-2508192 and R1-2508193, respectively, are endorsed.

[**R1-2507451**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507451.zip) Draft CR on PDCCH skipping after successful RAR reception in a contention-free random access Ofinno

**Redcap**

[**R1-2507340**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507340.zip) Correction to the RedCap HD-UE PRACH vs. DL RS prioritization procedure Nokia

Agreement:

The draft CR in R1-2507340 is endorsed in principle as **Alignment CR** for TS38.213 Clause 17.2 for Rel-17.

**Positioning**

[R1-2507448](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507448.zip) Aperiodic SRS Frequency Hopping Discussion Ofinno

[R1-2507449](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507449.zip) Draft CR on AP positioning SRS frequency hopping Ofinno

[R1-2507912](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507912.zip) Discussion on aperiodic SRS with frequency hopping Huawei, HiSilicon

[R1-2507913](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507913.zip) DraftCR on correction to aperiodic SRS with frequency hopping Huawei, HiSilicon

Agreement:

The draft CR R1-2508126 for Rel-18 is endorsed in principle.

Final CRs for Rel-18 and Rel-19 (mirror of Rel-18 CR) in R1-2508135 and R1-2508136, respectively, are endorsed.

**Channel modelling**

[R1-2507785](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507785.zip) Discussion on UL and DL reciprocity modelling Ericsson

[R1-2507786](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507786.zip) Draft CR on UL and DL reciprocity modelling Ericsson

**R1-2508101**

**R1-2508171**

Continue the discussion next meeting to resolve the issue in next meeting.

**DSS**

[R1-2507926](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507926.zip) Correction on higher layer parameter for Rel-18 DSS to Rel-18 Huawei, HiSilicon

Agreement:

The draft CR in R1-2507926 for TS38.213 for Rel-18 is endorsed in principle as **Alignment CR**.

**MIMO**

[**R1-2507563**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507563.zip) Discussions on CSI-RS resources counting for beam management Sharp

[R1-2507564](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507564.zip) Draft CR on CSI-RS resources counting for beam management Sharp

[**R1-2507565**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507565.zip) Discussions on CSI report priority and CPU occupation for P3 procedure Sharp

[**R1-2506869**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2506869.zip) Draft CR on two TAG operation (Rel-18) vivo

[**R1-2506870**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2506870.zip) Draft CR on two TAG operation (Rel-19 mirror) vivo

[**R1-2507048**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507048.zip) Draft CR on two TAs for MDCI in TS 38.213 ZTE Corporation, Sanechips

Agreement:

The draft CR for TS 38.213 in R1-2506869 for Rel-18 is endorsed in principle.

Final CR for Rel-18 and Rel-19 (mirror of Rel-18) are endorsed in R1-2508143 and R1-2508144, respectively.

[**R1-2506960**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2506960.zip) Draft CR on SFN-scheme dynamic switching for Rel-18 in TS 38.214 Xiaomi

Agreement:

The draft CR in R1-2506960 for TS38.214 for Rel-18 is endorsed in principle with the following change:

* Remove in the proposed TP “-r17” and “-18”.

Final CR for Rel-18 and Rel-19 (mirror of Rel-18) are endorsed in R1-2508166 and R1-2508167, respectively.

[**R1-2507047**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507047.zip) Draft CR on parameters for enhanced DMRS in TS 38.211 ZTE Corporation, Sanechips

[**R1-2507049**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507049.zip) Draft CR on power scaling for STxMP in TS 38.213 ZTE Corporation, Sanechips

R1-2508177

Agreement:

The draft CR for TS 38.213 in R1-2508177 for Rel-18 is endorsed in principle.

Final CR for Rel-18 and Rel-19 (mirror of Rel-18) are endorsed in R1-2508194 and R1-2508195, respectively.

[**R1-2507050**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507050.zip) Draft CR on the indicated TCI-state and UL-TCI state in TS 38.213 ZTE Corporation, Sanechips

Agreement:

The draft CR R1-2508165 is endorsed as Alignment CR for TS 38.213 for Rel-18.

[**R1-2507090**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507090.zip) Correction on power control for SRS antenna switching CATT

[**R1-2507091**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507091.zip) Correction on determination of power control adjustment state for UL transmission CATT

[**R1-2507092**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507092.zip) Correction on determination of power control parameters during link recovery procedures CATT

[**R1-2507132**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507132.zip) Draft CR for priority formula for doppler codebook OPPO

[**R1-2507317**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507317.zip) Draft CR on priority formula for predicted CSI in TS38.214 NEC

Agreement:

The draft CR in R1-2507132 is endorsed in principle as **Alignment CR** for TS38.214, Rel-18.

[**R1-2507318**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507318.zip) Draft CR on PUSCH ports mapping for multi-panel SFN in TS38.214 NEC

[**R1-2507788**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507788.zip) Draft CR on SRI in STxMP SFN non-codebook PUSCH NTT DOCOMO, INC.

[**R1-2507789**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507789.zip) Draft CR on SRI in STxMP SFN non-codebook PUSCH NTT DOCOMO, INC.

[**R1-2507319**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507319.zip) Draft CR on SRS ports mapping in one symbol in TS38.214 NEC

[**R1-2507514**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507514.zip) Draft CR on TDCP Report Configuration Google

Agreement:

The draft CR in R1-2507514 for TS38.214 for Rel-18 is endorsed in principle

Final CR for Rel-18 and Rel-19 (mirror of Rel-18) are endorsed in R1-2508180 and R1-2508181, respectively.

[**R1-2507931**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507931.zip) Correction on the condition for the number of UL PTRS ports in 38.214 Huawei, HiSilicon

[**R1-2507093**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507093zip) Draft CR on determination of cyclic shift for PRACH transmission in 2TA CATT

[**R1-2507932**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507932.zip) Correction on PRACH sequence generation and baseband signal generation in 38.211 Huawei, HiSilicon

Agreement:

The draft CR in R1-2507093 for TS38.211 for Rel-18 is endorsed in principle

Final CR for Rel-18 and Rel-19 (mirror of Rel-18) are endorsed in R1-2508196 and R1-2508197, respectively.

[**R1-2507934**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507934.zip) Discussion on the lowest numbered resource block for PRACH baseband signal generation Huawei, HiSilicon

[**R1-2507935**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_122b/Docs/R1-2507935.zip) Correction on the lowest numbered resource block for PRACH baseband signal generation in 38.211 Huawei, HiSilicon

# Maintenance on Rel-19 NR and E-UTRA

***The maximum number of contributions per company/organization/university is limited to 1 per agenda item unless stated otherwise.***

***For Rel-19 maintenance, only essential corrections will be considered. Only text proposals are to be submitted (no individual draft CRs, please!).***

* ***For each text proposal, companies are to provide relevant information (e.g. reason for change, summary of change, consequences if not approved) in a clear and concise manner***
* ***Editors to prepare final CRs***

## Maintenance on Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface

*Note: Maximum one contribution. For efficient review, please use the following sections in your contribution corresponding to the maintenance issues, if any:*

* *Specification support for beam management*
* *Specification support for positioning accuracy enhancements*
* *Specification support for CSI prediction*

[122bis-R19-AI/ML] Email discussion on AI/ML – Juan (Qualcomm)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508148** Session notes for 8.1 (Maintenance on AI/ML for NR Air Interface) Ad-Hoc Chair (Ericsson)

Session notes are endorsed and incorporated the session notes below.

R1-2506760 Remaining Issues of Rel-19 AI/ML for NR Air Interface Ericsson

R1-2506770 Discussion on maintenance of AI for Air Interface ZTE Corporation, Sanechips

R1-2506871 Maintenance on AI/ML for NR Air Interface vivo

R1-2506934 Maintenance of Rel-19 AI/ML for air interface Huawei, HiSilicon

R1-2506961 Maintenance on AI/ML for NR Air Interface Xiaomi

R1-2507000 Maintenance of specification support for AI/ML for NR Air Interface CMCC

R1-2507094 Remaining issues on AI/ML for NR air interface CATT

R1-2507155 Maintenance on Rel-19 AI/ML for NR air interface OPPO

R1-2507227 Remaining issue on AI/ML for NR Air Interface Samsung

R1-2507277 Remaining issues on AI/ML for air interface in Rel-19 Fujitsu

R1-2507302 Remaining Issues on AIML for NR Air Interface NEC

R1-2507374 Discussion on AI/ML maintenance in 5G NR interface Panasonic

R1-2507383 Maintenance on AI/ML for NR Air Interface Nokia

R1-2507394 Maintenance on AI/ML for NR Air interface LG Electronics

R1-2507442 Maintenance on Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface Lenovo

R1-2507452 Maintenance of AI beam management Ofinno

R1-2507515 Maintenance for AI/ML for NR Air Interface Google

R1-2507582 Maintenance on Rel-19 AI/ML InterDigital, Inc.

R1-2507648 Remaining issues for R19 AI/ML for NR air interface Apple

R1-2507694 Maintenance on AI/ML for NR air interface Qualcomm Incorporated

R1-2507774 Maintenance on AI/ML for NR Air Interface Sharp

R1-2507832 Remaining issues on AI/ML for air interface in Rel-19 Quectel

R1-2507865 Remaining issues on AI PHY ASUSTeK

### Specification support for beam management

**R1-2507998 FL summary #0 for AI/ML in beam management Moderator (Samsung)**

**Agreement:**

The following TP for TS 38.214 Clause 5.2.1.4.3b is endorsed.

**Reason for change:** The slot of transmission occasion for monitoring is unclear for the linkage of the corresponding CSI report for inference.

**Summary of change:** Clarify the first slot of transmission occasion for monitoring is used for the linkage.

**Consequences if not approved:** gNB and UE may have different understanding on the linkage.

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| TS 38.214 Clause 5.2.1.4.3b RS-PAI Reporting  <omitted texts>  - check a condition :  - for the transmission occasion of the second CSI Reporting Setting, there is a linked report of the first CSI Reporting Setting. When *nroftimeinstance-r19* is not configured in the first Reporting Setting, the linking is determined if CSI reference resource of a report of the first CSI Reporting Setting has a minimal slot offset, no larger than 64 slots, from the first slot of the transmission occasion of the corresponding Resource Set for channel measurement of the second CSI Reporting Setting. When *nroftimeinstance-r19* is configured in the first Reporting Setting, *timeinstanceformonitoring-r19* configured in the second CSI Reporting Setting indicates the *timeinstanceformonitoring-r19*-thtime instance among *nroftimeinstance-r19* time instance(s), and the linking is determined if the slot corresponding to the time instance indicated by *timeinstanceformonitoring-r19* of a report of the first CSI Reporting Setting has a minimal slot offset, no larger than 64 slots, from the first slot of the transmission occasion of the corresponding Resource Set for channel measurement of the second CSI Reporting Setting;  <omitted texts> |

**Agreement:**

The following TP for 38.214 Clause 6.2.1.3 is endorsed.

**Reason for change:** P-CRI/P-SSBRI/RS-PAI/P-L1-RSRP is missing in the prioritization rules between a transmission of SRS and transmission of a physical signal/channel.

**Summary of change**: AddP-CRI/P-SSBRI/RS-PAI/P-L1-RSRP in the prioritization rules.

**Consequences if not approved:** the prioritization rules between a transmission of SRS and transmission of a physical signal/channel with P-CRI/P-SSBRI/RS-PAI/P-L1-RSRP is unclear.

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| **6.2.1.3 UE sounding procedure between component carriers**  <omitted text>  The following prioritization rules shall be applied in case of collision between a transmission of SRS over carrier and transmission of a physical signal/channel over a carrier of a serving cell in set  - the UE shall not transmit SRS whenever SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell and PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/CRI/SSBRI/P-CRI/P-SSBRI/RS-PAI and/or PRACH on a carrier of a serving cell in set happen to overlap in the same symbol  - the UE shall not transmit a periodic/semi-persistent SRS whenever periodic/semi-persistent SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell and PUSCH transmission carrying aperiodic CSI on a carrier of a serving cell in set happen to overlap in the same symbol  - the UE shall drop PUCCH/PUSCH transmission carrying periodic/semi-persistent CSI comprising only CQI/PMI/L1-RSRP/L1-SINR/P-L1-RSRP, and/or SRS transmission on a carrier of a serving cell in set configured for PUSCH/PUCCH transmission whenever the transmission and SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell happen to overlap in the same symbol  - the UE shall drop PUSCH transmission carrying aperiodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR/TDCP/cjtc-Dd/cjtc-F/cjtc-Dd-F/cjtc-P/P-L1-RSRP on a carrier of a serving cell in set whenever the transmission and aperiodic SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133]) as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell happen to overlap in the same symbol.  <omitted text> |

**Agreement:**

The following TP for 38.214 Clause 6.2.1 is endorsed.

**Reason for change:** P-CRI/P-SSBRI/RS-PAI/P-L1-RSRP is missing in the collision handling procedure between a transmission of SRS and transmission of a physical signal/channel.

**Summary of change**: AddP-CRI/P-SSBRI/RS-PAI/P-L1-RSRP in the collision handling procedure.

**Consequences if not approved:** the collision handling procedure between a transmission of SRS and transmission of a physical signal/channel P-CRI/P-SSBRI/RS-PAI/P-L1-RSRP is unclear.

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| --- |
| **6.2.1 UE sounding procedure**  <omitted text>  For PUCCH and SRS on the same carrier, a UE shall not transmit SRS when semi-persistent or periodic SRS is configured in the same symbol(s) with PUCCH carrying only CSI report(s), or only L1-RSRP report(s), or only L1-SINR report(s), or only P-CRI/P-SSBRI/P-L1-RSRP report(s), or only RS-PAI report(s). A UE shall not transmit SRS when semi-persistent or periodic SRS is configured or aperiodic SRS is triggered to be transmitted in the same symbol(s) with PUCCH carrying HARQ-ACK, link recovery request (as defined in clause 9.2.4 of [6, 38.213]) and/or SR. In the case that SRS is not transmitted due to overlap with PUCCH, only the SRS symbol(s) that overlap with PUCCH symbol(s) are dropped. PUCCH shall not be transmitted when aperiodic SRS is triggered to be transmitted to overlap in the same symbol with PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only, or only L1-SINR report(s), or only P-CRI/P-SSBRI/P-L1-RSRP report(s), or only RS-PAI report(s) and the PUCCH starts no earlier than  after the last symbol of the PDCCH carrying the triggering command for the aperiodic SRS, where is the PUSCH preparation time for the corresponding UE processing capability assuming and corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the triggering command and the SCS configuration of the PUCCH.  <omitted text> |

**Agreement:**

Regarding the RAN2 LS from R1-2506715, for the UE-side candidate data collection configuration for BM-Case2, include the following IEs along with the already agreed IEs in RAN2:

* *TimeGap-r19*, i.e., the expected time gap between two consecutive predicted time instances and between the reference time and the earliest predicted time instance.
* *nroftimeinstance-r19*, i.e., number of expected predicted time instances.

**R1-2507999 FL summary #1 for AI/ML in beam management Moderator (Samsung)**

**Agreement**

Regarding the RAN2 LS R1-2506720, the answer to the question in the LS is as below:

|  |
| --- |
| From RAN1 perspective, Option 2 ~~is best option and~~ can resolve the issue.   * No additional RAN 1 impact was identified for Option 2. |

**Agreement**:

The following TP for TS 38.214 Clause 5.2.1.4.2 is endorsed.

**Reason for change:** The configuration restriction of AP RS resource set with no more than 16 resources is too restrictive for Set A for inference.

**Summary of change:** For Set A for inference, relax the configuration restriction of AP RS resource set with no more than 16 resources.

**Consequences if not approved:** The configuration of more than 16 resource within Set A for inference is not possible.

|  |
| --- |
| TS 38.214 Clause 5.2.1.4.2 Report quantity configurations  <omitted texts>  If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-LI-PMI-CQI', UE does not expect the *CSI-ReportConfig* to be configured with higher layer parameter *codebookType* set to '*typeII-r16*' or '*typeII-PortSelection-r16*', '*typeII-PortSelection-r17'*, 'typeII-CJT-r18', 'typeII-CJT-PortSelection-r18', 'typeII-Doppler-r18', 'typeII-Doppler-PortSelection-r18', 'eTypeII-r19', 'TypeII-FePortSelection-r19' or 'typeII-Doppler-r19'.  If the UE is configured with a *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'cri-RSRP', 'cri-SINR', 'none', 'cri-RSRP- Index', 'cri-SINR- Index, 'p-cri-r19', 'p-cri-RSRP-r19', 'p-ssb-index-r19', 'p-ssb-index-RSRP-r19', or ‘rs-pai-r19', and the *CSI-ReportConfig* is linked to a resource setting not configured by *resourcesForSetA-r19* and configured with the higher layer parameter *resourceType* set to 'aperiodic', then the UE is not expected to be configured with more than 16 CSI-RS resources in a CSI-RS resource set contained within the resource setting.  <omitted texts> |

**Agreement:**

The draft response LS in R1-2508121 is endorsed. Final LS in R1-2508122

### Specification support for positioning accuracy enhancements

**R1-2508009 Summary #3: maintenance of specification support for positioning accuracy enhancement Moderator (Ericsson)**

**Agreement:**

The following text proposal to TS 38.214 V19.1.0 is endorsed.

|  |  |
| --- | --- |
| **Reason for change** | * Capture the agreements related to associated ID for ensuring consistency between training and inference for Rel-19 AI/ML positioning. * For training data provided by PRU, *TRP-LocationInfo-Implicit* may be provided together with *NR-PRU-DL-Info* for ensuring consistency between training and inference for Rel-19 AI/ML positioning. |
| **Summary of change** | * Describe the UE behavior on receiving associated ID from the network. * Clarify that the UE may be provided with *NR-TRP-LocationInfo-Implicit* associated with *NR-PRU-DL-Info*. |
| **Consequences if not approved** | For Rel-19 AI/ML positioning, the UE may not be able to ensure consistency between training and inference. |
| **Suggested text proposal** | TS 38.214 V19.1.0 5.1.6.5 PRS reception procedure < Unchanged parts are omitted >  The UE expects that it will be configured with *dl-PRS-ID* each of which is defined such that it is associated with multiple DL PRS resource sets. The UE expects that one of these *dl-PRS-ID* along with a *nr-DL-PRS-ResourceSetID* and a *nr-DL-PRS-ResourceID-r16* can be used to uniquely identify a DL PRS resource.  The UE may be configured by the network with *nr-PhysCellID*, *nr-CellGlobalID*, and *nr-ARFCN* [17, TS 37.355] associated with a *dl-PRS-ID*.  - If *nr-PhysCellID* or *nr-CellGlobalID* is provided, and if *nr-PhysCellID*, *nr-CellGlobalID* and *nr-ARFCN* associated with the *dl-PRS-ID*, if provided, are the same as the corresponding information of a serving cell, the UE may assume that the DL PRS is transmitted from the serving cell;  - Otherwise, the UE may assume that the DL PRS is not transmitted from a serving cell.  If the UE assumes that the DL PRS is transmitted from a serving cell, and if the serving cell is the same as the serving cell defined by the SS/PBCH block, the UE may assume that the DL PRS and the SS/PBCH block are transmitted from the same serving cell.  If the UE assumes that the DL PRS is not transmitted from a serving cell, and if *nr-PhysCellID* is provided, and is the same as physical cell ID of the SS/PBCH block from a non-serving cell of the same band as the DL PRS, the UE may assume that the DL PRS and the SS/PBCH block are transmitted from the same non-serving cell.  The UE may be configured by the network with *TRP-LocationInfo-Implicit-Element* [17, TS 37.355].  - If *TRP-LocationInfo-Implicit-Element* is provided, and if *nr-PhysCellID* or *nr-CellGlobalID* is provided with *nr-AIML-AssociatedID,* for TRP(s) in the given cell, the UE may assume that the geographical coordinates of the TRP(s) are consistent for a same *nr-AIML-AssociatedID*.  < Unchanged parts are omitted >  The UE may be provided with *NR-PRU-DL-Info* which contains measurement(s) performed by a positioning reference unit (PRU) [20, TS 38.305], the timestamps associated with the measurement(s), and the location information of the PRU. The UE may be provided with *NR-TRP-LocationInfo-Implicit* [17, TS 37.355] associated with *NR-PRU-DL-Info*.  < Unchanged parts are omitted > |

**Agreement:**

Regarding the RAN2 LS R1-2506737, the following response from RAN1 is endorsed.

|  |
| --- |
| Question 1: Does a single *Associated ID* correspond to the location coordinates of one specific TRP within a cell, or does it represent the location information of a group of TRPs in the same cell, each having distinct location coordinates?  **Response to Question 1:**  As stated in RAN1#121 agreement, an associated ID is configured per cell (e.g., NCGI-r15). It is provided for a group of TRP(s) in the same cell, not for one specific TRP within a cell.  Note: A group of TRP(s) in the same cell can have only one TRP.  Question 2:  Is the *Associated ID* in any way related to the identification of the location of Antenna Reference Points (ARPs) associated with DL-PRS Resource Sets and DL-PRS Resources?  **Response to Question 2:**  It is up to network implementation whether the associated ID is related to the identification of the location of ARP(s).  Question 3:  Are *Associated IDs* unique across different cells? Can cells belonging to different Positioning Frequency Layers (PFLs) share the same *Associated ID*? Furthermore, if a single cell is part of multiple PFLs, should it be assigned a distinct *Associated ID* for each PFL?  **Response to Question 3:**  As captured in the RAN1#121 agreement, the associated ID is configured per cell, not per PFL. Specific to RAN2’s Question 3:   * Associated ID(s) are not required to be unique across different cells. * As associated ID(s) are unique only per cell, sharing associated ID(s) for cells belonging to different PFLs is irrelevant. * The associated ID is not PFL specific. The associated ID is specific only to geographical coordinates of a group of TRP(s) in a cell.   Question 4:  RAN2 observes that an *Associated ID* is configured "per-Cell". However, NR DL-PRS Assistance Data support also PRS-only Transmission Points (TPs), which are not associated to any specific cell (i.e., have no NCGI). Can an *Associated ID* also implicitly indicate the location coordinates of such PRS-only TPs?  **Response to Question 4:**  From RAN1’s perspective, in Rel-19, the associated ID cannot be used to implicitly indicate the consistency of location coordinates of such PRS-only TPs, as the PRS-only TPs are not associated with a cell. |

The final LS response to RAN2 is endorsed in R1-2508026.

### Specification support for CSI prediction

**R1-2508061 Summary #2 of maintenance on CSI prediction Moderator (LG Electronics)**

**Agreement:**

The following TP for TS 38.214 is endorsed.

|  |  |
| --- | --- |
| Reason for change | During non-active periods of cell DTX, UE is not expected to receive P/SP CSI-RS for CSI report associated with report quantity comprising at least RI which means this can be applied to SP inference report. However, whether it is applied for monitoring report is not clear. |
| Summary of change | Report quantity ‘csi-pai-r19’ is added. |
| Consequences if not approved | Inconsistent UE behaviour during non-active periods of cell DTX. |
| **TS38.214**  5.1.6.1 CSI-RS reception procedure  << Unchanged parts are omitted >>  During non-active periods of cell DTX if cell DTX is activated for a serving cell, the UE is not expected to receive the periodic CSI-RS and semi-persistent CSI-RS on the serving cell configured in CSI report configuration in CSI-*ReportConfig* associated with the higher layer parameter *reportQuantity* comprising at least 'RI' or 'cjtc-P' or ‘csi-pai-r19’. If the cell DTX is activated for a serving cell [10, TS 38.321], the most recent CSI measurement occasion of semi-persistent CSI-RS resource or periodic CSI-RS resource on the serving cell occurs in active periods of cell DTX for CSI report configured by *CSI-ReportConfig* associated with the higher layer parameter *reportQuantity* comprising at least 'RI' or 'cjtc-P' or ‘csi-pai-r19’.  << Unchanged parts are omitted >> | |

**Agreement:**

Regarding the RAN2 LS from R1-2506715, for the UE-side candidate data collection configuration for CSI prediction, include the following IEs:

* *CSI-ResourceConfigId*
* FFS: whether to include other parameters

**R1-2508062 Summary #3 of maintenance on CSI prediction Moderator (LG Electronics)**

**Agreement**

**Adopt the following TP for TS 38.214.**

|  |  |
| --- | --- |
| Reason for change | According to the agreement, Rel-16 eType II codebook is used for calculating both the precoder represented by PMI based on the channel measurement corresponding to the monitoring report and the precoder represented by PMI based on the latest CSI-RS resource transmission occasion, no later than CSI reference resource, corresponding to the inference report. However, the codebook for calculating was not clearly captured by the specification. |
| Summary of change | Add the corresponding description of the codebook for calculating in TS 38.214. |
| Consequences if not approved | How to select the codebook for calculating is not clearly defined in TS 38.214, which is not aligned with the agreement. |
| **TS38.214**  5.2.1.4.6 CSI-PAI reporting  << Unchanged parts are omitted >>  - to report CSI-PAI for the second Reporting Setting, the UE is expected to be configured in the second Report Setting with *codebookType* set to ‘etypeII-r16’ and it shall:  <Unrelated part omitted>   * for , is the RI reported for the CSI report corresponding to the first Reporting Setting, calculate SGCS value(s) as,   ,  ,  where is the predicted precoder represented by predicted PMI for -th layer, *n*-th subband and for -th time instance corresponding to the report of the first Reporting Setting, is the precoder represented by non-predicted PMI for -th layer, *n*-th subband based on the channel measurement corresponding to the second Reporting Setting, and is the precoder represented by PMI for -th layer and *n*-th subband, , corresponds to the subbands configured by *csi-ReportingBand* and *numberOfPMI-SubbandsPerCQI-Subband*, based on the latest CSI-RS resource transmission occasion, no later than CSI reference resource, corresponding to the report of the first Reporting Setting. Both and are calculated based on the *codebookConfig* within the second Reporting Setting. The UE is expected to be configured with same *csi-ReportingBand* and *numberOfPMI-SubbandsPerCQI-Subband* configurations for the first CSI Reporting Setting and the second CSI Reporting Setting.  << Unchanged parts are omitted >> | |

**Agreement**

**Following TP is endorsed as editorial corrections for TS 38.214 for Clauses 5.2.1.4.2, 5.2.1.4.6, 5.2.1.6 and 5.4.**

|  |
| --- |
| **TS38.214**  5.2.1.4.2 Report quantity configurations  << Unchanged parts are omitted >>  If the UE is configured with a *CSI-ReportConfig* with *reportQuantity-r19* set to ‘csi-pai-r19’,  - the UE shall be configured with *inferenceReportConfigId-r19* to link another *CSI-ReportConfig* configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19*,  - when semi-persistent Reporting Setting is configured for the *CSI-ReportConfig* configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19*, the UE is not expected to be configured with a periodic Reporting Setting for the *CSI-ReportConfig* with *reportQuantity-r19* set to ‘csi-pai-r19’.  - when aperiodic Reporting Setting is configured for the *CSI-ReportConfig* configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19*, the UE is not expected to be configured with a periodic or semi-persistent Reporting Setting for the *CSI-ReportConfig* with *reportQuantity-r19* set to ‘csi-pai-r19’.  << Unchanged parts are omitted >>  5.2.1.4.6 CSI-PAI reporting  When the UE is configured with a first CSI Reporting Setting for reporting CSI prediction, based on a *CSI-ReportConfig* configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* and a second CSI Reporting Setting for reporting CSI-PAI, based on a *CSI-ReportConfig* with *reportQuantity-r19* set to ‘csi-pai-r19’, and the second Reporting Setting is linked to the first Reporting Setting by *inferenceReportConfigId-r19*, the reporting of CSI-PAI corresponding to the second CSI Reporting Setting shall consider the following:  << Unchanged parts are omitted >>  5.2.1.6 CSI processing criteria  The UE indicates the number of supported simultaneous CSI calculations with parameter *simultaneousCSI-ReportsPerCC* or *simultaneousCSI-SubReportsPerCC-r18* in a component carrier, and *simultaneousCSI-ReportsAllCC* or *simultaneousCSI-SubReportsAllCC-r18* across all component carriers. If UE is configured with at least one CSI report setting with sub-configuration in a component carrier, UE shall use parameter *simultaneousCSI-SubReportsPerCC-r18* in the component carrier; otherwise, UE shall use *simultaneousCSI-ReportsPerCC* in the component carrier. If UE is configured with at least one CSI reporting setting with sub-configuration in any component carrier, UE shall use *simultaneousCSI-SubReportsAllCC-r18*; otherwise, UE shall use *simultaneousCSI-ReportsAllCC*. If a UE supports simultaneous CSI calculations it is said to have CSI processing units for processing CSI reports. If *L* CPUs are occupied for calculation of CSI reports in a given OFDM symbol, the UE has unoccupied CPUs. If *N* CSI reports start occupying their respective CPUs on the same OFDM symbol on which CPUs are unoccupied, where each CSI report corresponds to , the UE is not required to update the requested CSI reports with lowest priority (according to Clause 5.2.5), where is the largest value such that holds. For CSI reports with *reportQuantity* set to ‘p-cri-r19’, ‘p-cri-RSRP-r19’, ‘p-ssb-index-r19’, or ‘p-ssb-index-RSRP-r19’, or CSI reports configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19,* is considered.  For CSI reports with *reportQuantity* set to ‘p-cri-r19’, ‘p-cri-RSRP-r19’, ‘p-ssb-index-r19’, or ‘p-ssb-index-RSRP-r19’, and CSI reports configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19*, the UE may indicate a second value for the number of supported simultaneous CSI calculations with parameter *SecondValuesSimultaneousCSI-ReportsPerCC* in a component carrier, and *SecondValuesSimultaneousCSI-ReportsAllCC* across all component carriers, and if applicable, a third value for the number of supported simultaneous CSI calculations with parameter *ThirdValuesSimultaneousCSI-ReportsPerCC* in a component carrier, and *ThirdValuesSimultaneousCSI-ReportsAllCC* across all component carriers, in addition to . If a UE supports simultaneous CSI calculations it is said to have CSI processing units for processing CSI reports. If *Lx* CPUs are occupied for calculation of CSI reports in a given OFDM symbol, the UE has unoccupied CPUs. If CSI reports start occupying their respective CPUs on the same OFDM symbol on which CPUs are unoccupied, where each CSI report corresponds to , the UE is not required to update the requested CSI reports with lowest priority (according to Clause 5.2.5), where is the largest value such that holds. If only the second value is indicated, *x* = 2. If both of the second value and the third value are indicated, *x* = 2, 3 where the CSI reports with *reportQuantity* set to ‘p-cri-r19’, ‘p-cri-RSRP-r19’, ‘p-ssb-index-r19’, or ‘p-ssb-index-RSRP-r19’ corresponds to either *x* = 2 or *x* = 3 subject to UE capability and the CSI reports configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* corresponds to either *x* = 2 or *x* = 3 subject to UE capability.  For CSI reports with *reportQuantity* set to ‘p-cri-r19’, ‘p-cri-RSRP-r19’, ‘p-ssb-index-r19’, or ‘p-ssb-index-RSRP-r19’, and CSI reports configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* if a CSI report is not considered within any of and , the values for and are considered to be 0, for the procedure previously described in this clause and the UE is not required to update the CSI report.  A UE is not expected to be configured with an aperiodic CSI trigger state containing more than Reporting Settings. Processing of a CSI report occupies a number of CPUs for a number of symbols as follows:  << Unchanged parts are omitted >>  - and , for a CSI report configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19,* where the values of and are reported by UE capability.  For a CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* not set to ‘none’, or a CSI report with *LTM-CSI-ReportConfig*, or *reportQuantity* not set to ‘none-bm-r19’ or ‘none-csi-r19’, the CPU(s) (including and/or , for CSI reports with *reportQuantity* set to ‘p-cri-r19’, ‘p-cri-RSRP-r19’, ‘p-ssb-index-r19’, or ‘p-ssb-index-RSRP-r19’, or ‘csi-pai-r19’, or ‘rs-pai-r19’, and CSI reports configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* are occupied for a number of OFDM symbols as follows:  << Unchanged parts are omitted >>  In any slot, the UE is not expected to have more active CSI-RS ports or active CSI-RS resources in active BWPs than reported as capability. NZP CSI-RS resource is active in a duration of time defined as follows. For aperiodic CSI-RS, (excluding the case in which the corresponding aperiodic CSI Reporting Setting is configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* and is linked to another aperiodic CSI Reporting Setting with *reportQuantity-r19* set to ‘csi-pai-r19’), starting from the end of the PDCCH containing the request and ending at the end of the scheduled PUSCH containing the report associated with this aperiodic CSI-RS. When the PDCCH candidates are associated with a search space set configured with *searchSpaceLinkingId*, for the purpose of determining the NZP CSI-RS resource active duration, the PDCCH candidate that ends later in time among the two linked PDCCH candidates is used. For semi-persistent CSI-RS, starting from the end of when the activation command is applied, and ending at the end of when the deactivation command is applied. For periodic CSI-RS, starting when the periodic CSI-RS is configured by higher layer signalling, and ending when the periodic CSI-RS configuration is released.  << Unchanged parts are omitted >>  For aperiodic CSI-RS, when the corresponding aperiodic CSI Reporting Setting is configured with the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* and is linked to another aperiodic CSI Reporting Setting with *reportQuantity-r19* set to ‘csi-pai-r19’, NZP CSI-RS resource is active in a duration starting from the end of the PDCCH containing the request for the report of the corresponding CSI Reporting Setting and ending at the end of the scheduled PUSCH containing the report associated with the report of the linked CSI Reporting Setting.  5.4 UE CSI computation time  << Unchanged parts are omitted >>  , with of table 5.4-2, if the CSI report is configured with , *codebookType* is set to ‘typeII-Doppler-r18’ or ‘typeII-Doppler-PortSelection-r18’ and the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement is aperiodic with CSI-RS resources, and is according to UE reported capability as defined in [13, TS 38.306] when the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* is configured in *CSI-ReportConfig*, otherwise , or  - , with of table 5.4-2, where or symbols, according to the reported UE capability, where the value of ∈{1,2,4} is indicated by UE capability, if the CSI report is configured with , *codebookType* is set to ‘typeII-Doppler-r18’ or ‘typeII-Doppler-PortSelection-r18’ and the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement is periodic or semi-persistent with a single CSI-RS resource, and is according to UE reported capability as defined in [13, TS 38.306] when the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* is configured in *CSI-ReportConfig*, otherwise , or  - or , according to UE reported capability, with of table 5.4-2, if the CSI report is configured with , *codebookType* is set to ‘typeII-Doppler-r18’ and the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement is aperiodic with CSI-RS resources, and is according to UE reported capability as defined in [13, TS 38.306] when the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* is configured in *CSI-ReportConfig*, otherwise , or  - or , according to UE reported capability, with of table 5.4-2, if the CSI report is configured with , *codebookType* is set to ‘typeII-Doppler-r18’ and the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement is periodic or semi-persistent with a single CSI-RS resource, and is according to UE reported capability as defined in [13, TS 38.306] when the higher layer parameter*~~[RRC\_name-r19]~~* *csi-InferencePrediction-r19* is configured in *CSI-ReportConfig*, otherwise , or  << Unchanged parts are omitted >> |

**Agreement ( The previous agreement is revised as the following):**

Regarding the RAN2 LS from R1-2506715:

For the UE-side candidate data collection configuration for CSI prediction, include the following IEs:

* *CSI-ResourceConfigId*

For candidate UE-side data collection, following IE(s) in addition to *CSI-ResourceConfigId* can be provided.

* *CodebookConfig-r18* set to ‘typeII-Doppler-r18’

The draft response LS in R1-2508139 is endorsed. The Final LS is agreed in R1-2508140.

**R1-2508142 Summary #4 of maintenance on CSI prediction Moderator (LG Electronics)**

**Agreement**

Support the configuration of following parameter in a *CSI-ReportConfig* with the higher layer parameter reportQuantity set to 'none-CSI-r19'

* *CodebookConfig-r18* set to ‘typeII-Doppler-r18’

## Maintenance on NR MIMO Phase 5

*Note: Maximum one contribution. For efficient review, please use the following sections in your contribution corresponding to the maintenance issues, if any:*

* *Enhancements for UE-initiated/event-driven beam management*
* *CSI enhancements*
* *Support for 3-antenna-port codebook-based transmissions*
* *Enhancement for asymmetric DL sTRP/UL mTRP scenarios.*

[122bis-R19-MIMO] Email discussion on MIMO – Eko (Samsung)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508149** Session notes for 8.2 (Maintenance on NR MIMO Phase 5) Ad-Hoc Chair (Ericsson)

Session notes are endorsed and incorporated the session notes below.

R1-2506790 Maintenance of Rel-19 MIMO InterDigital, Inc.

R1-2506791 FL Summary Support for 3TX CB-based Uplink; First Round Moderator (InterDigital, Inc.)

R1-2506797 Remaining issues on NR MIMO Phase 5 Spreadtrum, UNISOC

R1-2506835 Maintenance on NR MIMO Phase 5 MediaTek Inc.

R1-2506872 Maintenance on MIMO phase 5 vivo

R1-2506923 Maintenance of MIMO Phase 5 Huawei, HiSilicon

R1-2506962 Maintenance on NR MIMO Phase 5 Xiaomi

R1-2507034 Maintenance topics on UE-initiated/event-driven beam management Panasonic

R1-2507036 Maintenance on NR MIMO Phase 5 ZTE Corporation, Sanechips

R1-2507095 Maintenance on NR MIMO Phase 5 CATT

R1-2507159 Remaining Issues of NR MIMO Phase 5 OPPO

R1-2507228 Remaining issue on NR MIMO Phase 5 Samsung

R1-2507269 Moderator Summary#1 on Maintenance for Rel-19 CSI Enhancements: Round 1 Moderator (Samsung)

R1-2507270 Moderator Summary#1 on Maintenance for Rel-19 CSI Enhancements: Round 2 Moderator (Samsung)

R1-2507271 Moderator Summary on Offline Session for Rel-19 CSI Enhancements Moderator (Samsung)

R1-2507278 Remaining issues on NR MIMO Phase 5 Fujitsu

R1-2507316 Remaining issues on NR MIMO Phase 5 NEC

R1-2507346 Maintenance on NR MIMO Phase 5 Ericsson

R1-2507372 Summary on Rel-19 asymmetric DL sTRP/UL mTRP Moderator (OPPO)

R1-2507436 Maintenance on NR MIMO Phase 5 Lenovo

R1-2507453 Maintenance on NR MIMO Phase 5 Ofinno

R1-2507558 Maintenance on Rel-19 CSI enhancements Tejas Network Limited

R1-2507577 Maintenance on NR MIMO Phase 5 Google

R1-2507628 Maintenance on UE-initiated/event-driven beam management Transsion Holdings

R1-2507695 Maintenance on NR MIMO Phase 5 Qualcomm Incorporated

R1-2507737 Maintenance of NR MIMO Phase 5 Nokia

R1-2507756 Discussions on Maintenance on MIMO phase5 China Telecom

R1-2507790 Maintenance on NR MIMO Phase 5 NTT DOCOMO, INC.

R1-2507864 Remaining issues on UE initiated beam report ASUSTeK

### Enhancements for UE-initiated/event-driven beam management

**R1-2508014 Moderator Summary #1 on UE-initiated/event-driven beam management Moderator (ZTE)**

Agreement:

The TP in Section 5 of R1-2508014 for proposal 3.5 for TS38.214 is endorsed.

Agreement:

The TP in Section 5 of R1-2508014 for proposal 3.6 for TS38.214 is endorsed.

Agreement:

On beam report transmission procedure for UE-initiated/event-driven beam reporting, regarding mode-A, introduce RRC configuration parameter of *reportSlotOffsetList* in the configuration of the report transmission mode.

**R1-2508074 Moderator Summary #2 on UE-initiated/event-driven beam management Moderator (ZTE)**

Agreement:

The TP in Section 5 of R1-2508074 for proposal 3.7 for TS38.214 is endorsed.

Agreement:

The TP in Section 5 of R1-2508074 for proposal 3.10B for TS38.214 is endorsed.

**R1-2508094 Moderator Summary #3 on UE-initiated/event-driven beam management Moderator (ZTE)**

**Agreement:**

Adopt the following changes in Clause 5.2.1.5.4.1 in TS38.214.

* **Reason for change:** Regarding the condition of resetting the counter of event instances, the following candidate#2 was agreed to be applied for Event-2, Event-1 and Event-7, i.e., the measured current beam RS is updated based on indicated TCI state. However, it is intuitive that current beam RS of Event-7 is just related to the activated TCI states, rather than the indicated TCI state. Consequently, the condition of resetting the counter for Event-7 has not yet been captured in the current specifications, i.e., the measured current beam RS is updated based on activated TCI states.
* **Summary of change:** Clarifying the condition of resetting the counter for Event-7, i.e., the measured current beam RS is updated based on activated TCI states.
* **Consequences if not approved:** It is unclear how to reset the counter for Event-7.

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| 5.2.1.5.4 UE Initiated reporting  5.2.1.5.4.1 UE Initiated CSI reporting  <Irrelevant part is omitted>  If the number of event instances determined by the counter for such reference signal is greater than or equal to *eventInstanceCount*, the UE transmits UEIRI on a PUCCH format 0 or format 1 in the PUCCH resource (in the CC provided by *pucchCell,* if configured, in the *CSI-ReportConfig*) configured by *PUCCHResource* in the *CSI-ReportConfig*.  The counter of the event instances for such reference signal is reset:  - if the reference signal in the indicated TCI state or the SS/PBCH block which is QCLed with the reference signal in the indicated TCI state is updated when the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *eventType* set to ‘event2’ or ‘event1’, or  - if the reference signal with the *valueOfQ* highest L1-RSRP out of the reference signals among the activated TCI states or the SS/PBCH block with the *valueOfQ* highest L1-RSRP out of the SS/PBCH blocks QCLed with the reference signals among the activated TCI states, which determines event instance(s), is updated when the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *eventType* set to ‘event7’.  The UE does not expect that a CSI trigger state associated with CSI report configuration(s) configured with the higher layer parameter *eventType* is further associated with other CSI report configurations that are not configured with the higher layer parameter *eventType*.  <Irrelevant part is omitted> |

**Agreement:**

Adopt the following changes in TS38.213 Section 9:

* **Reason for change:** Reusing the intra-UE multiplexing/prioritization rules of PUSCH with A-CSI for PUSCH for UEI-BR for Mode A was agreed. However, it is not captured in the current specification.
* **Summary of change:** In TS38.213 section 9, clarify the intra-UE multiplexing/prioritization rules of PUSCH with A-CSI for PUSCH is reused for UEI-BR for Mode A.
* **Consequences if not approved:** UE behavior is not clear when PUSCH carrying UEI-BR for Mode A overlaps with other uplink channels/RSs.

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| **9 UE procedure for reporting control information**  < Unchanged parts are omitted >  For the remaining of this clause, when a UE  - is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with a value of 0 for first CORESETs, and is provided *coresetPoolIndex* with a value of 1 for second CORESETs, on active DL BWPs of serving cells, and  - is provided *sTx-2Panel*  the UE separately determines and resolves time overlapping among first PUSCH transmissions that use respective first spatial domain filters corresponding to first *TCI-State* or *TCI-UL-State* associated with the first CORESETs, and among second PUSCH transmissions that use respective second spatial domain filters corresponding to second *TCI-State* or *TCI-UL-State* associated with the second CORESETs.  For the remaining of this clause, reference to PUSCH with semi-persistent CSI reports includes a PUSCH with UE initiated report~~s~~ when *reportTransmissionMode* is configured as ‘ModeB’ in the CSI report configuration [6, TS 38.214].  For the remaining of this clause, unless otherwise stated, reference to PUSCH with aperiodic CSI reports includes a PUSCH with UE initiated report when *reportTransmissionMode* is configured as ‘ModeA’ in the CSI report configuration [6, TS 38.214].  For the remaining of this clause, for a UE operating on an NTN serving cell, the timeline conditions for resolving time overlapping between a PUSCH transmission with repetitions in an OCC group [6, TS 38.214] and PUCCH transmissions are applicable with respect to the first repetition of the PUSCH transmission in the OCC group  - if the UE would multiplex UCI from the PUCCH transmissions in the PUSCH, the UE multiplexes the UCI in all repetitions of the PUSCH transmission in the OCC group  - if the UE would not transmit a repetition of the PUSCH transmission, the UE does not transmit all repetitions of the PUSCH transmission in the OCC group  - the UE does not expect to transmit in different slots more than one PUCCHs that provide HARQ-ACK information or CSI reports and would overlap with the PUSCH transmission in the OCC group  When a UE determines overlapping for PUCCH transmissions with SL HARQ-ACK reports and PUCCH of larger and/or smaller priority index, the UE resolves the overlapping for PUCCH transmissions with SL HARQ-ACK reports and PUCCH of each priority index as described in clause 9.2.5 and 9.2.6 before resolving the overlapping for PUCCH transmissions without SL HARQ-ACK or the overlapping for PUCCH transmissions and PUSCH transmissions.  < Unchanged parts are omitted > |

**R1-2508111 Moderator Summary #4 on UE-initiated/event-driven beam management Moderator (ZTE)**

### CSI enhancements

**R1-2507269 Moderator Summary#1 on Maintenance for Rel-19 CSI Enhancements: Round 1 Moderator (Samsung)**

Agreement

The TP2.A for TS38.214 in R1-2507269 is endorsed.

Agreement

The TP3.B.2 for TS38.214 in R1-2507269 is endorsed.

Agreement

The TP1.A for TS38.214 in R1-2507269 is endorsed.

Agreement

The TP1.B for TS38.214 in R1-2507269 is endorsed. Note that the Clause number for this TP is Clause 5.2.2.5 and not 5.2.1.4.1.

**R1-2507270 Moderator Summary#1 on Maintenance for Rel-19 CSI Enhancements: Round 2 Moderator (Samsung)**

Agreement

The TP1.C for TS38.214 in R1-2507270 is endorsed.

Agreement

The TP1.H for TS38.211 in R1-2507270 is endorsed.

### Support for 3-antenna-port codebook-based transmissions

**R1-2506791 FL Summary Support for 3TX CB-based Uplink; First Round Moderator (InterDigital, Inc.)**

**Agreement:**

Adopt the following corrections for TS 38.211, TS 38.213 and TS 38.214.

**Reason for change:** Adapt to the agreed terminology.

**Summary of change:** Correct the relevant RRC parameter to “fourPortSRS-3Tx”.

**Consequence if not changed:** Incorrect/Incomplete referencing.

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| **TS 38.211:**  6.3.1.5 Precoding  -**-------------------------------------------Unchanged parts are omitted------------------------------------------**  For codebook-based transmission, the precoding matrix depends on the number of antenna ports used for the transmission:  - for single-layer transmission on a single antenna port, ;  - for transmissions using 2, or 4 antenna ports, is given by Tables 6.3.1.5-1 to 6.3.1.5-7;  - for transmissions using 3 antenna ports when *fourPortSRS-3Tx ~~4portSRS\_3TX~~* is configured, is given by Tables 6.3.1.5-48 to 6.3.1.5-50;  -**-------------------------------------------Unchanged parts are omitted------------------------------------------**  **Table 6.3.1.5-48: Precoding matrix for single-layer transmission using three antenna ports with**  *fourPortSRS-3Tx ~~4portSRS\_3TX~~* **configured.**  -**-------------------------------------------Unchanged parts are omitted------------------------------------------**  **Table 6.3.1.5-49: Precoding matrix for two-layer transmission using three antenna ports with**  *fourPortSRS-3Tx ~~4portSRS\_3TX~~* **configured.**  -**-------------------------------------------Unchanged parts are omitted------------------------------------------**  **Table 6.3.1.5-50: Precoding matrix for three-layer transmission using three antenna ports with**  *fourPortSRS-3Tx ~~4portSRS\_3TX~~* **configured.**  -**-------------------------------------------Unchanged parts are omitted------------------------------------------**  6.4.1.4.3 Mapping to physical resources  -**-------------------------------------------Unchanged parts are omitted------------------------------------------**  - for an SRS resource in an SRS resource set with the higher-layer parameter *fourPortSRS-3Tx ~~4portSRS\_3TX~~* is configured,  - otherwise,  -**-------------------------------------------Unchanged parts are omitted------------------------------------------** |

### Enhancement for asymmetric DL sTRP/UL mTRP scenarios

**R1-2507372 Summary on Rel-19 asymmetric DL sTRP/UL mTRP Moderator (OPPO)**

Agreement

The TP in proposal 3.1 for TS38.212 in Section 3 of R1-2507372 is endorsed.

Agreement

The TP in proposal 3.2a for TS38.213 in Section 3 of R1-2507372 is endorsed.

Agreement

The TP in proposal 3.2b for TS38.214 in Section 3 of R1-2507372 is endorsed.

Agreement

The TPs in proposal 2.1 for TS38.213 and TS38.212 in Section 3 of R1-2507372 are endorsed.

**R1-2508097 Summary #2 on Rel-19 asymmetric DL sTRP/UL mTRP Moderator (OPPO)**

**Conclusion**:

Regarding the first agreement provided in RAN2 LS R1-2506721, whether any action from RAN1 is needed due to this new RRC parameter can be discussed after RAN2 RRC parameters are finalized.

## Maintenance on Evolution of NR duplex operation: Sub-band full duplex (SBFD)

*Note: Maximum one contribution. For efficient review, please use the following sections in your contribution corresponding to the maintenance issues, if any:*

* *SBFD TX/RX/measurement procedures*
* *SBFD random access operation*
* *CLI handling*

[122bis-R19-SBFD] Email discussion on SBFD – Xinghua (Huawei)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Agreement

Adopt the following TP in principle to Clause 11.1, TS 38.213.

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| --- |
| 11.1 Slot configuration  \*\*\* Unchanged parts are omitted \*\*\*  A downlink or flexible symbol provided by *tdd-UL-DL-ConfigurationCommon* can include an UL sub-band provided by *ul-SubbandlocationAndBandwidth*, a first DL sub-band provided by *firstDL-SubbandlocationAndBandwidth* and may additionally include a second DL sub-band provided by *secondDL-SubbandlocationAndBandwidth*, for a SCS configuration of any configured UL BWP or DL BWP, respectively, as provided by *scs-SpecificCarrierList* [4, TS 38.211]. The downlink or flexible symbol is then referred to as an SBFD symbol; otherwise, it is referred to as a non-SBFD symbol. Unless otherwise stated, the UE considers symbols in a slot indicated as downlink and as SBFD by *tdd-UL-DL-ConfigurationCommon* to be available for transmissions. Uplink symbols by *tdd-UL-DL-ConfigurationCommon* are non-SBFD symbols. An SBFD symbol or a non-SBFD symbol provided by *tdd-UL-DL-ConfigurationCommon* cannot change to a non-SBFD symbol or to an SBFD symbol, respectively, by other information. The UE is not provided *coresetPoolIndex* and is not configured to receive PDSCH according to more than one TCI states mapped to one TCI codepoint [6, TS 38.214] for a serving cell where the UE is provided SBFD symbols.  For an UL sub-band, a first DL sub-band or a second DL sub-band, the frequency location of the sub-band is provided by the corresponding parameters, respectively: a common RB and a number of contiguous RBs provided by *ul-SubbandlocationAndBandwidth*, or *firstDL-SubbandlocationAndBandwidth* or *secondDL-SubbandlocationAndBandwidth* that indicates an offset and a length as RIV according to [6, TS 38.214], setting , and a value provided by *offsetToCarrier* for the *subcarrierSpacing*.  \*\*\* Unchanged parts are omitted \*\*\* |

Send an LS to RAN2 to inform that the assumptions of *firstDL-subbandlocationAndBandwidth*, *secondDL-subbandlocationAndBandwidth* and *ul-subbandlocationAndBandwidth* highlighted below are described in TS 38.213, clause 11.1 instead of clause 12.

|  |
| --- |
| ***firstDL-subbandlocationAndBandwidth***  Configures frequency domain location and bandwidth of the first DL subband. The value of the field shall be interpreted as resource indicator value (RIV) as defined in TS 38.214 with assumptions as described in TS 38.213 [13], clause 12. The network does not configure this field for UL carriers. |
| ***secondDL-subbandlocationAndBandwidth***  Configures frequency domain location and bandwidth of the second DL subband. The value of the field shall be interpreted as resource indicator value (RIV) as defined in TS 38.214 with assumptions as described in TS 38.213 [13], clause 12. The network does not configure this field for UL carriers. |
| ***ul-subbandlocationAndBandwidth***  Configures frequency domain location and bandwidth of UL subband. The value of the field shall be interpreted as resource indicator value (RIV) as defined in TS 38.214 with assumptions as described in TS 38.213 [13], clause 12. The network does not configure this field for DL carriers. |

Agreement

Adopt the following TP in principle to Clause 5.1, TS 38.214.

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| --- |
| 5.1 UE procedure for receiving the physical downlink shared channel  **<\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*omitted\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*>**  If more than one PDSCH on a serving cell each without a corresponding PDCCH transmission are in a slot, after resolving overlapping with symbols in the slot indicated as uplink by *tdd-UL-DL-ConfigurationCommon*, or by *tdd-UL-DL-ConfigurationDedicated*, or across both SBFD symbols and non-SBFD symbols as described in 5.1.2.1a, or in invalid symbol type if the UE is not configured with *sbfd-Configuration2-Reception* as described in 5.1.2.1a, or determined as non-active periods of cell DTX, if the serving cell is activated with cell DTX, based on [10, TS 38.321], a UE receives one or more PDSCHs without corresponding PDCCH transmissions in the slot as specified below.  ‒ Step 0: set *j=0*, where *j* is thenumber of selected PDSCH(s) for decoding. *Q* is the set of activated PDSCHs without corresponding PDCCH transmissions within the slot  ‒ Step 1: A UE receives one PDSCH with the lowest configured *sps-ConfigIndex* within *Q*, set *j=j+1*. Designate the received PDSCH as survivor PDSCH.  ‒ Step 2: The survivor PDSCH in step 1 and any other PDSCH(s) overlapping (even partially) with the survivor PDSCH in step 1 are excluded from *Q*.  ‒ Step 3: Repeat step 1 and 2 until *Q* is empty or *j* is equal to the number of unicast/multicast PDSCHs in a slot supported by the UE.  A UE capable of PDSCH repetitions for broadcast channels, which assumed the DCI format 1\_0 in the Type0 PDCCH CSS of searchSpaceZero transmitted with two inter-slot repetitions may assume that PDSCHs scheduled by the DCI format 1\_0 have also been transmitted with inter-slot repetitions in the same slots as the Type0 PDCCH CSS, with the same RV as indicated by the DCI format 1\_0.  For a cell detected in cell search procedure with synchronization raster defined in Table 5.4.3.1-2 or Table 5.4.3.1-3 of [8, TS 38.101-1], the size of CORESET 0 for the cell in this clause refers to the size of punctured CORESET 0 as defined in clause 7.3.2.2 of [4, TS 38.211] if any.  **<\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*omitted\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*>** |

Agreement

Adopt the following TP in principle to Clause 6.1.2.2.1, TS 38.214.

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| --- |
| 6.1.2.2.1 Uplink resource allocation type 0  <-------------------------------- unchanged text omitted ------------------------------->  If a UE is configured with SBFD symbols,  - only the resource blocks that are both in the active UL BWP and in the UL sub-band are used for PUSCH transmission in SBFD symbol(s). For a single PUSCH transmission in SBFD symbol(s) within a slot or for PUSCH transmission across different slots where the valid symbol type is SBFD symbol (Clause ~~5.1.2.1~~6.1.2.1a), the UE does not expect to be assigned with a RBG for PUSCH in SBFD symbol(s) which is fully outside the PRBs that are both in the active UL BWP and in the UL sub-band.  <-------------------------------- unchanged text omitted -------------------------------> |

Agreement

Adopt the following TP in principle to Clause 11.1, TS 38.213.

|  |
| --- |
| 11.1 Slot configuration  <omitted text>  If a UE would transmit a PRACH triggered by higher layers in a set of SBFD symbols and would receive a PDCCH, or a PDSCH, or a CSI-RS, or a DL PRS, the UE can select based on its implementation whether to either transmit the PRACH or receive the PDSCH, or the CSI-RS, or the DL PRS~~PL RS~~, or the PDCCH.  <omitted text> |

Agreement

Adopt the following TP in principle to section 7.1.1, TS 38.213:

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| --- |
| 7.1.1 UE behaviour  **<Unchanged parts omitted>**  - If a UE established dedicated RRC connection using a Type-1 random access procedure, as described in clause 8, and is not provided *P0-PUSCH-AlphaSet* or for a PUSCH (re)transmission corresponding to a RAR UL grant as described in clause 8.3,  , , and ,  where is provided by *preambleReceivedTargetPower* or *sbfd-RACH-SingleConfig-preambleReceivedTargetPower* when configured [11, TS 38.321] and is provided by *msg3-DeltaPreamble* or *deltaPreamble*, or dB if *msg3-DeltaPreamble* and *deltaPreamble* are not provided, for carrier of serving cell |

Conclusion

* A UE does not expect to be configured with SUL and SBFD on NUL in the same cell.

Agreement

Adopt the following TP to section 7.3.1.2.1, TS 38.212:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 7.3.1.2.1 Format 1\_0 **<Unchanged parts omitted>**  - RACH occasion indicator - 0 or 1 bit  - 1 bit if the UE is configured with higher layer parameter *sbfd-RACHSingleConfig* or *sbfd-RACHDualConfig*. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the RACH occasion for PRACH transmission according to Table 7.3.1.2.1-6; otherwise, this field is reserved.  - 0 bit otherwise.  **<Unchanged parts omitted>**  **Table 7.3.1.2.1-6: RACH occasion indicator**   |  |  | | --- | --- | | **Bit field** | **RACH occasion indicator** | | 0 | The RACH occasion for the PRACH transmission is from the first PRACH occasionsas defined in Clause 8 of [5, TR38.213] | | 1 | The RACH occasion for the PRACH transmission is from the second PRACH occasions as defined in Clause 8 of [5, TR38.213] | |

Agreement

Draft LS R1-2508107 to RAN2 is endorsed.

Agreement

Final LS R1-2508108 is endorsed.

Agreement

Adopt the following TP in principle to Clause 11.1, TS 38.213.

|  |
| --- |
| 11.1 Slot configuration \*\*\* Unchanged parts are omitted \*\*\*  For each slot having a corresponding index provided by *slotIndex*, the UE applies a format provided by a corresponding *symbols*. The UE does not expect *tdd-UL-DL-ConfigurationDedicated* to indicate as uplink or as downlink a symbol that *tdd-UL-DL-ConfigurationCommon* indicates as a downlink or as an uplink symbol, respectively. For a set of symbols of a slot that are indicated as SBFD by *tdd-UL-DL-ConfigurationCommon*, the UE ignores the symbols format provided by *tdd-UL-DL-ConfigurationDedicated*, if any.  \*\*\* Unchanged parts are omitted \*\*\* |

Agreement

Adopt the following TP in principle to Clause 6.1.2.1, TS 38.214.

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| --- |
| 6.1.2.1 Resource allocation in time domain  \*\*\* Unchanged parts are omitted \*\*\*  For PUSCH repetition Type B, the UE determines invalid symbol(s) for PUSCH repetition Type B transmission as follows:  - A symbol that is indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated*, and, when applicable, not indicated as SBFD symbols by *tdd-UL-DL-ConfigurationCommon,* is considered as an invalid symbol for PUSCH repetition Type B transmission.  - For operation in unpaired spectrum, symbols indicated by *ssb-PositionsInBurst* in SIB1 or *ssb-PositionsInBurst* in *ServingCellConfigCommon* for reception of SS/PBCH blocks are considered as invalid symbols for PUSCH repetition Type B transmission.  - For a reduced capability half-duplex UE in paired spectrum, symbols that do not start or end at least or , respectively, from the last or first symbol of an SS/PBCH block with index indicated by *ssb-PositionsInBurst* in SIB1 or by *ssb-PositionsInBurst* in *ServingCellConfigCommon* or by *NonCellDefiningSSB*, or by *ssb-PositionsInBurst* in *SSB-MTC-AdditionalPCI* associated to physical cell ID with active TCI states for PDCCH or PDSCH, or for a set of symbols of a slot corresponding to SS/PBCH blocks configured for L1 beam measurement/reporting for reception of SS/PBCH blocks are considered as invalid symbols for PUSCH repetition Type B transmission.  - For operation in unpaired spectrum, symbol(s) indicated by *pdcch-ConfigSIB1* in *MIB* for a CORESET for Type0-PDCCH CSS set are considered as invalid symbol(s) for PUSCH repetition Type B transmission.  - For operation in unpaired spectrum, if *numberOfInvalidSymbolsForDL-UL-Switching* is configured,   * + *numberOfInvalidSymbolsForDL-UL-Switching* symbol(s) after the last symbol that is indicated as downlink in each consecutive set of all symbols that are indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* are considered as invalid symbol(s) for PUSCH repetition Type B transmission. The symbol(s) given by *numberOfInvalidSymbolsForDL-UL-Switching* are defined using the reference SCS configuration *referenceSubcarrierSpacing* provided in *tdd-UL-DL-ConfigurationCommon*.   \*\*\* Unchanged parts are omitted \*\*\* |

Agreement

Adopt the following TP in principle for section 8.1, TS 38.213:

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| 8.1 Random access preamble  **<Unchanged parts omitted>**  - if a UE is provided *tdd-UL-DL-ConfigurationCommon* for a cell, a PRACH occasion for the cell in a PRACH slot is valid if  - For a first PRACH occasion,  - it is within UL symbols, or  - it does not precede a SS/PBCH block in the PRACH slot, if it is only in UL symbols, and starts at least symbols after a last downlink symbol and at least symbols after a last SS/PBCH block symbol, where is provided in Table 8.1-2, and if *channelAccessMode* = "*semiStatic*" is provided, does not overlap with a set of consecutive symbols before the start of a next channel occupancy time where there shall not be any transmissions, as described in [15, TS 37.213]  - the candidate SS/PBCH block index of the SS/PBCH block corresponds to the SS/PBCH block index provided by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* or in *SSB-MTC-AdditionalPCI* corresponding to the cell, as described in clause 4.1  - For a second PRACH occasion,  - it starts at least symbols after a last non-SBFD downlink symbol and at least symbols after a last SS/PBCH block symbol, where is provided in Table 8.1-2, and does not overlap with a SS/PBCH block symbol, and  - it is only within SBFD symbols and including at least one SBFD symbol indicated as downlink by *tdd-UL-DL-ConfigurationCommon*, and in RBs that are both in the active UL BWP and in the UL sub-band if the UE is provided *sbfd-RACHSingleConfig*, or  - it is only within SBFD symbols and is in RBs that are both in the active UL BWP and in the UL sub-band if the UE is provided *sbfd-RACHDualConfig*, or  - it starts from an SBFD symbol and ends in a non-SBFD symbols and is in RBs that are both in the active UL BWP and in the UL sub-band if the UE is provided *sbfd-RACHDualConfig* and *sbfd-RACHDualConfig-ValidROAcrossSymbolTypes* |

Agreement

Adopt the following TP in principle for section 11.1, TS 38.213:

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| --- |
| 11.1 Slot configuration **<Unchanged parts omitted>**  For a set of symbols of a slot corresponding to a valid PRACH occasion and symbols before the valid PRACH occasion, as described in clause 8.1, the UE does not receive PDCCH, PDSCH, or CSI-RS in the slot if a reception would overlap with any symbol from the set of symbols. The UE does not expect the set of symbols of the slot to be indicated as downlink by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* and, when applicable, not indicated as SBFD by *tdd-UL-DL-ConfigurationCommon*.  If a UE would transmit a PRACH triggered by higher layers in a set of SBFD symbols and would receive a PDCCH, or a PDSCH, or a CSI-RS, or a DL PRS, the UE can select based on its implementation whether to either transmit the PRACH or receive the PDSCH, or the CSI-RS, or the PL RS, or the PDCCH. |

Agreement

Adopt the following TP in principle to section 5.2.1.5.1 and 5.2.1.5.1a, TS 38.214

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| --- |
| 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have the same numerology  **<Unchanged parts omitted>**  - ~~[~~If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CLI measurement resources in a *CLI-RSSI-MeasurementResourceSet* or in a *SRS-RSRP-MeasurementResourceSet* is equal to or greater than the UE reported threshold *beamSwitchTiming* when the reported value is one of the values of {14,28,48} and *enableBeamSwitchTiming* is not provided, or is equal to or greater than 48 when the UE provides *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided, and~~]~~  - if the UE is configured with a list of TCI states in *CSI-AssociatedReportConfigInfo* and it is configured with *unifiedTCI-StateType*, the UE is expected to apply the QCL assumptions indicated by *qcl-Info* for the aperiodic CLI measurement resources in the CSI triggering state indicated by the CSI trigger field in DCI.  - if the UE is not configured with a list of TCI states in *CSI-AssociatedReportConfigInfo* and if the UE is configured with *unifiedTCI-StateType*, the UE is expected to apply the indicatedDL TCI state or joint TCI state*.*  - if the UE is not configured with a list of TCI states in CSI-AssociatedReportConfigInfo and if the UE is not configured with unifiedTCI-StateType, the UE is expected to assume that the aperiodic CLI measurement resources are the QCL ‘typeD’ to one of the latest received PDSCH and the latest monitored CORESET.  **<Unchanged parts omitted>**  5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies  **<Unchanged parts omitted>**  ~~[~~- If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CLI measurement resources in a *CLI-RSSI-MeasurementResourceSet* or in a *SRS-RSRPMeasurementResourceSet* is equal to or greater than *beamSwitchTiming* + *d*  in CLI measurement resource symbols, when the reported value is one of the values of {14,28,48} and *enableBeamSwitchTiming* is not provided, or is equal to or greater than 48+ in CLI measurement resource symbols when the UE provides *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided, where if the µPDCCH < µCLI, the beam switching timing delay *d* is defined in Table 5.2.1.5.1a-1, else *d* is zero, and~~]~~  - if the UE is configured with a list of TCI states in *CSI-AssociatedReportConfigInfo* and it is configured with *unifiedTCI-StateType*, the UE is expected to apply the QCL typeD assumptions indicated by *qcl-Info* for the aperiodic CLI measurement resources in the CSI triggering state indicated by the CSI trigger field in DCI.  - if the UE is not configured with a list of TCI states in *CSI-AssociatedReportConfigInfo* and if the UE is configured with *unifiedTCI-StateType*, the UE is expected to apply the DL TCI state or joint TCI state as indicated by *unifiedTCI-StateType*.  - if the UE is not configured with a list of TCI states in *CSI-AssociatedReportConfigInfo*, and if the UE is not configured with *unifiedTCI-StateType*, the UE is expected to assume that the aperiodic CLI measurement resources are the QCL ‘typeD’ to one of the latest received PDSCH and the latest monitored CORESET. |

Agreement

Adopt the following TP in principle to section 5.2.1.4.8, TS 38.214

|  |
| --- |
| **5.2.1.4.8 L1-CLI-RSSI Reporting**  <Unchanged part omitted>  If the higher layer parameter *timeRestrictionForChannelMeasurements* in *CSI-ReportConfig* is set to ‘Configured’, the UE shall derive the channel measurements for computing L1-CLI-RSSI reported in uplink, SBFD or [flexible] slot *n* based on only the most recent, no later than the CSI reference resource, occasion of CLI-RSSI resources (defined in [4, TS 38.211]) associated with the CSI resource setting.  A UE configured with SBFD symbols and with a CLI-RSSI measurement resource in SBFD symbols and across two DL subbands shall derive the frequency resources for L1-CLI-RSSI measurement by excluding the frequency resources outside the RBs that are both in the active DL BWP and in the DL sub-bands and shall report a single wideband L1-CLI-RSSI measurement.  A UE configured with SBFD symbols does not expect to be configured with a *CSI-ReportConfig* associated with CLI-RSSI measurement resources configured within an UL subband and with CLI-RSSI measurement resources configured within one DL subband or across two DL subbands.  A UE configured with SBFD symbols does not expect to be configured with CLI-RSSI measurement resources within an UL subband and CLI-RSSI measurement resources within one DL subband or across two DL subbands in a same symbol. |

Agreement

Adopt the following TP in principle to section 5.2.2.6, TS 38.214

|  |
| --- |
| 5.2.1.4.1 Resource Setting configuration  **<Unchanged parts omitted>**  For *~~a~~* semi-persistent or periodic L1-SRS-RSRP or L1-CLI-RSSI measurement resources if a UE is configured with SBFD symbols and a *CSI-ReportConfig* with the higher layer parameter *symbolType*, the UE only considers the measurement resources within either SBFD symbol(s) or non-SBFD symbol(s) as indicated by *symbolType* for the measurement and reporting. If a UE is not configured with SBFD symbols, the higher layer parameter *symbolType* is not applicable and the UE considers the measurement resources provided in *CSI-ResourceConfig* indicated by *CSI-ReportConfig.* |

Agreement

Adopt the following TP in principle to section 5.2.2.7, TS 38.214

|  |
| --- |
| 5.2.2.7 CLI-RSSI measurement resource  **<Unchanged parts omitted>**  ~~[~~The bandwidth and initial common resource block (CRB) index of a CLI-RSSI resource within a BWP, as defined in Clause 7.4.1.5 of [4, TS 38.211], are determined based on the higher layer parameters *nrofRBs* and *startingRB*, respectively. ~~Both~~ *nrofRBs* ~~and~~ *~~startingRB~~* ~~are~~ is configured as integer multiples of ~~[~~4~~]~~ RBs~~, and the reference point for~~ *~~startingRB~~* ~~is CRB 0 on the common resource block grid. If the UE shall assume that the initial CRB index of the CLI-RSSI resource is , otherwise . If , the UE shall assume that the bandwidth of the CLI-RSSI resource is , otherwise~~ .~~]~~ |

Agreement

Adopt the following TP in principle to section 5.2.1.5.1a, 5.2.2.5 and 5.2.2.6, TS 38.214.

|  |
| --- |
| 5.2.1.5.1a Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have different numerologies  **<Unchanged parts omitted>**  [- If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CLI measurement resources in a *CLI-RSSI-MeasurementResourceSet* or in a *SRS-RSRPMeasurementResourceSet* is equal to or greater than *beamSwitchTiming* + *d*  in CLI measurement resource symbols, when the reported value is one of the values of {14,28,48} and *enableBeamSwitchTiming* is not provided, or is equal to or greater than 48+ in CLI measurement resource symbols when the UE provides *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided, where if the µPDCCH < µCLI, the beam switching timing delay *d* is defined in Table 5.2.1.5.1a-1, else *d* is zero, and]  - if the UE is configured with a list of TCI states in *CSI-AssociatedReportConfigInfo* and it is configured with *unifiedTCI-StateType*, the UE is expected to apply the QCL typeD assumptions indicated by *qcl-Info* for the aperiodic CLI measurement resources in the CSI triggering state indicated by the CSI trigger field in DCI.  - if the UE is not configured with a list of TCI states in *CSI-AssociatedReportConfigInfo* and if the UE is configured with *unifiedTCI-StateType*, the UE is expected to ~~apply the DL TCI state or joint TCI state as indicated by~~ *~~unifiedTCI-StateType~~* apply the indicatedDL ~~TCI state~~ or joint TCI state.  - if the UE is not configured with a list of TCI states in *CSI-AssociatedReportConfigInfo*, and if the UE is not configured with *unifiedTCI-StateType*, the UE is expected to assume that the aperiodic CLI measurement resources are the QCL ‘typeD’ to one of the latest received PDSCH and the latest monitored CORESET.  **<Unchanged parts omitted>**  5.2.2.5 SRS-RSRP measurement resource  **<Unchanged parts omitted>**  For all *K* periodic SRS-RSRP resources within an SRS-RSRP resource set:  - If *qcl-InfoPeriodicSRS-RSRP-MeasurementResource* is configured, the UE shall also be configured with *unifiedTCI-StateType* and shall assume the configured TCI state indicated by *qcl-InfoPeriodicSRS-RSRP-MeasurementResource*.  - If *qcl-InfoPeriodicSRS-RSRP-MeasurementResource* is not configured and *unifiedTCI-StateType* is not configured, the UE shall perform the SRS-RSRP measurement assuming that the resources are QCL ‘typeD’ to one of the latest received PDSCH and the latest monitored CORESET.  - If *qcl-InfoPeriodicSRS-RSRP-MeasurementResource* is not configured and *unifiedTCI-StateType* is configured, the UE shall perform the SRS-RSRP measurement assuming ~~the DL TCI state or joint TCI state as indicated by~~ *~~unifiedTCI-StateType~~* the indicatedDL ~~TCI state~~ or joint TCI state.  **<Unchanged parts omitted>**  5.2.2.6 CLI-RSSI measurement resource  **<Unchanged parts omitted>**  A UE expects all *K* periodic CLI-RSSI resources within a CLI-RSSI resource set to be configured or not with *qcl-InfoPeriodicCLI-RSSI-MeasurementResource.* If *qcl-InfoPeriodicCLI-RSSI-MeasurementResource* is configured, the UE shall also be configured with *unifiedTCI-StateType* and shall assume the configured TCI state indicated by *qcl-InfoPeriodicCLI-RSSI-MeasurementResource*. If *qcl-InfoPeriodicCLI-RSSI-MeasurementResource* is not configured and *unifiedTCI-StateType* is not configured, the UE shall perform the CLI-RSSI measurement assuming that the resources are QCL ‘typeD’ to one of the latest received PDSCH and the latest monitored CORESET. If *qcl-InfoPeriodicCLI-RSSI-MeasurementResource* is not configured and *unifiedTCI-StateType* is configured, the UE shall perform the CLI-RSSI measurement assuming ~~the DL TCI state or joint TCI state as indicated by~~ *~~unifiedTCI-StateType~~* the indicatedDL ~~TCI state~~ or joint TCI state. |

R1-2508016 Summary #1 of CLI handling Moderator (Huawei)

R1-2508018 Summary#2 on SBFD random access operation Moderator (Huawei)

R1-2508106 Summary #2 of SBFD TX/RX/measurement procedures Moderator (Xiaomi)

R1-2508017 Summary#1 on SBFD random access operation Moderator (Huawei)

R1-2508013 Summary #1 of SBFD TX/RX/measurement procedures Moderator (Xiaomi)

R1-2506771 Discussion on maintenance of SBFD ZTE Corporation, Sanechips

R1-2506798 Remaining issues on SBFD Spreadtrum, UNISOC

R1-2506873 Maintenance on evolution of NR duplex operation: SBFD vivo

R1-2506948 Maintenance of Rel-19 SBFD Huawei, HiSilicon

R1-2506963 Maintenance on Rel-19 SBFD operation Xiaomi

R1-2507096 Maintenance on SBFD CATT

R1-2507149 Maintenance on NR duplex operation OPPO

R1-2507229 Remaining issues on NR duplex operation Samsung

R1-2507279 Remaining issues on SBFD operation Fujitsu

R1-2507313 Maintenance on SBFD procedure NEC

R1-2507342 Remaining issues on SBFD Tx/Rx/measurement procedures Fraunhofer HHI, Fraunhofer IIS

R1-2507352 Remaining issues on SBFD LG Electronics

R1-2507405 Maintenance of SBFD Nokia, Nokia Shanghai Bell

R1-2507445 SBFD operations and CLI handling InterDigital, Inc.

R1-2507454 Maintenance on evolution of NR duplex operation Ofinno

R1-2507493 Maintenance on SBFD ETRI

R1-2507574 Maintenance on R19 SBFD operation MediaTek Inc.

R1-2507696 Maintenance for NR duplex evolution Qualcomm Incorporated

R1-2507759 Maintenance on SBFD Ericsson

R1-2507781 Maintenance on SBFD Sharp

R1-2507791 Maintenance on Evolution of NR duplex operation: Sub-band full duplex (SBFD) NTT DOCOMO, INC.

R1-2507829 Maintenance on SBFD TX/RX/measurement procedures ITRI

R1-2507848 Maintenance on SBFD operation WILUS Inc.

R1-2507874 Support of partial PRG for SBFD ASUSTeK

## Maintenance on Solutions for Ambient IoT (Internet of Things) in NR

*Note: Maximum one contribution.*

[122bis-R19-A-IoT] Email discussion on A-IoT – Jingwen (CMCC)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508154** Session notes for 8.4 (Maintenance on Solutions for Ambient IoT (Internet of Things) in NR) Ad-Hoc Chair (Huawei)

Session notes are endorsed and incorporated the session notes below.

R1-2506823 Discussion on remaining issues of Rel-19 Ambient IoT ZTE Corporation, Sanechips

R1-2506874 Discussion on potential overlapping between TDMed Msg1 transmissions vivo

R1-2506964 Discussion on remaining issues for Ambient IoT in NR Xiaomi

R1-2507001 Discussion on remaining issues of Ambient IoT (Internet of Things) in NR CMCC

R1-2507097 Remaining issues on Rel-19 A-IoT CATT

R1-2507154 Maintenance on Rel-19 Ambient IoT OPPO

R1-2507230 Maintenance issues on Rel-19 A-IoT Samsung

R1-2507298 Maintenance on Solutions for Ambient IoT in NR NEC

R1-2507455 Maintenance of AIoT Ofinno

R1-2507489 Maintenance on Rel-19 Ambient IoT Ericsson

R1-2507697 Maintenance on Ambient IoT Qualcomm Incorporated

R1-2507792 Maintenance on solutions for Ambient IoT in NR NTT DOCOMO, INC.

R1-2507922 Maintenance on Rel-19 Ambient IoT Huawei, HiSilicon

R1-2507949 Maintenance on Rel-19 Ambient IoT Ericsson

(Revision of R1-2507489)

**R1-2508038** Summary #1 for maintenance on solutions for A-IoT in NR Moderator (CMCC)

**Agreement**

RAN1 endorses text proposal #3.1 below for TS 38.291 Clause 7.1.2 and 7.1.3.

Text proposal #3.1

|  |  |
| --- | --- |
| **Reasons for change** | Editorial and to align with RAN2 specification/terminology. |
| **Summary of change** | Change a *Random ID* message (Msg1) to an *Access Random ID* message (Msg1);  Change “contention-free random access” to “contention-free access”. |
| **Consequences if not approved** | Misaligned terms between RAN1 and RAN2 specifications. |
| **Text proposal** | <Unchanged parts omitted>  7.1.2 Device procedure for transmission time determination  A device shall upon receiving a PRDCH intended for the device in an R2D transmission ending in chip , perform a corresponding D2R transmission with chip starting an amount of time after the end of chip according to the configuration received from higher layers.  If the D2R transmission is for an *Access Random ID* message (Msg1) or corresponds to a *Random ID Response* message (Msg2)   * the device shall determine …   …  If the D2R transmission is for an *Access Random ID* message   * if after chip there are potential access occasion(s), as defined in TS 38.391 [3], for the transmission which are earlier in time than the access occasion selected for the transmission   - the device shall set   * otherwise   - the device shall set  else if the D2R transmission corresponds to a R2D *Random ID Response* message or to a contention-free ~~random~~ access procedure  <Unchanged parts omitted>  7.1.3 Device procedure for modulation scheme determination  To determine the modulation scheme for the entire D2R transmission, the device shall:  - if the PDRCH is for transmitting Msg1 or corresponds to a contention-free ~~random~~ access procedure  - determine according to its implementation to use either OOK modulation or BPSK modulation  …  <Unchanged parts omitted> |

**R1-2508039** Summary #2 for maintenance on solutions for A-IoT in NR Moderator (CMCC)

**Agreement**

A device is not required to monitor R2D during for preparing D2R transmission

* FFS in RAN1#123: how to capture this behaviour in the specifications

**Conclusion**

The issue in Section 5.1 of R1-2508039 is not pursued.

**Conclusion**

The following text proposals of R1-2508039 are not pursued:

* The text proposal in Section 3.2.1;
* The text proposal in Section 3.3.1;
* The text proposal in Section 4.1.1;
* The text proposal in Section 4.3.1.

**Conclusion**

When X = 2, for the potential overlap of the 1st and 2nd Msg1 time resource due to the time drift during postamble and padding chips:

* RAN1#123 will make a decision on whether to specify a solution for this issue, or to leave it to be avoided or handled by reader implementation.

## Maintenance on Enhancements of network energy savings for NR

*Note: Maximum one contribution. For efficient review, please use the following sections in your contribution corresponding to the maintenance issues, if any:*

* *On-demand SSB SCell operation*
* *On-demand SIB1 for idle/inactive mode UEs*
* *Adaptation of common signal/channel transmissions*

[122bis-R19-NES] Email discussion on NES– Ajit (Ericsson)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508150** Session notes for 8.5 (Maintenance on Enhancements of network energy savings for NR) Ad-Hoc Chair (Ericsson)

Session notes are endorsed and incorporated the session notes below.

R1-2506824 Discussion on remaining issues of Rel-19 NES ZTE Corporation, Sanechips

R1-2506875 Maintenance on enhancements of network energy savings for NR vivo

R1-2506950 Maintenance on Rel-19 Network Energy Savings Huawei, HiSilicon

R1-2506965 Maintenance on Enhancements of network energy savings for NR Xiaomi

R1-2507002 Discussion on maintenance issue on Enhancements of network energy savings for NR CMCC

R1-2507122 Maintenance on enhancements of network energy savings for NR CATT

R1-2507134 Maintenance on enhancements of network energy savings for NR OPPO

R1-2507231 Maintenance on Enhancements of network energy savings for NR Samsung

R1-2507293 Maintenance on Enhancements of network energy savings Nokia, Nokia Shanghai Bell

R1-2507353 Remaining issues on enhancements of NES for NR LG Electronics

R1-2507456 Discussion on on-demand SSB SCell operation Ofinno

R1-2507494 A remaining issue on SSB time domain adaptation ETRI

R1-2507516 Maintenance for Network Energy Saving Google

R1-2507556 Maintenance on enhancements of network energy savings for NR DENSO CORPORATION

R1-2507566 Maintenance on enhancements of network energy savings for NR Sharp

R1-2507621 Maintenance on Enhancements of network energy savings for NR MediaTek Inc.

R1-2507639 Maintenance for R19 NES Ericsson

R1-2507649 Remaining issues on Rel-19 NES Apple

R1-2507698 Maintenance on network energy savings for NR Qualcomm Incorporated

R1-2507875 Correction on OD-SIB1 ASUSTeK

### On-demand SSB SCell operation

**R1-2508034 Summary #1 of on-demand SSB for NES Moderator (LG Electronics)**

**Agreement:**

* For a cell supporting on-demand SSB SCell operation,
  + The periodicity of on-demand SSB is equal to or smaller than that of always-on SSB.

**Conclusion:**

* For a cell supporting on-demand SSB SCell operation and for Case #2 (i.e., Always-on SSB is periodically transmitted on the cell),
  + If a CSI report configuration is associated with both of AO-SSB and OD-SSB,
    - if the higher layer *timeRestrictionForChannelMeasurements* in *CSI-ReportConfig* is set to “*Configured*”,
      * Which SSB to measure between the most recent AO-SSB no later than the CSI reference resource and the most recent OD-SSB no later than the CSI reference resource is up to UE implementation as long as RAN4 requirements are met.
  + No spec change is expected

**R1-2508036 Summary #3 of on-demand SSB for NES Moderator (LG Electronics)**

**Conclusion:**

Regarding the relation in terms of time location between the always-on SSB and on-demand SSB,

* For the case when the center frequency locations of always-on SSB and on-demand SSB are same,
  + It is up to gNB implementation whether half frame index is the same or different for AO-SSB and OD-SSB
  + Note: As agreed, PBCH payload for the same SSB index (other than SFN index, half frame index) is the same for AO-SSB and OD-SSB
* For the case when the center frequency locations of always-on SSB and on-demand SSB are different,
  + PBCH payload between AO-SSB and OD-SSB can be different.
* No spec change is expected.

### On-demand SIB1 for idle/inactive mode UEs

**R1-2507962 FL summary 2 for on-demand SIB1 in idle/inactive mode Moderator (MediaTek)**

Agreement:

The proposed TP for TS38.211, Clause 4.4.2, captured in FL Proposal 3-1 in Section “Issue 3” in R1-2507962, is endorsed.

Agreement:

The proposed TP for TS38.213, Clause 8.1, captured in FL Proposal 3-2 in Section “Issue 3” in R1-2507962, is endorsed.

Agreement:

The proposed TP for TS38.211, Clause 5.3.2, captured in FL Proposal 4-1 in Section “Issue 4” in R1-2507962, is endorsed.

**Conclusion:**

* There is no concern in RAN1 on RAN2 LS R1-2506714. No response is needed.

**R1-2507963 FL summary 3 for on-demand SIB1 in idle/inactive mode Moderator (MediaTek)**

Agreement:

The proposed TP for TS38.211, Clause 5.3.2, captured in FL Proposal 2-4 in Section “Issue 2” in R1-2507963, is endorsed.

Agreement:

The proposed TP for TS38.213, Clause 23, captured in FL Proposal 3-4 in Section “Issue 3” in R1-2507963, is endorsed.

### Adaptation of common signal/channel transmissions

**R1-2508027 Summary#1 of R19 maintenance for adaptation of common signalling Moderator (Ericsson)**

**Conclusion:**

Amongst the following parameters in RACH-ConfigCommon for legacy PRACH resources

* *zeroCorrelationZoneConfig*
* *preambleReceivedTargetPower*
* *preambleTransMax*
* *powerRampingStep*
* *ra-ResponseWindow*
* *ra-Msg3SizeGroupA*
* *messagePowerOffsetGroupB*
* *ra-ContentionResolutionTimer*
* *rsrp-ThresholdSSB*
* *rsrp-ThresholdSSB-SUL*
* *prach-RootSequenceIndex*
* *msg1-SubcarrierSpacing*
* *restrictedSetConfig*
* *msg3-transformPrecoder*
* *~~numberOfRA-PreamblesGroupA~~*
* *~~totalNumberOfRA-Preambles~~*

There is no consensus in RAN1 to provide any of these parameters separately for additional PRACH.

**R1-2508164 Summary#2 of R19 maintenance for adaptation of common signalling Moderator (Ericsson)**

Agreement:

Adopt below TP to clarify spectifcation text regarding separate mapping of SS/PBCH block indexes to legacy RO configuration and additional RO configuration.

|  |  |
| --- | --- |
| ***Reason for change:*** | The specification text regarding separate mapping of SS/PBCH block indexes to legacy RO configuration and additional RO configuration is confusing since the IE addl-RACH-Config-Adaptation is also within RACH-ConfigCommon. |
|  |  |
| ***Summary of change:*** | In clause 8.1 of TS 38.213, update the specification text to properly reference the IEs regarding the separate mapping of SS/PBCH block indexes to legacy RO configuration and additional RO configuration |
|  |  |
| ***Consequences if not approved:*** | Incorrect specification for the separate mapping of SS/PBCH block indexes to legacy RO configuration and additional RO configuration |

-------------------------------------------- End of text proposal to TS 38.213 v19.1.0 ------------------

**8.1 Random access preamble**

< Unchanged parts are omitted >

SS/PBCH block indexes provided by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* or in *SSB-MTC-AdditionalPCI* or in *LTM-SSB-Config* are mapped to valid PRACH occasions in the following order where the parameters are described in [4, TS 38.211]. The mapping of SS/PBCH block indexes to valid PRACH occasions is separate for valid PRACH occasions determined by *RACH-ConfigCommon* and not determined by *addl-RACH-Config-Adaptation* and for valid PRACH occasions determined by *addl-RACH-Config-Adaptation*.

- First, in increasing order of preamble indexes within a single PRACH occasion

- Second, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions

- Third, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot

- Fourth, in increasing order of indexes for PRACH slots

-------------------------------------------- End of text proposal to TS 38.213 v19.1.0 ------------------

## Maintenance on Low-power wake-up signal and receiver for NR (LP-WUS/WUR)

*Note: Maximum one contribution. For efficient review, please use the following sections in your contribution corresponding to the maintenance issues, if any:*

* *LP-WUS and LP-SS design*
* *LP-WUS operation in IDLE/INACTIVE modes*
* *LP-WUS operation in CONNECTED modes*

[122bis-R19-LP-WUS] Email discussion on LP-WUS – Xueming (vivo)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Agreement

Adopt the following TP to Section 10.4D, TS 38.213 for alignment.

---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------

**10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED**

<Unchanged Text Omitted>

If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI states indicated by a most recent DCI format or MAC CE, after a respective application time in clause 5.1.5 [6, TS 38.214]; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *WUS\_TCI\_states\_CONNECTED*.

<Unchanged Text Omitted>

---------------------------------End of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------

Agreement

Adopt the following TP to Section 10.4D, TS 38.213.

|  |
| --- |
| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.0.0-----------------------  **10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED**  <Unchanged parts are omitted>  The UE reports a number of ~~slots~~ milliseconds [18, TS 38.306] where the UE is not required to monitor WUS prior to the slot where the *drx-onDurationTimer* would start.  <Unchanged parts are omitted>  ---------------------------------End of Text Proposal on 3GPP TS 38.213 V19.0.0----------------------- |

Agreement

Adopt the following TP to Section 10.4D, TS 38.213 in principle.

|  |
| --- |
| **10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED**  \*\*\* Unchanged parts are omitted \*\*\*  A UE configured with DRX mode operation and operating in the RRC\_CONNECTED state can be provided for WUS reception on the primary cell of a cell group  - a number of OOK symbols per OFDM symbol, a first RB, and overlaid OFDM sequences per OOK symbol for WUS reception [4, TS 38.211], and  - a number of codepoints provided for the UE by the WUS [6, TS 38.212], by *WUS-codepointCONNECTED*  A UE assumes that a WUS is quasi co-located with an SS/PBCH block or a CSI-RS with respect to quasi co-location 'typeC' or 'typeD' properties, when applicable.  If a UE is provided *ABC*, the UE receives WUS based on the quasi co-location information of the TCI states provided by *ABC*, indicated by a most recent DCI format or MAC CE, after a respective application time; otherwise, the UE receives WUS based on the quasi co-location information of the TCI states for a CORESET with *controlResourceSetId* value that is same as the one indicated by *WUS\_TCI\_states\_CONNECTED*.  \*\*\* Unchanged parts are omitted \*\*\* |

Agreement

Adopt the following TP to Section 10.4D, TS 38.213 in principle:

|  |
| --- |
| ---------------------------------Start of Text Proposal on 3GPP TS 38.213 V19.1.0-----------------------  **10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED**  \*\*\* Unchanged parts are omitted \*\*\*  A UE can be provided, by *WUS\_available\_slot\_CONNECTED*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. A set of time units includes a total of either 10, or 20, or 40 time units. A duration , in msec, of the set of time units has maximum value of 40 msec. The first symbol of the set of time units every 40 msec/ periods is a first symbol in frame mod 4 = 0. The UE can be additionally provided, by *WUS\_available\_symbol\_CONNECTED*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_CONNECTED*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_CONNECTED*, the UE assumes that, for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when  - the symbol is indicated as uplink, by tdd-UL-DL-configurationCommon or tdd-UL-DL-ConfigurationDedicated  - the symbol is indicated for transmission of SS/PBCH blocks, by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon  \*\*\* Unchanged parts are omitted \*\*\* |

Agreement

Adopt the following TP Section 10.4C and 10.4D for TS 38.213:

|  |
| --- |
| **10.4C PDCCH monitoring activation by WUS in RRC\_IDLE/RRC\_INACTIVE**  < unchanged text omitted >  A UE can be provided, by *WUS\_available\_slot\_IDLE/INACTIVE*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. A set of time units includes a total of either 10, or 20, or 40 time units. A duration , in msec, of the set of time units has maximum value of 40 msec. The first symbol of the set of time units every 40 msec/ periods is a first symbol in frame mod 4 = 0. The UE can be additionally provided, by *WUS\_available\_symbol\_IDLE/INACTIVE*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_IDLE/INACTIVE*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_IDLE/INACTIVE*, the UE assumes a time unit of one slot, ~~that,~~ and for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when  - the symbol is indicated as uplink, by *tdd-UL-DL-configurationCommon*  - the symbol is indicated for an SS/PBCH block transmission, by *ssb-PositionsInBurst* in *SIB1*, and the SS/PBCH block transmission would overlap in frequency with the WUS transmission  - the symbol is indicated for PDCCH transmissions, by *pdcch-ConfigSIB1*, and CORESET 0 for the PDCCH transmissions would overlap in frequency with the WUS transmission  < unchanged text omitted >  10.4D PDCCH monitoring activation by WUS in RRC\_CONNECTED  < unchanged text omitted >  A UE can be provided, by *WUS\_available\_slot\_CONNECTED*, a bitmap that corresponds to a set of time units that repeats continuously and indicates a subset of time units from the set of time units that is available for the UE to monitor WUS [12, TS 38.331]. A time unit includes one slot or two slots. The UE can be additionally provided, by *WUS\_available\_symbol\_CONNECTED*, an indication of symbols in each time unit from the subset of time units that is available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_slot\_CONNECTED*, the UE assumes that all time units are available for the UE to monitor WUS. If the UE is not provided *WUS\_available\_symbol\_CONNECTED*, the UE assumes a time unit of one slot, ~~that,~~ and for a time unit that is available for the UE to monitor WUS, all symbols in the time unit are available for the UE to monitor WUS. The UE assumes that a symbol is not available to monitor WUS when  - the symbol is indicated as uplink, by tdd-UL-DL-configurationCommon or tdd-UL-DL-ConfigurationDedicated  - the symbol is indicated for transmission of SS/PBCH blocks, by ssb-PositionsInBurst in SIB1 or in ServingCellConfigCommon  < unchanged text omitted > |

Agreement

Endorse the following TP for TS 38.215:

====================================Start of the TP====================================

5.1.53 Low power reference signal received power (LP-RSRP)

SS-RSRP shall be measured only among the reference signals corresponding to SS/PBCH blocks with the same SS/PBCH block index and the same physical-layer cell identity.

|  |  |
| --- | --- |
| **Definition** | Low power reference signal received power (LP-RSRP) is defined as the linear average over the power contributions (in [W]) of the resource elements that carry on-off keying (OOK) ON symbols of Low power synchronization signals (LP-SS).  LP-RSRP shall be measured only among the LP-SS associated with the same SS/PBCH block index and the same physical-layer cell identity.  For frequency range 1, the reference point for the LP-RSRP shall be the antenna connector of the UE. For frequency range 2, LP-RSRP shall be measured based on the combined signal from antenna elements corresponding to a given receiver branch. For frequency range 1 and 2, if receiver diversity is in use by the UE, the reported LP-RSRP value shall not be lower than the corresponding LP-RSRP of any of the individual receiver branches. |
| **Applicable for** | RRC\_IDLE for serving cell,  RRC\_INACTIVE for serving cell, |

< unchanged text omitted >

====================================End of the TP====================================

Agreement

The LO determination based on *lpwus-LoFrameOffsetList* is clarified as follows:

* If the number of POs associated with a LO is less than *Ns* (the number of POs per PF), the UE uses the ()-th value in *offsetForLongerWakeUpDelay* (if configured) and the ()-th value in *offsetForShorterWakeUpDelay* (if configured) provided by *lpwus-LoFrameOffsetList*.
* For the case when both *offsetForLongerWakeUpDelay* and *offsetForShorterWakeUpDelay* are configured,
  + If the gap between the end of the last LP-WUS MO the UE would monitor in the LO associated with the value in *offsetForShorterWakeUpDelay* and the start of the corresponding PO is no less than the wake-up delay a UE reports, the UE monitors the LO associated with the value in *offsetForShorterWakeUpDelay*;
  + Otherwise if the gap between the end of the last LP-WUS MO the UE would monitor in the LO associated with the value in *offsetForLongerWakeUpDelay* and the start of the corresponding PO is no less than the wake-up delay a UE reports, the UE monitors the LO associated with the value in *offsetForLongerWakeUpDelay*;
  + Otherwise, the UE monitors legacy PO.
* For the case when only one of *offsetForLongerWakeUpDelay* and *offsetForShorterWakeUpDelay* is configured,
  + If the gap between the end of the last LP-WUS MO the UE would monitor in the LO associated with the value in *offsetForLongerWakeUpDelay* or *offsetForShorterWakeUpDelay* (whichever is configured) and the start of the corresponding PO is no less than the wake-up delay a UE reports, the UE monitors the LO;
  + Otherwise, the UE monitors legacy PO.

Agreement

Regarding where to capture the LO determination based on *lpwus-LoFrameOffsetList*, Option 2: It is captured in TS 38.304.

* + RAN1 sends an LS to RAN2 on the agreed clarification on LO determination based on *lpwus-LoFrameOffsetList*.
  + TP for TS 38.213 will be discussed later.

Agreement

For RRC connected, for a UE incapable of monitoring the LP-WUS outside the active BWP and when LP-WUS frequency resource is outside the active BWP, UE performs legacy C-DRX operation.

|  |  |  |  |
| --- | --- | --- | --- |
| 62. NR\_LPWUS | 62-2 | LP-WUS operation in CONNECTED mode based on OOK signal | 1. LP-WUS operation in CONNECTED mode based on OOK signal  2. The supported procedure(s)  3. Minimum time gap between LP-WUS reception and UE to start PDCCH monitoring in CONNECTED mode  4. Support of LP-WUS frequency resource within active DL BWP. In case LP-WUS frequency resource is outside the active BWP, UE performs legacy C-DRX operation.  5. Support of all M values {1, 2, 4} for FR1  6. “Support of M values {1, 2} for 60 kHz SCS for FR2, M value 1 for 120 kHz SCS FR2  7. Maximum number of codepoints to be checked by UE per MO |
| 62. NR\_LPWUS | 62-2a | LP-WUS operation in CONNECTED mode based on OFDM overlaid sequence | 1. LP-WUS operation in CONNECTED mode based on OFDM overlaid sequence(s)  2. The supported procedure(s)  3. Minimum time gap between LP-WUS reception and UE to start PDCCH monitoring in CONNECTED mode  4. Support of LP-WUS frequency resource within active DL BWP. In case LP-WUS frequency resource is outside the active BWP, UE performs legacy C-DRX operation.  5. Support of all M values {1, 2, 4} for FR1  6. “Support of M values {1, 2} for 60 kHz SCS for FR2, M value 1 for 120 kHz SCS FR2  7. Maximum number of codepoints to be checked by UE per MO |

Conclusion

If the CORESET ID provided for a UE to derive the active TCI state for LP-WUS where the CORESET has two activated TCI states, it is up to UE implementation which/how to use the active TCI states of the CORESET for LP-WUS reception.

Conclusion

Confirm that all the collision cases when MR is in active time and when MR is performing transmission or reception outside active time are covered by the existed agreement below.

Agreement(Made in RAN1#121)

As the reply to RAN2 LS in R1-2503616, RAN1 assumes that UE is not able to operate LR and MR simultaneously in Rel-19. RAN1 understanding is that the terminology of LR and MR operations are for discussion purpose and will not be specified

* LR operation is the UE operation for LP-WUS monitoring
* MR operation is the UE operation for all other NR signals/channels transmissions/receptions in connected mode

Agreement

Draft Reply LS R1-2508127 to RAN2 is endorsed.

Agreement

Final LS R1-2508128 is endorsed.

Agreement

Draft LS R1-2508169 is endorsed in principle.

Agreement

Final LS R1-2508170 is endorsed

R1-2508020 Summary #2 on remaining issues of LP-WUS/LP-SS design and LP-WUS operation for connected mode Moderator (vivo)

R1-2507652 Summary #2 on maintenance for LP-WUS operation in IDLE/INACTIVE mode Moderator(OPPO)

R1-2508019 Summary #1 on remaining issues of LP-WUS/LP-SS design and LP-WUS operation for connected mode Moderator (vivo)

R1-2506825 Discussion on remaining issues of Rel-19 LP WUS ZTE Corporation, Sanechips

R1-2506876 Maintenance on Low-power wake-up signal and receiver for NR vivo

R1-2506921 Maintenance on LP-WUS/WUR Huawei, HiSilicon

R1-2506966 Remaining issues on LP-WUS operation in connected mode Xiaomi

R1-2507003 Discussion on maintenance issue on Low-power wake-up signal and receiver for NR (LP-WUS/WUR) CMCC

R1-2507098 Remaining issues on LP-WUS and LP-WUR CATT

R1-2507163 Remaining issues on LP-WUS/WUR OPPO

R1-2507232 Maintenance on Low-power wake-up signal and receiver for NR Samsung

R1-2507267 Maintenance on Low-power wake-up signal and receiver for NR Ericsson

R1-2507354 Maintenance on Low-power wake-up signal and receiver for NR LG Electronics

R1-2507457 Maintenance of LP-WUS Operation Ofinno

R1-2507528 Maintenance of LP-WUS operation Nokia

R1-2507567 Remaining issues on LP-WUS operation Sharp

R1-2507583 Maintenance on LP-WUS operation InterDigital, Inc.

R1-2507650 Maintenance on R19 LP-WUS/WUR Apple

R1-2507651 Summary #1 on maintenance for LP-WUS operation in IDLE/INACTIVE mode Moderator (Apple)

R1-2507652 Summary #2 on maintenance for LP-WUS operation in IDLE/INACTIVE mode Moderator (Apple)

R1-2507699 Maintenance on Low-power wake-up signal and receiver for NR Qualcomm Incorporated

R1-2507793 Maintenance on LP-WUS/WUR NTT DOCOMO, INC.

## Maintenance on Non-Terrestrial Networks (NTN) for NR Phase 3, Internet of Things (IoT) Phase 3, and IoT-NTN TDD mode

[122bis-R19-NTN] Email discussion on Rel-19 NTN enhancement – Mohamed (Thales)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508155** Session notes for 8.7 (Maintenance on Non-Terrestrial Networks (NTN) for NR Phase 3, Internet of Things (IoT) Phase 3, and IoT-NTN TDD mode) Ad-Hoc Chair (Huawei)

Session notes are endorsed and incorporated the session notes below.

### Maintenance for Rel-19 NR NTN

*Note: Maximum one contribution for NR\_NTN\_Ph3, and potential RAN1 impact from NR\_NTN\_Ku\_bands and NR\_IoT\_NTN\_req\_test\_enh.*

*Note: For efficient review, please use the following sections in your contribution corresponding to the maintenance issues, if any:*

* *NR\_NTN\_Ph3*
* *RAN1 impact from NR\_NTN\_Ku\_bands and NR\_IoT\_NTN\_req\_test\_enh*

R1-2506786 Maintenance for Rel-19 NR-NTN Ericsson

R1-2506799 Remaining issues on NR-NTN Spreadtrum, UNISOC

R1-2506877 Maintenance on Rel-19 NR NTN vivo

R1-2506910 Remaining issues on Rel-19 NR NTN ZTE Corporation, Sanechips

R1-2506936 Maintenance for Rel-19 NR NTN Huawei, HiSilicon

R1-2506967 Maintenance for Rel-19 NR NTN Xiaomi

R1-2507123 Maintenance for Rel-19 NR NTN CATT

R1-2507139 Maintenance for Rel-19 NR NTN OPPO

R1-2507233 Maintenance for Rel-19 NR NTN Samsung

R1-2507322 Maintenance for Rel-19 NR NTN THALES

(Withdrawn)

R1-2507533 Maintenance of uplink capacity/throughput enhancement for Rel.19 NR-NTN Ph3 Panasonic

R1-2507559 Discussion on Maintenance for Rel-19 NR NTN Nokia

R1-2507700 Maintenance for Rel-19 NR NTN Qualcomm Incorporated

R1-2507794 Maintenance of R19 NR-NTN NTT DOCOMO, INC.

**Maintenance for NR NTN (e)RedCap UEs**

**R1-2508078** Summary #1 for Support of RedCap and eRedCap UEs with NR NTN operating in FR1-NTN bands Moderator (CATT)

**Conclusion**

Rel-19 NTN doesn’t support TA report enhancement for HD-FDD (e)RedCap.

**Conclusion**

No further discussion in Rel-19 for the case of a HD-FDD (e)RedCap collision in NTN involving more than two UL transmissions or DL receptions.

**Agreement**

The TP in section 5 of R1-2508078 is endorsed for the TS38.213 alignment CR.

**Maintenance for NR NTN DL coverage enhancements**

**R1-2508065** FL Summary #1 - Maintenance on NR-NTN downlink coverage enhancements Moderator (Thales)

**Conclusion**

It is RAN1 understanding that Msg 3 PUSCH retransmission carry indication of support for *msg4-NumberofRepetitions* when initial Msg 3 PUSCH transmission carry indication of support for *msg4-NumberofRepetitions.*

* FFS: RAN1 specification impact

**R1-2508066** FL Summary #2 - Maintenance on NR-NTN downlink coverage enhancements Moderator (Thales)

**Conclusion**

It is RAN1 understanding that if Rel-19 NR NTN Msg4 PDSCH repetition is enabled, the retransmissions for PDSCH carrying Msg4 using MCS field which indicates a value larger than or equal to 29 (i.e. gNB uses the reserved states of the MCS table) may not be possible in some cases if the physical resources for retransmissions are changed compared to earlier transmissions.

R1-2508067 FL Summary #3 - Maintenance on NR-NTN downlink coverage enhancements Moderator (Thales)

**Maintenance for RAN4-led NR NTN WIs (NR\_NTN\_Ku\_bands and NR\_IoT\_NTN\_req\_test\_enh)**

R1-2508070 FL Summary #1 - Impact from RAN4-led wor Moderator (Thales)

**R1-2508071** FL Summary #2 - Impact from RAN4-led work items Moderator (Thales)

**Agreement**

The TP in section 3.1 of R1-2508071 for 38.211 is endorsed for the support of 3MHz CBW for NTN.

**Agreement**

The TP in section 3.2 of R1-2508071 for 38.213 is endorsed for the support of 3MHz CBW for NTN.

**Agreement**

The TP in section 3.3 of R1-2508071 for 38.214 is endorsed for the support of 3MHz CBW for NTN.

**Agreement**

The TP in section 3.4 of R1-2508071 for 38.212 is endorsed for the support of 3MHz CBW for NTN.

**Conclusion**

At RAN1#122bis, no RAN1 specification impact was identified to be needed for the support for Ku band for NTN in Rel-19.

R1-2508072 FL Summary #3 - Impact from RAN4-led work items Moderator (Thales)

**Maintenance for NR NTN uplink capacity/throughput enhancements and RAN1 impact of CB-Msg3-EDT**

**R1-2507989** Feature lead summary #1: NR-NTN uplink capacity and throughput enhancements Moderator (MediaTek)

**Agreement**

TP\_2\_4\_2 in section 2.4 of R1-2507989 is endorsed for TS 38.214 Clause 6.1.2.1.

**R1-2507990** Feature lead summary #2: NR-NTN uplink capacity and throughput enhancements Moderator (MediaTek)

**Agreement**

Endorse TP\_2\_1\_5 from section 2.1 of R1-2507990 for TS 38.211 Clause 6.2.

TP for UCI multiplexing:

Proposal 2.3.1: Adopt TP\_2\_3\_1 to TS 38.213 Clause 9

**Conclusion**: revisit this issue at RAN1#123.

R1-2507991 Feature lead summary #3: NR-NTN uplink capacity and throughput enhancements Moderator (MediaTek)

**LS on power ramping and RRC configuration for CB-Msg3-EDT**

**R1-2507987** Moderator summary #1: Reply LS on CB-msg3-EDT on IoT-NTN uplink capacity and throughput enhancements Moderator (MediaTek)

**Agreement**

RAN1 response on power ramping for CB-Msg3-EDT: RAN1 will discuss and update corresponding RAN1 specifications based on RAN2 agreement to support power ramping for both NB-IoT and eMTC in CB-Msg3-EDT.

**Agreement**

RAN1 response for CB-Msg3-EDT configuration: RAN1 has no concern regarding the additional TBS size configured for CB-Msg3, i.e., 144 bits, for NB-IoT and eMTC.

**Agreement**

RAN1 response for support MPDCCH narrowband configuration: From RAN1 perspective, introducing 2 MPDCCH narrowbands requires additional RAN1 standard effort. RAN1 would like to inform RAN2 that there are no concerns with supporting two MPDCCH narrowbands, but RAN2 should decide on a mechanism to ensure the UE is monitoring a unique narrowband.

**Agreement**

RAN1 response forsupport both multi-PRB allocation and sub-PRB allocation for CB-Msg3-EDT: RAN1 will discuss and update corresponding RAN1 specifications to support both multi-PRB allocation and sub-PRB allocation for eMTC CB-Msg3-EDT for eMTC and support both single tone allocation and multi tone allocation NB-IoT CB-Msg3-EDT.

**R1-2508113** Draft reply LS on power ramping and RRC configuration for CB-Msg3-EDT Moderator (MediaTek)

**Agreement**

The draft LS reply to RAN2 on power ramping and RRC configuration for CB-Msg3-EDT is endorsed in R1-2508113. Final LS is agreed in R1-2508114.

### Maintenance for Rel-19 IoT NTN

*Note: Maximum one contribution for IoT\_NTN\_Ph3 and IoT\_NTN\_TDD*

*Note. For efficient review, please use the following sections in your contribution corresponding to the maintenance issues, if any:*

* *IoT\_NTN\_Ph3*
* *IoT\_NTN\_TDD*

R1-2506878 Maintenance on Rel-19 IoT-NTN vivo

R1-2506911 Remaining issues on Rel-19 IoT NTN ZTE Corporation, Sanechips

R1-2506937 Maintenance for IoT NTN Phase 3 and TDD mode Huawei, HiSilicon

R1-2506968 Maintenance for Rel-19 IoT NTN Xiaomi

R1-2507124 Maintenance for Rel-19 IoT NTN CATT

R1-2507140 Maintenance for Rel-19 IoT NTN OPPO

R1-2507234 Maintenance for Rel-19 IoT NTN Samsung

R1-2507264 Maintenance for Rel-19 IoT NTN Ericsson

R1-2507294 Maintenance for Rel19 IoT-NTN Nokia, Nokia Shanghai Bell

R1-2507312 TP for HARQ feedback resource of CB-Msg4 NEC

R1-2507701 Maintenance for Rel-19 IOT NTN Qualcomm Incorporated

**Maintenance for IoT NTN uplink capacity/throughput enhancement**

**R1-2508044** FL Summary #1 for Rel-19 IoT-NTN maintenance Moderator (Sony)

**Conclusion**

Specification changes for handling UL gaps for synchronisation (from Rel-13) are not supported in Rel-19.

**Conclusion**

OCC for multi-tone transmissions of NPUSCH format 1 is not supported in Rel-19.

**Agreement**

Endorse TP#1\_CB4 in section 5 of R1-2508044 for Clause 16.4.2 and 10.1.2.1 of TS36.213.

**Agreement**

Endorse TP#2\_CB4 in section 5 of R1-2508044 for NB-IoT Clause 6.4.3.2 of TS36.212

**Agreement**

Endorse TP#3\_CB4 in section 5 of R1-2508044 for eMTC Clause 5.3.3.1.12 of TS36.212

**R1-2508100** FL Summary #2 for Rel-19 IoT-NTN maintenance Moderator (Sony)

**R1-2508125** FL Summary #3 for Rel-19 IoT-NTN maintenance Moderator (Sony)

Possible Agreement

The TP in [FL5] Proposal 4\_8\_2v6 in section 8 of R1-2508125 is endorsed.

**Conclusion**: this issue is postponed to RAN1#123.

**Maintenance for IoT NTN TDD mode**

**R1-2507993** Feature lead summary #1 for IoT NTN TDD mode Moderator (Qualcomm)

**Agreement**

The following TP is endorsed

|  |  |
| --- | --- |
| ***Spec*** | TS36.213 |
| ***Reason for change:*** | For description on *n0*, the indentation of ‘*n0* is the first NB-IoT UL slot starting after the end of subframe *n+k0+K*offset for FDD or IoT NTN TDD’ is incorrect. It should be under the otherwise branch. Also, the main bullet “For FDD” should also include “IoT NTN TDD”. |
| ***Summary of change:*** | Increase the indentation of ‘*n0* is the first NB-IoT UL slot starting after the end of subframe *n+k0+K*offset for FDD or IoT NTN TDD’ |
| ***Consequences if not approved:*** | How to determine *n0* is not clear |
| ***Clauses affected:*** | 16.5.1 |
| 16.5.1 UE procedure for transmitting format 1 narrowband physical uplink shared channel NPUSCH format 1 transmission can be scheduled by a NPDCCH with DCI format N0, or the transmission can correspond to using preconfigured uplink resource configured by higher layers. Transmission using preconfigured uplink resource is initiated by higher layers as specified in [14] , while retransmission of transport blocks transmitted using preconfigured uplink resource are scheduled by a NPDCCH with DCI format N0.  A UE shall upon detection on a given serving cell of a NPDCCH with DCI format N0 ending in NB-IoT DL subframe *n* scheduling NPUSCH intended for the UE, perform, at the end of  *- n+k0+K*offset DL subframe for FDD or IoT NTN TDD,  *- k0* NB-IoT UL subframes following the end of *n+*8 subframefor TN TDD,  a corresponding NPUSCH transmission using NPUSCH format 1 in *N* consecutive NB-IoT UL slots *ni* with *i = 0, 1, …, N-1* according to the NPDCCH information where  - subframe *n* is the last subframe in which the NPDCCH is transmitted and is determined from the starting subframe of NPDCCH transmission and the DCI subframe repetition number field in the corresponding DCI; and  - , where the value of  is determined as specified in Clause 16.5.1.1, the value of is determined by the resource assignment field in the corresponding DCI (see Clause 16.5.1.1), the value of  is the number of NB-IoT UL slots of the resource unit (defined in clause 10.1.2.3 of [3]) corresponding to the  allocated number of subcarriers (as determined in Clause 16.5.1.1) in the corresponding DCI, and the value of is determined by the Number of scheduled TB for Unicast field, if present, in the corresponding DCI,  otherwise  - for FDD or IoT NTN TDD,  - if NPUSCH transmission with subcarrier spacing and the UE configured with higher layer parameter *npusch-OCC-Enabled* and and OCC enabled in the corresponding DCI,  - *n0* is the first NB-IoT UL slot, , starting after the end of subframe *n+k0+K*offset that fulfills  - otherwise,  - *n0* is the first NB-IoT UL slot starting after the end of subframe *n+k0+K*offset  - for TN TDD, *n0* is the first NB-IoT UL slot starting after *k0* NB-IoT UL subframes following the end of *n*+8 subframe  ==omitted== | |

**Agreement**

Update the RAN1#122 agreement as follows:

Agreement

The set of D/U-subframes in a non-anchor carrier is the same as the set of D/U-subframes in the anchor carrier, and are time-aligned.

~~FFS: specification impact, if any.~~ No specification impact

**Agreement**

Endorse the TP below

**TP1 (36.211)**

10.2.6 Narrowband reference signal (NRS)

Before a UE obtains *operationModeInfo*:

- If frame structure type 1 is used in FDD, the UE may assume narrowband reference signals (NRSs) are transmitted in subframes #0 and #4 and in subframes #9 not containing NSSS.

- If frame structure type 2 is used, the UE may assume narrowband reference signals (NRSs) are transmitted in subframes #9 and in subframes #0 not containing NSSS.

- If frame structure type 1 is used in IoT NTN TDD, the UE may assume narrowband reference signals (NRSs) are transmitted in subframes #0, #3, #4, #6, #7, #8 and in subframes #9 not containing NSSS within the *D* consecutive downlink subframes according to the TDD pattern.

On an NB-IoT carrier for which a UE receives higher-layer parameter *operationModeInfo* indicating *guardband* or *standalone.*

- If frame structure type 1 is used in FDD, before the UE obtains *SystemInformationBlockType1-NB*, the UE may assume narrowband reference signals are transmitted in subframes #0, #1, #3, #4 and in subframes #9 not containing NSSS.

- If frame structure type 2 is used, before the UE obtains *SystemInformationBlockType1-NB*, the UE may assume narrowband reference signals are transmitted in subframes #9, and in subframes #0 not containing NSSS, and in subframes #4 if subframes #4 is configured for *SystemInformationBlockType1-NB* transmissions.

- If frame structure type 1 is used, after the UE obtains *SystemInformationBlockType1-NB*, the UE may assume narrowband reference signals are transmitted in subframes #0, #1, #3, #4, subframes #9 not containing NSSS, and in NB-IoT downlink subframes.

- If frame structure type 2 is used, after the UE obtains *SystemInformationBlockType1-NB*, the UE may assume narrowband reference signals are transmitted in subframes #9, subframes #0 not containing NSSS, in subframes #4 if subframes #4 is configured for *SystemInformationBlockType1-NB* transmissions, and in NB-IoT downlink subframes.

- If frame structure type 1 is used in IoT NTN TDD, the UE may assume narrowband reference signals (NRSs) are transmitted in subframes #0, #3, #4, #6, #7, #8 and in subframes #9 not containing NSSS within the *D* consecutive downlink subframes according to the TDD pattern.

**<Unchanged parts omitted>**

**R1-2508112** Feature lead summary #2 for IoT NTN TDD mode Moderator (Qualcomm)

Proposal 3 Alt1

To alleviate the issue that only 1-out-of-4 legacy scheduling delays is suitable for scheduling NPUSCH Format 1, NB-IoT TDD NTN uses scheduling delays 2, 3, 4, and 7 together with counting only unmuted subframes.

Proposal 3 Alt2 (Conclusion)

RAN1 does not specify further enhancements for NPUSCH format 1 scheduling delays in Rel-19 IoT NTN TDD mode.

**Conclusion**: this issue is postponed to RAN1#123.

**LS Reply on precompensation for NB-IoT NTN TDD mode**

**Agreement**

Reply to RAN4 LS in R1-2506731 is endorsed as follows:

|  |
| --- |
| RAN1 has reached the following agreement on segmented precompensation at RAN1#121, related to the working assumption on the previous RAN1 LS:  **Agreement**  Confirm the following working assumption with modifications:  For precompensation, from RAN1 perspective:   * The UE may adjust its time/frequency pre-compensation before the beginning of each set of consecutive 8 uplink subframes. No pre-compensation gap is needed before the beginning of each set of consecutive 8 uplink subframes. * The UE may adjust its time/frequency pre-compensation at the beginning of an NPUSCH/NPRACH transmission (same behavior as Rel-18)   + Segmented precompensation is not supported.   + It is not supported to perform precompensation within the set of 8 consecutive uplink subframes other than at the beginning of an NPUSCH/NPRACH transmission * FFS: whether spec impact is in RAN1, RAN4 or both.   NOTE: RAN1 may revisit this agreement if RAN4 reply LS shows concerns, including concerns on meeting the requirements without segmented precompensation  The RAN4 CR may not be aligned with the latest RAN1 agreement. RAN1 would like to ask RAN4 if they have concerns on the updated agreement, and:   * If RAN4 has concerns on the RAN1 agreement, RAN1 will modify its specifications to introduce segmented precompensation within the set of 8 consecutive uplink subframes. * If RAN4 has no concerns on the RAN1 agreement, we recommend RAN4 to update their specifications to clarify that segmented precompensation is not supported in IoT NTN TDD mode. |

**R1-2508063** [DRAFT] Reply LS on precompensation for NB-IoT NTN TDD mode RAN1, Moderator (Qualcomm Incorporated)

R1-2508064 Reply LS on precompensation for NB-IoT NTN TDD mode RAN1, Moderator (Qualcomm Incorporated)

**Agreement**

The draft LS reply to RAN4 in R1-2508063 is endorsed. The final LS is agreed R1-2508064.

**LS on OCC for IoT-NTN TDD mode**

**R1-2508005** Summary#1 on OCC for IoT-NTN TDD mode Huawei, HiSilicon

R1-2508006 Draft Reply LS on OCC for IoT-NTN TDD mode Huawei, HiSilicon

**Conclusion**

For 3.75 kHz SCS and 15 kHz SCS NPUSCH Format 1, single-tone, OCC operation in NB-IoT NTN TDD cannot be supported without RAN1 specifications change.

The amount of specification change is larger for 3.75 kHz than for 15 kHz SCS.

**Agreement**

The following response in the reply LS to RAN2 on OCC for IoT-NTN TDD mode is agreed:

**Reply to RAN2:** From RAN1’s perspective, introducing OCC for NB-IoT NTN TDD mode requires RAN1 specifications change. Therefore, RAN1 cannot confirm RAN2’s assumption “that OCC defined for NB-IoT NTN Rel-19 can be supported for NB-IoT NTN TDD mode without any RAN1 spec impact”.

**R1-2508109** Draft Reply LS on OCC for IoT-NTN TDD mode Huawei, HiSilicon

**Agreement**

The draft LS reply to RAN2 on OCC for IoT-NTN TDD mode is endorsed in R1-2508109. Final LS is agreed in R1-2508110.

## Maintenance on others

*Note: Including MCE Phase 3, LB-CA, 7-24GHz for NR, ISAC, Mobility Phase 4, XR Phase 3, LTE-based 5G broadcast Phase 2 and endorsed R19 TEI proposals.*

***Note: For more efficient review, please use/fill the WI code field when requesting tdoc numbers according to the proposals for individual items, if any. Maximum one contribution per WI code.***

[122bis-R19-Others] To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc – Chair

**Maintenance issues on LTM, MCE&LB-CA, 7-24GHz and R19 TEI will be discussed in RAN1 main session (chaired by Xiaodong).**

**R1-2508156** Session notes for 8.8 (Maintenance on channel modelling for ISAC and LTE broadcast) Ad-Hoc Chair (Huawei)

Session notes are endorsed and incorporated the session notes below.

**R19 LTM**

Agreement

Adopt the following TP to TS38.214 Section 5.2.1.2 in principle.

|  |
| --- |
| 5.2.1.2 Resource settings <unchanged parts are omitted>  Each LTM CSI Resource Setting *LTM-CSI-ResourceConfig* contains either configuration of a *ltm-CSI-SSB-ResourceSet* or a *ltm-NZP-CSI-RS-ResourceSet*.  - A *ltm-CSI-SSB-ResourceSet* comprises of a list of Z ≥ 1 SS/PBCH blocks indices (given by *ltm-CSI-SSB-ResourceList*) and a list of Z *LTM-CandidateIds* (given by *ltm-CandidateIdList*) referring to candidate cells associated with the SS/PBCH block indices. For each candidate cell, the UE determines the time domain behavior of a SS/PBCH block from *ssb-Periodicity* and *ssb-PositionsInBurst* and the frequency domain behavior of a SS/PBCH block is determined by the higher layer parameters *subcarrierSpacing*, *ssb-Frequency*.  - A *ltm-NZP-CSI-RS-ResourceSet* comprises of a list of Z ≥ 1 NZP CSI-RS resource indices (given by *ltm- CSI-RS-ResourceList*) and a list of Z *LTM-CandidateIds* (given by *ltm-CandidateIdList*) referring to candidate cells associated with the NZP CSI-RS resource indices. The UE shall expect that ~~the NZP CSI-RS resources in~~ *ltm-NZP-CSI-RS-ResourceSet* are configured with the higher layer parameter *repetition* set to *‘*off*’* when *LTM-ReportContent* configured within the *LTM-CSI-ReportConfig* associated with the LTM CSI Resource Setting is set to ‘*cri-RSRP*’.  For a report setting *ltm-CSI-ReportConfig* configured with *ltm-ReportConfigType* set to ‘periodic’ or ‘semiPersistentOnPUCCH’ or ‘semiPersistentOnPUSCH’ or ‘aperiodic’, the time domain behavior of the NZP CSI-RS resources within a *ltm-NZP-CSI-RS-ResourceSet* are indicated by the higher layer parameter *resourceType*.  <unchanged parts are omitted> |

Agreement

Adopt the following TP to TS38.214 Section 5.2.1.5.2 in principle

<omitted text>

**5.2.1.5.2 Semi-persistent CSI/Semi-persistent CSI-RS**

…

For semi-persistent reporting on PUCCH, the PUCCH resource used for transmitting the CSI report are configured by *reportConfigType* or *ltm-ReportConfigType*. Semi-persistent reporting on PUCCH is activated by an activation command as described in clause 6.1.3.16 of [10, TS 38.321], which selects one of the semi-persistent reporting settings for use by the UE on the PUCCH. For a selected reporting setting for which the *CSI-ReportConfig* contains a list of sub-configurations provided by the higher layer parameter *csi-ReportSubConfigToAddModList*, the activation command can also select one or more sub-configurations to use by the UE as described in clause 6.1.3.X of [10, TS 38.321]. When the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command, the indicated semi-persistent Reporting Setting should be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH.

…

<omitted text>

Agreement

Adopt the following to TS38.213 Section 4.2 in principle.

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| **4.2 Transmission timing adjustments**  < Unchanged parts are omitted >  A timing advance command [11, TS 38.321] in case of random access response or in an absolute timing advance command MAC CE or in a cell switch command or in LTM Candidate Timing Advance Command MAC CE, , for a TAG indicates values by index values of = 0, 1, 2, ..., 3846, where an amount of the time alignment for the TAG with SCS of kHz is . is defined in [4, TS 38.211] and is relative to the SCS of the first uplink transmission from the UE after the reception of the random access response or absolute timing advance command MAC CE or the cell switch command or the first uplink transmission from UE after RACH-less CLTM cell switch is performed.  ……  For a timing advance command received on uplink slot , except for a timing advance command received in a cell switch command or LTM Candidate Timing Advance Command MAC CE, and for a transmission other than a PUSCH scheduled by a RAR UL grant or a fallbackRAR UL grant as described in clause 8.2A or 8.3, or a PUCCH with HARQ-ACK information in response to a successRAR as described in clause 8.2A, the corresponding adjustment of the uplink transmission timing applies from the beginning of uplink slot where , is a time duration in msec of symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured, is a time duration in msec of symbols corresponding to a PUSCH preparation time for UE processing capability 1 [6, TS 38.214], is the maximum timing advance value in msec that can be provided by a TA command field of 12 bits, is the number of slots per subframe, is the subframe duration of 1 msec, and , where is provided by *cellSpecificKoffset* and is provided by a Differential Koffset MAC CE command [11, TS 38.321]; otherwise, if not respectively provided, or . and are determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG and of all configured DL BWPs for the corresponding downlink carriers. For , the UE assumes [6, TS 38.214]. Slot and are determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG. is determined with respect to the minimum SCS among the SCSs of all configured UL BWPs for all uplink carriers in the TAG and for all configured initial UL BWPs provided by *initialUplinkBWP*. The uplink slot is the last slot among uplink slot(s) overlapping with the slot(s) of PDSCH reception assuming , where the PDSCH provides the timing advance command and is defined in [4, TS 38.211].  < Unchanged parts are omitted > 21 L1/L2-triggered mobility procedures < Unchanged parts are omitted >  …..  If *ltm-UE-MeasuredTA-ID* of a candidate cell and *ltm-ServingCellUE-MeasuredTA-ID* of the serving cell are provided to a UE and have same value, the UE estimates based on the UE implementation a timing advance to apply from a first transmission on the candidate cell that is after the reception of a cell switch command for the candidate cell when the condition defined in clause 5.18.35 of [11, TS 38.321] is satisfied or to apply from a first transmission on the CLTM target cell when the condition defined in clause 5.y.3 of [11, TS 38.321] is satisfied.  < Unchanged parts are omitted > |

Agreement

* For the purpose of deriving the CQI for target candidate cell, the UE shall assume the following:
  + The parameters are derived from the initial BWP configuration of the target cell.

Agreement

* In case PUSCH repetition Type-B or Type-A is applied for first CG-PUSCH or DG-PUSCH, reuse the legacy rule for CSI multiplexing and CSI for target candidate cell is transmitted on the first actual repetition for Type-B or the first repetition for Type-A.

Conclusion

Confirm the following UE behavior as RAN1 common understanding:

* After UE receives the LTM CSC MAC CE, a capable UE can still measure P-CSI-RS and SP CSI-RS resources activated before the LTM CSC MAC-CE, even if these CSI-RS resources are not counted/defined as “active”.

Agreement

Adopt the following TP#7-1 to TS38.214 Section 5.2.4a.

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| **5.2.4a CSI Reporting for LTM**  <omitted Text>  For RACH-less LTM cell switch [23, TS 38.300], the UE shall transmit the CSI report to the candidate cell using the first PUSCH corresponding to a dynamic grant or a configured grant [6, TS 38.213].  For RACH-based LTM cell switch using a contention-free random access procedure [23, TS 38.300], the UE shall transmit the CSI report to the candidate cell using the PUSCH scheduled by the RAR UL grant or MsgA PUSCH.  For RACH-based LTM cell switch using a contention-based random access procedure [23, TS 38.300], the UE shall transmit the CSI report to the candidate cell using the first PUSCH corresponding to a dynamic grant or a configured grant after the HARQ-ACK transmission corresponding to ~~Msg4 or~~ MsgB, or the first PUSCH scheduled by a PDCCH transmission addressed to the C-RNTI, received in response to Msg3.  <omitted Text> |

Agreement

* After RACH-based CLTM is performed, all activated candidate TCI states are deactivated.

Agreement

For C-LTM, after the LTM cell switch is triggered,

* For RACH-less LTM, the UE determines an indicated TCI state in CandidateTCI-State or CandidateTCI-UL-State whose QCL RS has the same value as the RS signaled from higher layer to lower layer that meets the C-LTM execution condition.
* Upon RACH-less CLTM procedure being triggered, activated Candidate TCI state(s), other than the indicated TCI state, should be deactivated.

Agreement

* Draft LS R1-2507925 is endorsed in principle.
* Adopt the following TP for TS38.214 Section 5.2.4a and TS 38.212, section 6.3.1.2.1
* Note: No dedicated issue to support early CSI acquisition for L3 handover to be discussed in RAN1 before RAN#111.

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| **1. Overall Description**  RAN1 thanks RAN2 for the LS R1-2506717 (R2-2506504) on early CSI acquisition for L3 handover.  From RAN1 perspective, there is no problem to support early CSI acquisition for L3 by re-using the early CSI acquisition framework for LTM.  On the configuration of channel measurement and interference measurement resources in RAN2 RRC CR (R2-2506450), RAN1 suggest to directly use NZP CSI RS resource set and CSI-IM resource set and suggest the following changes on *EarlyCSI-Acquisition-r19*.  EarlyCSI-Acquisition-r19 ::= SEQUENCE {  early-NZP-CSI-RS-ResourceSet-r19 NZP-CSI-RS-ResourceSetId,  early-CSI-IM-ResourceSet-r19 CSI-IM-ResourceSetId OPTIONAL, -- Need R  reportQuantity-r19 ENUMERATED {cri-RI-PMI-CQI, spare},  cqi-Table-r19 ENUMERATED {table1, table2, table3, table4-r17},  codebookConfig-EarlyCSI-r19 CodeBookConfig-EarlyCSI-r19  }  **2. Actions**  **To RAN2**  **ACTION:** RAN1 respectfully asks RAN2 to take the above information into account. |

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| 5.2.4a CSI Reporting for LTM and handover A UE configured with *LTM-Config* can be provided configurations for CSI acquisition, by up to one Reporting Setting, *ltm-CSI-ReportConfig*, for a candidate cell. A UE can be provided configuration for CSI acquisition, by one Reporting Setting, *earlyCSI-Acquisition* in *ReconfigurationWithSync,* for a target cell. Each Reporting Setting *ltm-CSI-ReportConfig* or *earlyCSI-Acquisition* is associated with either one or two Resource Settings   * When one Resource Setting (given by higher layer parameter *ltm-ResourcesForChannelMeasurement* or *early-NZP-CSI-RS-ResourceSet*) is configured, it provides a list of NZP CSI-RS resources for both channel and interference measurements. The UE is not expected to be configured with more than 128 NZP CSI-RS ports in the CSI-RS resource set contained within the Resource Setting. * When two Resource Settings are configured, the first Resource Setting (given by higher layer parameter *ltm-ResourcesForChannelMeasurement* or *early-NZP-CSI-RS-ResourceSet*) provides a list of NZP CSI-RS resources for channel measurement, and the second Resource Setting (given by higher layer parameter *ltm-ResourceForInterferenceMeasurements* or *early-CSI-IM-ResourceSet*), provides a list of [CSI-IM resources] for interference measurement. The UE is not expected to be configured with more than 128 NZP CSI-RS ports in the CSI-RS resource set contained within the Resource Setting.   The Resource Setting given by higher layer parameter *ltm-ResourcesForChannelMeasurement*, *LTM-CSI-ResourceConfig*,contains configuration of a *ltm-NZP-CSI-RS-ResourceSet* which comprises of a list of Z ≥ 1 NZP CSI-RS resource indices (given by *ltm-CSI-RS-ResourceList*) and a list of Z *LTM-CandidateIds* (given by *ltm-CandidateIdList*) referring to candidate cells associated with the NZP CSI-RS resource indices. For CSI acquisition associated with a Reporting Setting, *ltm-CSI-ReportConfig*, the UE is expected to measure the NZP-CSI-RS resources in *ltm-CSI-RS-ResourceList* associated with the *LTM-CandidateId* that is equal to the *LTM-CandidateId* of the *LTM-Candidate* under which the Reporting Setting is configured.  The UE shall expect the following configuration provided by *ltm-CSI-ReportConfig* or *earlyCSI-Acquisition*:  - For the frequency granularity of the CSI report, the CQI format indicator is Wideband CQI.  - For the frequency granularity of the CSI report, the PMI format indicator is Wideband PMI.  - The codebook type is *typeI-SinglePanel.*  - The *reportQuantity* is set to ‘cri-RI-PMI-CQI’.  After a UE receives an LTM Cell Switch Command MAC CE [10, TS 38.321] providing a candidate cell (given by Target Configuration ID field), and a *ltm-CSI-ReportConfig* is configured for the candidate cell, the UE can measure corresponding NZP CSI-RS resources and CSI-IM resources if configured, and shall transmit a CSI report to the candidate cell.  After a UE receives an *ReconfigurationWithSync* configured with *earlyCSI-Acquisition*, the UE can measure corresponding NZP CSI-RS resources and CSI-IM resources if configured, and shall transmit a CSI report to the target cell.  For RACH-less LTM cell switch or RACH-less handover [23, TS 38.300], the UE shall transmit the CSI report to the candidate cell using the first PUSCH corresponding to a dynamic grant or a configured grant [6, TS 38.213].  For RACH-based LTM cell switch or RACH-based handover using a contention-free random access procedure [23, TS 38.300], the UE shall transmit the CSI report to the candidate cell using the PUSCH scheduled by the RAR UL grant or MsgA PUSCH.  For RACH-based LTM cell switch or RACH-based handover using a contention-based random access procedure [23, TS 38.300], the UE shall transmit the CSI report to the candidate cell using the first PUSCH corresponding to a dynamic grant or a configured grant after the HARQ-ACK transmission corresponding to Msg4 or MsgB.  If a valid CSI is not available, the UE shall transmit a CSI report which contains a CQI corresponding to the lowest CQI index. Depending on the UE capability, the UE may measure NZP CSI-RS resources and CSI-IM resources if configured corresponding to a *ltm-CSI-ReportConfig* before receiving the LTM Cell Switch Command MAC CE [10, TS 38.321]. |
| 6.3.2.1.2 CSI If *cqi-BitsPerSubband* is configured, this Clause 6.3.2.1.2 applies by taking Subband CQI as Subband differential CQI and replacing the corresponding number of bits 2 by 4.  <Unchanged part omitted>  The mapping order of CSI fields of one report for CSI reporting for L1/L2‑triggered mobility and handover as defined in Clause 5.2.4a of [6, TS 38.214] is provided in Table 6.3.1.1.2-7 by taking only Tables 6.3.1.1.2-1/3 for the determination of the bitwidth of a CSI field. The mapping order of CSI fields of one report for CRI/RSRP or SSBRI/RSRP or CRI/RSRP/CapabilityIndex or SSBRI/RSRP/CapabilityIndex reporting is provided in Table 6.3.1.1.2-8. The mapping order of CSI fields of one report for inter-cell SSBRI/RSRP reporting is provided in Table 6.3.1.1.2-8. The mapping order of CSI fields of one report for CRI/SINR or SSBRI/SINR or CRI/SINR/CapabilityIndex or SSBRI/SINR/CapabilityIndex reporting is provided in Table 6.3.1.1.2-8A. The mapping order of CSI fields of one report for group-based CRI/RSRP or SSBRI/RSRP reporting is provided in Table 6.3.1.1.2-8B. The mapping order of CSI fields of one report for SSBRI/RSRP or CRI/RSRP reporting for L1/L2‑triggered mobility is provided in Table 6.3.1.1.2-8C. The mapping order of CSI fields of one report for MRI/CLI-RSSI is provided in Table 6.3.1.1.2-8D. The mapping order of CSI fields of one report for predicted CRI/RSRP or predicted SSBRI/RSRP reporting is provided in Table 6.3.1.1.2-8E. The mapping order of CSI fields of one report for time instance indicator/predicted CRI/predicted RSRP or time instance indicator/predicted SSBRI/predicted RSRP reporting is provided in Table 6.3.1.1.2-8F. The mapping order of CSI fields of one report for CRI/RSRP or SSBRI/RSRP if *nrofReportedRS* is configured is provided in Table 6.3.1.1.2-8G. The mapping order of CSI fields of one report for RS-PAI is provided in Table 6.3.1.1.2-8H. The procedure in clause 6.3.2 described for CSI part 1 is also applicable for one report for CRI/RSRP, SSBRI/RSRP, predicted CRI/RSRP, predicted SSBRI/RSRP, time instance indicator/predicted CRI/predicted RSRP, time instance indicator/predicted SSBRI/predicted RSRP, RS-PAI, CRI/SINR, SSBRI/SINR, MRI/SRS-RSRP, MRI/CLI-RSSI reporting, CSI reporting for L1/L2‑triggered mobility, CSI reporting for handover, TDCP reporting, delay offset reporting, frequency offset reporting, both delay offset and frequency offset reporting, and phase offset reporting.  <Unchanged part omitted> |

Agreement

Final LS R1-250xxxx is endorsed.

**R1-2507657**

R1-2507656 FL Summary #1 of NR Mobility enhancement Phase 4 Moderator (Apple)

R1-2507657 FL Summary #2 of NR Mobility enhancement Phase 4 Moderator (Apple)

R1-2506800 Remaining issues on measurements related enhancements for LTM Spreadtrum, UNISOC

R1-2506880 Maintenance on NR Mobility Enhancement Phase 4 vivo

R1-2506942 Measurements related enhancements for LTM Huawei, HiSilicon

R1-2507037 Maintenance on Mobility Phase 4 ZTE Corporation, Sanechips

R1-2507068 Maintenance on measurement related enhancements for LTM Nokia

R1-2507655 Maintenance on NR mobility enhancements Phase 4 Apple

R1-2507125 Maintenance on measurements related enhancements for LTM CATT

R1-2507235 Maintenance on other Rel-19 topics Samsung

R1-2507355 Remaining issues on measurements related enhancements for LTM LG Electronics

R1-2507437 Maintenance on the measurements for LTM Lenovo

R1-2507459 Maintenance on mobility enhancement phase 4 Ofinno

R1-2507474 Maintenance on NR mobility enhancements Phase 4 Ericsson

R1-2507578 Maintenance on Mobility Phase 4 Google

R1-2507873 Maintenance on measurements related enhancements for LTM Sharp

**R19 MCE and LB-CA**

Agreement

* Following TP to Section 6.1.2.1, TS38.214 is endorsed in principle.

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| 6.1.2 Resource allocation  6.1.2.1 Resource allocation in time domain  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  For *pusch-TimeDomainAllocationListForMultiPUSCH* and *pusch-TimeDomainAllocationListForMultiPUSCH***-***DCI-0-3* in *pusch-Config*, if a row indicates resource allocation for two to eight contiguous PUSCHs and *extendedK2* is not configured, *K2* given by *k2-r16* indicates the slot where UE shall transmit the first PUSCH of the multiple PUSCHs. Each PUSCH has a separate SLIV and mapping type. The number of scheduled PUSCHs is signalled by the number of indicated valid SLIVs in the row of the *pusch-TimeDomainAllocationListForMultiPUSCH* signalled in DCI format 0\_1 or in the row of the *pusch-TimeDomainAllocationListForMultiPUSCH-DCI-0-3* signalled in DCI format 0\_3.  For *pusch-TimeDomainAllocationListForMultiPUSCH* and *pusch-TimeDomainAllocationListForMultiPUSCH***-***DCI-0-3* in *pusch-Config,* if a row indicates resource allocation of more than one PUSCH and *extendedK2* is configured, each PUSCH has a separate SLIV, mapping type and *K2* given by *extendedK2*. If a row indicates resource allocation of a single PUSCH, the PUSCH has a single SLIV, mapping type, and *K2*, where *K2* is given by *extendedK2*, if configured, otherwise *K2* is given by *k2-r16*. The number of scheduled PUSCHs is signalled by the number of indicated SLIVs in the row of the *pusch-TimeDomainAllocationListForMultiPUSCH* signalled in DCI format 0\_1 or in the row of the *pusch-TimeDomainAllocationListForMultiPUSCH-DCI-0-3* signalled in DCI format 0\_3.  If a UE is configured with *extendedK2* in *pusch-TimeDomainAllocationListForMultiPUSCH* in which one or more rows contain multiple *SLIV*s for PUSCH on a UL BWP of a serving cell, and the UE is indicated re-transmission of PUSCH by DCI format 0\_1, where the PUSCH is correspond to a configured grant Type 1 or Type 2, the UE does not expect that the number of indicated *SLIV*s in the row of the *pusch-TimeDomainAllocationListForMultiPUSCH* by the DCI is more than one.  If a UE is configured with *pusch-TimeDomainAllocationListForMultiPUSCH* or *pusch-TimeDomainAllocationListForMultiPUSCH***-***DCI-0-3* in which one or more rows contain multiple *SLIV*s for PUSCH on a UL BWP of a serving cell, the UE does not expect to be scheduled with one or multiple PUSCH transmissions by a single DCI format 0\_1 or 0\_3, where each PUSCH transmission overlaps with a DL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, or a symbol of an SS/PBCH block with index provided by *ssb-PositionsInBurst*.  If a UE is configured with *pusch-TimeDomainAllocationListForMultiPUSCH* in which one or more rows contain multiple SLIVs for PUSCH on a UL BWP of a serving cell within a PUCCH group, the UE does not expect to be configured with higher layer parameter *pusch-TimeDomainAllocationListForMultiPUSCH-DCI-0-3* on any serving cell within the PUCCH group.  When the UE is configured with *minimumSchedulingOffsetK2* in an active UL BWP it applies a minimum scheduling offset restriction indicated by the '*Minimum applicable scheduling offset indicator*' field in DCI format 0\_1, 0\_3, 1\_1 or 1\_3 if the same field is available. When the UE is configured with *minimumSchedulingOffsetK2* in an active UL BWP and it has not received '*Minimum applicable scheduling offset indicator*' field in DCI format 0\_1, 0\_3, 1\_1 or 1\_3, the UE shall apply a minimum scheduling offset restriction indicated based on '*Minimum applicable scheduling offset indicator*' value '0'. When the minimum scheduling offset restriction is applied the UE is not expected to be scheduled with a DCI in slot *n* to transmit a PUSCH scheduled with C-RNTI, CS-RNTI, MCS-C-RNTI or SP-CSI-RNTI with *K*2 smaller than, where *K*2min and are the applied minimum scheduling offset restriction and the numerology of the active UL BWP of the scheduled cell when receiving the DCI in slot *n*, respectively, and is the numerology of the new active UL BWP in case of active UL BWP change in the scheduled cell and is equal to , otherwise. The minimum scheduling offset restriction is not applied when PUSCH transmission is scheduled by RAR UL grant or fallbackRAR UL grant for RACH procedure, or when PUSCH is scheduled with TC-RNTI. The application delay of the change of the minimum scheduling offset restriction is determined in Clause 5.3.1.  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*<Unchanged parts are omitted>\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

Agreement

* Following TP to Section 9.1.3.1, TS38.213 is endorsed in principle.

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| 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel  <Unchanged parts are omitted>  If a UE is provided *pdsch-TimeDomainAllocationListForMultiPDSCH-DCI-1-3* for a serving cell in a set of serving cells provided by *MC-DCI-SetofCells* in a PUCCH group, the UE determines the according to the previous pseudo-codes with the following modifications  - the first HARQ-ACK sub-codebook is associated with  - unicast SPS PDSCH receptions  - any unicast DCI format scheduling a single PDSCH reception on a serving cell  - any unicast DCI format having associated HARQ-ACK information without scheduling a PDSCH reception  - any DCI format 1\_3 scheduling more than one PDSCH receptions on a serving cell for which the UE is provided *nrofHARQ-BundlingGroups* with value  - the second HARQ-ACK sub-codebook is associated with DCI format 1\_3 that  - schedules PDSCH receptions on more than one serving cells from the set of serving cells, or  - schedules more than one PDSCH receptions on a serving cell , from the set of serving cells, for which the UE is not provided *nrofHARQ-BundlingGroups* or is provided *nrofHARQ-BundlingGroups* with value , or  - does not include a SCell dormancy indication field or the SCell dormancy indication field is reserved, indicates SCell dormancy, and schedules PDSCH receptions on one or more serving cells from the set of serving cells  - in the above, and for the purpose of providing HARQ-ACK information corresponding to SCell dormancy indication by the DCI format 1\_3  - the UE assumes that the UE receives one PDSCH, with first SLIV in the row of *pdsch-TimeDomainAllocationListForMultiPDSCH-DCI-1-3* for DCI format 1\_3, on the serving cell associated with fields in DCI format 1\_3 for SCell dormancy indication, as described in Clause 10.3, and that the PDSCH provides one transport block that the UE correctly decodes, if the UE is not provided *nrofHARQ-BundlingGroups* for the serving cell  - the UE assumes that the UE receives one or more PDSCHs associated with a TBG with smallest index, or a PDSCH reception group with smallest index, among one or more PDSCH receptions scheduled by the DCI format 1\_3, on the serving cell associated with fields in DCI format 1\_3 for SCell dormancy indication, as described in Clause 10.3, and that each of the one or more PDSCHs provides one transport block that the UE correctly decodes if the UE is provided *nrofHARQ-BundlingGroups* for the serving cell  - the UE assumes incorrect decoding for transport blocks in each of the remaining PDSCH receptions scheduled by the DCI format 1\_3 on the serving cell associated with fields in DCI format 1\_3 for SCell dormancy indication  - instead of generating HARQ-ACK information bits when *harq-ACK-SpatialBundlingPUCCH* is not provided, or generating HARQ-ACK information bits when *harq-ACK-SpatialBundlingPUCCH* is provided, for the PDSCH receptions scheduled by a DCI format 1\_3, the UE generates  - HARQ-ACK information bits for the PDSCH receptions scheduled by the DCI format 1\_3, where is the maximum number, over the number sets of serving cells provided by *MC-DCI-SetofCells* in the PUCCH group, of the sum of  - if *nrofHARQ-BundlingGroups* is not provided for a serving cell , or  - if *nrofHARQ-BundlingGroups* is provided for the serving cell ,  across serving cells of a respective set of serving cells *MC-DCI-SetofCells* that can be scheduled PDSCH reception by a DCI format 1\_3,  where  - is the value of *maxNrofCodeWordsScheduledByDCI* for serving cell if *harq-ACK-SpatialBundlingPUCCH* is not provided; else, ;  - is the maximum number of SLIVs over all rows of the TDRA table provided by *pdsch-TimeDomainAllocationListForMultiPDSCH-DCI-1-3* for serving cell ; and  - is provided by *nrofHARQ-BundlingGroups* for serving cell  - If the UE is provided with *pdsch-TimeDomainAllocationListForMultiPDSCH-DCI-1-3* for the serving cell in the set s, by applying the above procedure, the UE generates  - HARQ-ACK information bits if *nrofHARQ-BundlingGroups* is not provided for a serving cell  - HARQ-ACK information bits if *nrofHARQ-BundlingGroups* is provided for the serving cell  - where the UE assumes incorrect decoding for transport blocks in each of the PDSCH receptions scheduled by the DCI format 1\_3 on the serving cell , if PDCCH monitoring occasion is before an active DL BWP change on serving cell , and the active DL BWP change is not triggered in PDCCH monitoring occasion , and the PUCCH with the HARQ-ACK information starts at or after a slot for the active DL BWP change*.*  - If for a set of serving cells provided by *MC-DCI-SetofCells*, is equal to the sum of  - if *nrofHARQ-BundlingGroups* is not provided for a serving cell , or  - if *nrofHARQ-BundlingGroups* is provided for the serving cell ,  across the serving cells of the set that are scheduled PDSCH receptions by a DCI format 1\_3, and , the UE generates NACK values for the last HARQ-ACK information bits corresponding to the DCI format 1\_3  - The counter DAI value and the total DAI value apply separately for each HARQ-ACK sub-codebook.  - The UE generates the HARQ-ACK codebook by appending the second HARQ-ACK sub-codebook to the first HARQ-ACK sub-codebook.  <Unchanged parts are omitted> |

Conclusion

For Rel-19 low NR band carrier aggregation via switching, if the switch pattern is applicable, it applies to the UE RACH procedure

Conclusion

For Rel-19 low NR band carrier aggregation via switching, in RAN1, there is no consensus to support UE processing timeline relaxation for the following scenarios

* a PDCCH reception schedules a PUSCH transmission
* a PDCCH reception indicates SRS transmission
* a RAR schedules a PUSCH transmission
* a PUCCH transmission with HARQ-ACK for a PDSCH or PDCCH reception

Conclusion

For Rel-19 low NR band carrier aggregation via switching, in RAN1, there is no consensus to support the following HARQ-ACK enhancement

* For HARQ-ACK feedback timing, support more than 8 values in the K1 set with new values larger than 15

R1-2507654 FL summary #2 of Low band carrier aggregation via switching Moderator (Apple)

R1-2507996

R1-2507653 FL summary #1 of Low band carrier aggregation via switching Moderator (Apple)

R1-2506879 Maintenance on Low band carrier aggregation via switching vivo

R1-2506927 Maintenance of Rel-19 Multi-carrier enhancements Huawei, HiSilicon

R1-2506928 Maintenance of Rel-19 low band CA via switching Huawei, HiSilicon

R1-2506970 Remaining issues on low band CA via switching Xiaomi

R1-2506969 Text proposals for Rel-19 Multi-carrier enhancements Xiaomi

R1-2507099 Maintenance of Rel-19 low band CA via switching CATT

R1-2507152 Maintenance on low-band CA via switching OPPO

R1-2507196 Maintenance on Multi-carrier enhancements for NR phase 3 ZTE Corporation, Sanechips

R1-2507197 Maintenance on Low band carrier aggregation via switching ZTE Corporation, Sanechips

R1-2507291 Clarification on maximum number of schedulable PxSCH for multi-PxSCH multi-cell scheduling Nokia

R1-2507235 Maintenance on other Rel-19 topics Samsung

R1-2507341 Correction to Low-Band CA via switching behaviour during SCell activation/deactivation Nokia

R1-2507356 Remaining issues on low band CA operation via switching for Rel-19 LG Electronics

R1-2507458 Discussion on low-band CA with switching Ofinno

R1-2507614 Multi-carrier enhancements for NR Phase 3 MediaTek Inc.

R1-2507637 On remaining issues for Low band Carrier Aggregation via switching Google

R1-2507861 Maintenance on MCE for NR Phase 3 Ericsson Inc.

**R19 Channel model 7-24GHz**

Agreement

Draft CR R1-2508132 to section 7.3.2, TR38.901 is endorse in principle

Agreement

Final CR R1-2508172 to section 7.3.2, TR38.901 is endorsed.

R1-2508132 Draft CR on Handheld UT Polarized Antenna Model Intel Corporation

R1-2506912 Remaining issues on 7-24 GHz channel model ZTE Corporation, Sanechips

R1-2507728 Calibration results for 7-24 GHz channel model Intel

(Withdrawn)

R1-2507729 Correction of Polarized Antenna Field Pattern Rotation for Handheld UE model Intel

**R19 TEI**

Agreement

CR R1-2508191 to TS 38.213 is endorsed in principle.

R1-2508191

R1-2507702 SR triggered SSSG switching (Maintenance for Rel-19 TEI) Qualcomm Incorporated

Maintenance issues R19 Channel model for ISAC and LTE based 5G broadcast will be discussed in RAN1 adhoc2 session (chaired by David).

**R19 Channel model for ISAC**

R1-2507153 Maintenance on ISAC channel modelling OPPO

R1-2507192 TP for ISAC channel modeling ZTE Corporation, Sanechips

R1-2507572 Maintenance on ISAC channel model Ericsson

R1-2507703 Maintenance on others: ISAC Channel Modelling Qualcomm Incorporated

**R1-2508090** Summary #1 on channel modelling for ISAC Moderator (Xiaomi)

**Agreement**

The TP in [FL2] Proposal 3.1-rev1 in section 2 of R1-2508090 is endorsed for TR 38.901 v19.1.0.

**Agreement**

The TP in [FL2] Proposal 3.2-rev1 in section 2 of R1-2508090 is endorsed for TR 38.901 v19.1.0.

**Agreement**

The TP in [FL2] Proposal 3.3-rev1 in section 2 of R1-2508090 is endorsed for TR 38.901 v19.1.0.

**Agreement**

The TP below is endorsed for TR 38.901 v19.1.0.

|  |
| --- |
| **< Unchanged text omitted >** 7.9.0 Introduction The channel model for ISAC in Clause 7.9 is designed based on the channel model defined in the previous clauses within Clause 7 taking into account the known properties, e.g., location, Radar Cross-Section (RCS), polarization and etc. of one or more physical objects. A physical object is categorized as a sensing target (ST) or an environment object (EO). A ST is an object of interest for sensing. An EO is a non-target object with known location. Two types of EO are supported in the ISAC channel model. A first type of EO (type-1 EO) has similar characteristic as a ST and is modelled in the same way as a ST. In the following descriptions in Clause 7.9, only the related details on ST are described, which are also applicable to type-1 EO. A second type of EO (type-2 EO, Clause 7.9.5.2) is of large size and is modelled differently from a ST.  The large scale and small scale parameters of the channel between any two of sensing transmitter (STX), ST and sensing receiver (SRX) in a sensing scenario are obtained from the Technical Reports for the same communication scenario unless updates on the parameter values are specially described. The ST is considered as a receiver or transmitter, respectively, in the determination of a reference Technical Report to generate the ~~proper~~ channel model for a STX-ST link or a ST-SRX link.  **< Unchanged text omitted >** |

**Agreement**

The TP#3.5 in section 3.5 of R1-2508090 is endorsed for TR 38.901 v19.1.0.

**Agreement**

The TP#3.9 in section 3.9 of R1-2508090 is endorsed for TR 38.901 v19.1.0.

**Agreement**

The TP in [FL2] Proposal 3.10-rev2 in section 2 of R1-2508090 is endorsed for TR 38.901 v19.1.0.

R1-2508092 Draft CR to incorporate new agreements on ISAC CM Xiaomi, AT&T

R1-2508093 CR to incorporate new agreements on ISAC CM Xiaomi, AT&T

**Agreement**

The draft CR in R1-2508092 is endorsed. Final CR for TR38.901 is agreed in R1-2508093.

**R19 LTE based 5G broadcast**

R1-2506971 Maintenance on LTE based 5G broadcast Xiaomi

R1-2507023 Maintenance on 38.901 Ericsson

(Withdrawn)

R1-2507235 Maintenance on other Rel-19 topics Samsung

**R1-2508033** FL summary#1 on Rel-19 LTE-based 5G Broadcast Phase 2 Moderator (EBU)

**Agreement**

Endorse the TP in section 3.1 of R1-2508033 for Clause 6.5.1 for TS 36.211 for the editor’s alignment CR.

**Conclusion**

From RAN1 perspective, it is clarified that “for an MBMS-dedicated cell, if E-UTRAN configures a value other than "0" for additionalNonMBSFNSubframes within MasterInformationBlock-MBMS, notificationSF-Index-r9 configuration indicates the subframe pointed out by additionalNonMBSFNSubframes and MBMS-NotificationConfig-v1430 is not configured when one of the additional subframes is used to transmit MCCH change notifications on PDCCH.”

* No RAN1 specification impact

# Rel-19 UE Features

***The maximum number of contributions per company/organization/university is limited to 1 per agenda item unless stated otherwise.***

[122bis-R19-UE\_features] Email discussion on Rel-19 UE features – Ralf (AT&T), Naoya (DOCOMO)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Agreement

Sent LS to RAN2 with attachment R1-2507979.

Draft LS R1-2507980 is endorsed in principle.

Agreement

Final LS R1-2507981 is endorsed

Agreement

Sent LS to RAN2 with attachment R1-2507982.

Draft LS R1-2507983 is endorsed in principle.

Agreement

Final LS R1-2507984 is endorsed

## UE features for AI/ML for NR Air Interface

**R1-2508080** Session Notes of AI 9.1 Ad-Hoc Chair (AT&T)

Session notes are endorsed and incorporated the session notes below.

1-2506761 UE Features for Rel-19 AI/ML for NR Air Interface Ericsson

R1-2506772 Discussion on UE features for AI/ML for NR Air Interface ZTE Corporation, Sanechips

R1-2506881 UE R features for AI/ML for NR Air Interface vivo

R1-2506935 UE features for AI/ML for NR air interface Huawei, HiSilicon

R1-2506972 Discussion on UE features for AI/ML for NR Air Interface Xiaomi

R1-2507004 Discussion on UE features for AI/ML for NR air Interface CMCC

R1-2507072 UE features for AI/ML for NR Air Interface Nokia

R1-2507100 UE features for AI/ML for NR Air Interface CATT, CICTCI

R1-2507156 UE features for AIML for NR air interface OPPO

R1-2507236 Remaining issues on UE features for AI/ML for NR air interface Samsung

R1-2507395 Discussion on UE features for AI/ML for NR Air Interface LG Electronics

R1-2507658 Views on UE features for Rel-19 AI/ML for NR air interface Apple

R1-2507704 UE features for AI/ML air interface Qualcomm Incorporated

R1-2507738 Summary of UE features for AI/ML for NR Air Interface Moderator (AT&T)

R1-2507795 Discussion on UE features for AI/ML for NR Air Interface NTT DOCOMO, INC.

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-2-3a | DL PRS Resources for UE-based positioning Case 1 on a band | [1. Max number of DL PRS Resources per DL PRS Resource Set  2. Max number of DL PRS Resources per positioning frequency layer | ~~[13-1~~ 58-2-4~~]~~ | N/A | N/A |  | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2, 4, 8, 16, 32, 64}  Component 2 candidate values: {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: For component 1, the values 16, 32, 64 are only applicable to FR2 bands  Note: For component 2, the value 6 is only applicable to FR1 bands  Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-2-3b | DL PRS Resources for UE-based positioning Case 1 on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only  2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only  3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation  4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation | ~~[13-1~~ 58-2-4~~]~~ | N/A | N/A |  | Per BC | n/a | n/a | n/a | Component 1 candidate values: {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC  Component 2 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  Component 3 candidate values: {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  Component 4 candidate values: {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands]  Need for location server to know if the feature is supported.  Note: the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-2-4 | DL PRS Processing Capability for UE-based positioning Case 1 | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  3. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  4. Max number of DL PRS resources that UE can process in a slot under it  Note: The above parameters are reported assuming a configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than 30%. |  | No | N/A |  | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Component 1 candidate values:  -FR1 bands values {5, 10, 20, 40, 50, 80, 100}  -FR2 bands values {50, 100, 200, 400}  Component 3 candidate values:  -T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  -N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 4 candidate values:  -FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  -FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Notes for component 3:  a. UE reports one combination of (N, T) values per band, where N is a duration of DL PRS symbols in ms processed every T ms for a given maximum bandwidth (B) in MHz supported by UE  b. UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth value  c. UE DL PRS processing capability is defined for a single positioning frequency layer. UE capability for simultaneous DL PRS processing across positioning frequency layers is not supported in Rel.16 (i.e. for a UE supporting multiple positioning frequency layers, a UE is expected to process one frequency layer at a time)  d. UE DL PRS processing capability is agnostic to DL PRS comb factor configuration  e. The reporting of (N, T) values for maximum BW in MHz is not dependent on SCS  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination.  ~~Note: If UE does not provide [this FG] but the UE supports Case 1, FG 13-1 indicates the DL PRS processing capabilities common across all positioning methods including UE-based positioning Case 1.]~~ | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-2-5 | Support of SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of SSB from neighbour cell as QCL source of a DL PRS  2. Support of reuse SSB measurement from RRM for receiving PRS  ~~Note: Refers to Type-C for FR1 and Type-C & Type-D support for FR2~~ | ~~[~~58-2-4~~; otherwise~~  ~~13-1]~~ | No | N/A | SSB from neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported  Note: Refers to Type-C for FR1 and Type-C & Type-D support for FR2 | Optional with capability signaling |

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| 58. NR\_AIML\_Air | 58-2-6 | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  ~~Note 1: Refers to Type-D support for FR2~~  ~~Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell~~ | ~~[~~58-2-4~~; otherwise~~  ~~13-1]~~ | No | N/A | DL PRS from serving/neighbour cell as QCL source of a DL PRS for UE-based positioning Case 1 is not supported | Per Band | n/a | n/a | n/a | Need for location server to know if the feature is supported.  Note: DL PRSs are in the same band  Note: Refers to Type-D support for FR2  Note: A PRS from a PRS-only TP is not considered in Rel. 19 | Optional with capability signaling |

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| 58. NR\_AIML\_air | 58-0-1 | CSI report framework for UE-side inference | 1. Number of ~~APU~~ CPU,x pools N  2. Maximum number of ~~APU~~ CPU,x in each ~~APU~~ CPU,x pool of UE-sided inference for CSI report(s) ~~for~~ simultaneously in a CC  3. Maximum number of ~~APU~~ CPU,x in each ~~APU~~ CPU,x pool of UE-sided inference for CSI report(s) simultaneously across all CCs | ~~FFS~~  2-35 | yes | n/a | Maximum number of APUs for UE-sided inference is unknown to the network | ~~Per UE~~  Per band and per BC | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Component 1 candidate values: {1,2}  Component 2candidate values: {1…8}  Component 3 candidate values: {1…32}  Note: Component 2 and 3 candidate values are signalled separately for each pool  ~~[~~A UE that does not support this FG should not report non-zero occupied CPU,2 or CPU,3 values in any dependency FG ~~reuses the CPU]~~ | Optional with capability signalling |

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| 58. NR\_AIML\_air | 58-1-1 | Increased number of reported RSs for beam management | 1. Support of reporting format for L1-RSRP measurements not including CRI/SSBRI other than one for the largest measured L1-RSRP in a reporting instance, if the number of reported L1-RSRPs is equal to the size of the measurement resource set.  2. Support of reporting format for L1-RSRPs and corresponding beam information of Top M beam(s) with largest M measured value(s) of L1-RSRP(s) of a measurement resource set, where M is configured by gNB, if the number of reported L1-RSRPs is smaller than the size of the measurement resource set  3. Maximum number of M reported RSs, M>4 | ~~FFS~~  {2-21, 2-22} or {2-23, 2-23a} or 2-29 or 2-24 | yes | n/a | Increased number of reported beams for beam management is not supported | ~~Per UE~~  Per band | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Component 3 candidate values: {6,8} | Optional with capability signalling |

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| 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7a: Supported maximum number of resources for Set B  7b: Supported maximum number of resources for Set A  8. Supported CSI-RS resource types for Set B  9. Supported inference report types  11. Supported BM-Case 1 sub-usecase(s)~~: {setB-subset-of-setA, setB-different-from-setA, both}]~~  12. Supported maximum number of predicted beams in each reporting instance ~~FFS: whether/how to merge this FG with other FG(s) for performance monitoring and/or data collection~~  13. Supported number of occupied CPU  14. Supported number of occupied ~~APU~~ CPU,2/CPU,3  15. Supported value of d for the relaxation of Z3 timeline  16. Supported value of d’ for the relaxation of Z’3 timeline  17. ~~Index of the~~ Occupied ~~APU~~ resource pool between CPU,2 and CPU,3 | ~~FFS~~ 2-35 | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 for inference is not supported | ~~Per UE~~  Per band | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Component 3 candidate values:   * Periodic reporting: {1, 2, 3, 4} * Aperiodic reporting: {1, 2, 3, 4} * Semi-persistent reporting: {1, 2, 3, 4}   Component 3a candidate values: {1, 2, 3, 4, 8, 10, 12, 16}  Component 7a candidate values: {4, 8, 16}  Component 7b candidate values: {8, 16, 32, 64}  Component 8 candidate values: {Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS}  Component 9 candidate values: {Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report}  Component 11 candidate values: {setB-subset-of-setA, setB-different-from-setA, both}  Component 12 candidate values: {1, 2, 3, 4}  Component 13 candidate values: {0, 1, 2, …, 8}  Component 14 candidate values: {0, 1, 2, …, 8}  Note: The values of component 13 and 14 are not allowed to be 0 simultaneously  Component 15 candidate values: FFS  Component 16 candidate values: FFS  Component 17 candidate values: {1, 2} representing the first APU pool (i.e., CPU,2) and the second APU pool (i.e., CPU,3), respectively  Note: “CPU” corresponds to “CPU,1” in TS 38.214, and “APU” corresponds to “CPU,x” in TS 38.214, x = 2, 3  ~~FFS: candidate values for components~~ | Optional with capability signalling |

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| 58. NR\_AIML\_air | 58-1-3 | UE-side beam prediction for BM Case1 with predicted RSRP for inference | 1. Support of beam prediction, reporting of predicted beam index and predicted RSRP, for BM-Case1 for inference  2. Supported maximum number of predicted beams with RSRP in each reporting instance | 58-1-2 | yes | n/a | UE-side beam prediction for BM Case 1 with predicted RSRP for inference is not supported | ~~Per UE~~  Per band | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Component 2 candidate values: {1, 2, 3, 4} | Optional with capability signalling |

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| 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7a: Supported maximum number of resources for Set B  7b: Supported maximum number of resources for Set A  8. Supported CSI-RS resource types for Set B  9. Supported inference report types  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  13. Supported maximum total number of reported predicted beams for predicted time instances in one report  ~~14. Supported combinations of supported value(s) of valid time duration for each predicted time instance and number of predicted beams for each value of valid time duration~~  15. Supported value(s) of time gap between predicted time instances and between reference time to the first future time instance  21. supported number of occupied CPU  22. supported number of occupied ~~APU~~ CPU,2/CPU,3  23. supported value of d for the relaxation of Z3 timeline  24. supported value of d’ for the relaxation of Z’3 timeline  25. ~~Index of the~~ Occupied ~~APU~~ resource pool between CPU,2 and CPU,3 | ~~FFS~~ 2-35 | yes | n/a | UE-side beam prediction for BM-Case2 for inference is not supported | ~~Per UE~~  Per band | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Component 3 candidate values:   * Periodic reporting: {1, 2, 3, 4} * Aperiodic reporting: {1, 2, 3, 4} * Semi-persistent reporting: {1, 2, 3, 4}   Component 3a candidate values: {1, 2, 3, 4, 8, 10, 12, 16}  Component 7a candidate values: {4, 8, 16, 32, 64}  Component 7b candidate values: {4, 8, 16, 32, 64}  Component 8 candidate values: {Periodic CSI-RS, Semi-persistent CSI-RS}  Component 9 candidate values: {Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report}~~FFS: candidate values for components~~  Component 11 candidate values: {1, 2, 3, 4}  Component 12 candidate values: {1, 2, 4, 8}  Component 13 candidate values: {1, 2, 4, 6, 8, 12, 16, 32}  Component 15 candidate values: {10ms, 20ms, 40ms, 80ms, 160ms}  Component 21 candidate values: {0, 1, 2, … 8}  Component 22 candidate values: {0, 1, 2, … 8}  Note: The values of component 21 and 22 are not allowed to be 0 simultaneously.  Component 23 candidate values: FFS  Component 24 candidate values: FFS  Component 25 candidate values: {1, 2} representing the first APU pool (i.e., CPU,2) and the second APU pool (i.e., CPU,3), respectively  Note: “CPU” corresponds to “CPU,1” in TS 38.214, and “APU” corresponds to “CPU,x” in TS 38.214, x = 2, 3  Note: UE should not report non-zero value for Component 22 if FG 58-0-1 is not signalled | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-1-5 | UE-side beam prediction for BM-Case2 with predicted RSRP for inference | 1. Support of beam prediction, reporting of predicted beams and predicted RSRP, for BM-Case2 (~~spatial and time~~ domain beam prediction) for inference  2. Supported maximum number of predicted beams in each predicted time instance  3. Supported maximum number of predicted time instances  4. Supported maximum total number of reported predicted beams for predicted time instances in one report | 58-1-4 | yes | n/a | UE-side beam prediction for BM-Case2 for inference is not supported | ~~Per UE~~  Per band | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Component 2 candidate values: {1, 2, 3, 4}  Component 3 candidate values: {1, 2, 4, 8}  Component 4 candidate values: {1, 2, 3, 4, 8, 12, 16, 32} | Optional with capability signalling |

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| 58. NR\_AIML\_air | 58-1-6 | Performance monitoring for UE-sided model | 1. Support of performance monitoring with RS-PAI of AI/ML model for beam prediction.  2. Maximum total number of the configured SSB resources and/or CSI-RS resources for monitoring RS resource set  3. Maximum number of monitoring report(s) configured per BWP  4. Maximum number of monitoring report(s) configured across all CCs  5. Maximum number of monitoring occasions for RS-PAI calculation  6. Support of SSB as RS type for monitoring  7. Support of CSI-RS as RS type for monitoring  8. Supported monitoring resource types  9. Supported monitoring report types | ~~FFS~~ 58-1-2 or 58-1-4 | yes | n/a | Performance monitoring for UE-sided model is not supported | ~~FFS~~  Per band | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | Component 2 candidate values: {4, 8, 16, 32, 64}  Component 3 candidate values:   * Periodic reporting: {1, 2, 3, 4,} * Aperiodic reporting: {1, 2, 3, 4} * Semi-persistent reporting: {1, 2, 3, 4}   Component 4 candidate values: {1, 2, 4, 8}  Component 5 candidate values: {1, 3, 7, 15}  Component 8 candidate values: {Periodic CSI-RS, Semi-persistent CSI-RS}  Component 9 candidate values: {Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report}  ~~FFS: candidate values for components~~ | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-1-7 | Data collection for UE-side beam prediction | 1. Support of data collection for UE-side beam prediction  2. Support of SS/PBCH block and 1-port CSI-RS based RSRP measurements for measurement RS resource sets (Set B and Set A) for data collection  3. Supported sub-use cases  6: Supported maximum number of resources for Set B  7: Supported maximum number of resources for Set A  8. Support of SSB as RS type for Set B  9. Support of CSI-RS as RS type for Set B  10. Support of SSB as RS type for Set A  11. Support of CSI-RS as RS type for Set A | ~~FFS~~ 2-35 | yes | n/a | Data collection for UE-side beam prediction is not supported | ~~Per UE~~  Per band | ~~No~~ n/a | ~~No~~ n/a | ~~No~~ n/a | Component 3 candidate values: {‘Set B equal to Set A’, ‘Set B subset of Set A’,’Set B not a subset of Set A’}  Component 6 candidate values: {4, 8, 16, 32, 64}  Component 7 candidate values: {8, 16, 32, 64}  Note: it is up to RAN2 whether this FG is merged into data collection FG defined by RAN2 | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-3-1 | CSI prediction for UE-sided inference when N4=1 | 1. Support of CSI prediction for UE-sided inference when N4=1  2. Support for reporting predicted PMI with N4=1  3. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Support of Rel-16 eType-II regular codebook refinement for predicted PMI with PMI subband R=1  5. Support parameter combinations with L=2,4  6. Support for rank = 1,2  7. Support for the size of DD-basis, N4=1  8. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  11. Scaling factor for active resource counting Kp  12. supported value of t for the relaxation of Z and Z’ timeline  13. supported number of occupied CPU  14. supported number of occupied ~~APU~~ CPU,2/CPU,3  15. ~~Index of the~~ Occupied ~~APU~~ resource pool between CPU,2 and CPU,3 | ~~58-0-1~~ 2-35 | yes | n/a | CSI prediction for N4=1 for inference is not supported | Per band and Per BC | n/a | n/a | n/a | Component 3 candidate values:  a. {4,8,12,16,24,32}  b. {2,3,4 … 64}  c. {4, …, 256}  Component 11 candidate values: {1,2,4}  Component 12 candidate values: FFS  Component 13 candidate values: {0, 1, 2, … 8}  Component 14 candidate values: {0, 1, 2, … 8}  Component 15 candidate values: {1, 2} representing the first APU pool (i.e., CPU,2) and the second APU pool (i.e., CPU,3), respectively.  Note: “CPU” corresponds to “CPU,1” in TS 38.214, and “APU” corresponds to “CPU,x” in TS 38.214, x = 2, 3  Note: UE should not report non-zero value for Component 14 if FG 58-0-1 is not signaled | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-3-2 | CSI prediction for UE-sided inference when N4>1 | 1. Support of CSI prediction for UE-sided inference when N4>1  2. Support for reporting predicted PMI with N4>1  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR  5. Support for the size of DD-basis, N4>1  6. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} for one CSI report setting  7. Supported number of occupied CPU  8. Supported number of occupied ~~APU~~ CPU,2/CPU,3  9. ~~Index of the~~ Occupied ~~APU~~ resource pool between CPU,2 and CPU,3 | 58-3-1 | yes | n/a | CSI prediction for N4>1 for inference is not supported | Per band and Per BC | N/A | N/A | N/A | Component 3 candidate values: a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {2,3,4 … 64}  d. {4, …, 256}  Component 6 candidate values:  a. {1,2,4,8}  b. {4,8,12,16,24,32}  c. {4,8,12}  d.{4, …, 256}  Component 7 candidate values: {0, 1, 2, …8}  Component 8 candidate values: {0, 1, 2, … 8}  Component 9 candidate values: {1, 2} representing the first APU pool (i.e., CPU,2) and the second APU pool (i.e., CPU,3), respectively  Note: “CPU” corresponds to “CPU,1” in TS 38.214, and “APU” corresponds to “CPU,x” in TS 38.214, x = 2, 3  Note: UE should not report non-zero value for Component 8 if FG 58-0-1 is not signalled | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-3-4 | UE side data collection for CSI prediction | 1. Support of data collection for CSI prediction | ~~FFS~~ 2-35 | yes | n/a | UE side data collection for CSI prediction is not supported | Per band and Per BC | N/A | N/A | N/A |  | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_Air | 58-3-5 | Performance monitoring for CSI prediction model | 1. Support of two performance metric SGCS  2. Support of one wideband frequency granularity SGCS per layer  3. Support of one configured time instance for N4>1  4. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  5. Supported number of occupied CPU | 58-3-1 | Yes | n/a | Performance monitoring for CSI prediction model is not supported | Per Band and Per BC | N/A | N/A | N/A | Component 4 candidate values:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Component 5 candidate values: {1, 2}  Note: The summation of the value reported by Component 5 and the one reported by Component 13 of FG58-3-1 (or Component 7 of FG58-3-2) should not significant than the N\_CPU UE reported | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-0-1 | CSI report framework for UE-side inference | 1. Number of CPU,x pools N  2. Maximum number of CPU,x in each CPU,x pool of UE-sided inference for CSI report(s) ~~for~~ simultaneously in a CC  3. Maximum number of CPU,x in each CPU,x pool of UE-sided inference for CSI report(s) simultaneously across all CCs | 2-35 | yes | n/a | Maximum number of ~~APU~~ CPU,x for UE-sided inference is unknown to the network | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values: {1,2}  Component 2candidate values: {1…8}  Component 3 candidate values: {1…32}  Note: Component 2 and 3 candidate values are signalled separately for each pool  A UE that does not support this FG should not report non-zero occupied CPU,2 or CPU,3 values in any dependency FG | Optional with capability signalling |

**Agreement: In FG 58-1-2, 58-1-4, 58-3-1, 58-3-2, in the Notes column, delete the following note: “CPU” corresponds to “CPU,1” in TS 38.214, and “APU” corresponds to “CPU,x” in TS 38.214, x = 2, 3**

**Agreement: In FG 58-1-2, 58-1-4, in the notes column, for component 17 candidate values, replace “APU pool” with “CPU pool”**

**Agreement: In FGs 58-1-2, 58-1-4, 58-3-1, 58-3-2, in the notes column, replace “APU pool” with “CPU pool”**

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-1-2 | UE-side beam prediction for BM Case1 for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case1 for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case1 per BWP  3a. Maximum number of inference report(s) configured for BM-Case1 across all CCs  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7a: Supported maximum number of resources for Set B  7b: Supported maximum number of resources for Set A  8. Supported CSI-RS resource types for Set B  9. Supported inference report types  11. Supported BM-Case 1 sub-usecase(s)  12. Supported maximum number of predicted beams in each reporting instance  13. Supported number of occupied CPU  14. Supported number of occupied CPU,2/CPU,3  15. Supported value of d for the relaxation of Z3 timeline, where i is the index of SCS, i=1,2,3,4,5,6 corresponding to 15,30,60,120,480,960 kHz SCS  16. Supported value of d’ for the relaxation of Z’3 timeline, where i is the index of SCS, i=1,2,3,4,5,6 corresponding to 15,30,60,120,480,960 kHz SCS  17. Occupied resource pool between CPU,2 and CPU,3 | 2-35 | yes | n/a | UE-side~~d~~ beam prediction for BM Case 1 for inference is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values:   * Periodic reporting: {1, 2, 3, 4} * Aperiodic reporting: {1, 2, 3, 4} * Semi-persistent reporting: {1, 2, 3, 4}   Component 3a candidate values: {1, 2, 3, 4, 8, 10, 12, 16}  Component 7a candidate values: {4, 8, 16}  Component 7b candidate values: {8, 16, 32, 64}  Component 8 candidate values: {Periodic CSI-RS, Semi-persistent CSI-RS, Aperiodic CSI-RS}  Component 9 candidate values: {Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report}  Component 11 candidate values: {setB-subset-of-setA, setB-different-from-setA, both}  Component 12 candidate values: {1, 2, 3, 4}  Component 13 candidate values: {0, 1, 2, …, 8}  Component 14 candidate values: {0, 1, 2, …, 8}  Note: The values of component 13 and 14 are not allowed to be 0 simultaneously  Component 15 candidate values:  d1 is FFS  d2 is FFS  d3 is FFS  d4 is FFS  d5 is FFS  d6 is FFS  Component 16 candidate values:  d'1 is FFS  d’2 is FFS  d’3 is FFS  d’4 is FFS  d’5 is FFS  d’6 is FFS  Component 17 candidate values: {1, 2} representing the first APU pool (i.e., CPU,2) and the second APU pool (i.e., CPU,3), respectively  Note: “CPU” corresponds to “CPU,1” in TS 38.214, and “APU” corresponds to “CPU,x” in TS 38.214, x = 2, 3 | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 58. NR\_AIML\_air | 58-1-4 | UE-side beam prediction for BM Case2 for inference | 1. Support of beam prediction with reporting of predicted beam index for BM-Case2 for inference with UE-side model  3. Maximum number of inference report(s) configured for BM-Case2 per BWP  3a. Maximum number of inference report(s) configured for BM-Case2 across all CCs  6. Support of SSB as RS type for Set B  6a. Support of CSI-RS as RS type for Set B  6b. Support of SSB as RS type for Set A  6c. Support of CSI-RS as RS type for Set A  7a: Supported maximum number of resources for Set B  7b: Supported maximum number of resources for Set A  8. Supported CSI-RS resource types for Set B  9. Supported inference report types  11. Supported maximum number of predicted beams in each predicted time instance  12. Supported maximum number of predicted time instances  13. Supported maximum total number of reported predicted beams for predicted time instances in one report  15. Supported value(s) of time gap between predicted time instances and between reference time to the first future time instance  21. supported number of occupied CPU  22. supported number of occupied CPU,2/CPU,3  23. supported value of d for the relaxation of Z3 timeline, where i is the index of SCS, i=1,2,3,4,5,6 corresponding to 15,30,60,120,480,960 kHz SCS  24. supported value of d’ for the relaxation of Z’3 timeline, where i is the index of SCS, i=1,2,3,4,5,6 corresponding to 15,30,60,120,480,960 kHz SCS  25. Occupied resource pool between CPU,2 and CPU,3 | 2-35 | yes | n/a | UE-side beam prediction for BM-Case2 for inference is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values:   * Periodic reporting: {1, 2, 3, 4} * Aperiodic reporting: {1, 2, 3, 4} * Semi-persistent reporting: {1, 2, 3, 4}   Component 3a candidate values: {1, 2, 3, 4, 8, 10, 12, 16}  Component 7a candidate values: {4, 8, 16, 32, 64}  Component 7b candidate values: {4, 8, 16, 32, 64}  Component 8 candidate values: {Periodic CSI-RS, Semi-persistent CSI-RS}  Component 9 candidate values: {Periodic CSI report, Aperiodic CSI report, semi-persistent CSI report}  Component 11 candidate values: {1, 2, 3, 4}  Component 12 candidate values: {1, 2, 4, 8}  Component 13 candidate values: {1, 2, 4, 6, 8, 12, 16, 32}  Component 15 candidate values: {10ms, 20ms, 40ms, 80ms, 160ms}  Component 21 candidate values: {0, 1, 2, … 8}  Component 22 candidate values: {0, 1, 2, … 8}  Note: The values of component 21 and 22 are not allowed to be 0 simultaneously.  Component 23 candidate values:  d1 is FFS  d2 is FFS  d3 is FFS  d4 is FFS  d5 is FFS  d6 is FFS  Component 24 candidate values:  d'1 is FFS  d’2 is FFS  d’3 is FFS  d’4 is FFS  d’5 is FFS  d’6 is FFS  Component 25 candidate values: {1, 2} representing the first APU pool (i.e., CPU,2) and the second APU pool (i.e., CPU,3), respectively  Note: “CPU” corresponds to “CPU,1” in TS 38.214, and “APU” corresponds to “CPU,x” in TS 38.214, x = 2, 3  Note: UE should not report non-zero value for Component 22 if FG 58-0-1 is not signalled | Optional with capability signalling |

## UE features for NR MIMO Phase 5

**R1-2508081** Session Notes of AI 9.2 Ad-Hoc Chair (AT&T)

Session notes are endorsed and incorporated the session notes below.

R1-2506882 UE features for NR MIMO Phase 5 vivo

R1-2506924 UE features for NR MIMO Phase 5 Huawei, HiSilicon

R1-2507038 Discussion on UE features for NR MIMO Phase 5 ZTE Corporation, Sanechips

R1-2507073 NR MIMO Phase 5 UE features Nokia

R1-2507127 Maintenance on UE features for NR MIMO Phase 5 CATT

R1-2507160 UE features for NR MIMO Phase 5 OPPO

R1-2507237 UE features for NR MIMO Phase 5 Samsung

R1-2507460 Views on UE features for NR MIMO Phase 5 Ofinno

R1-2507705 UE features for NR MIMO phase 5 Qualcomm Incorporated

R1-2507739 Summary of UE features for NR MIMO Phase 5 Moderator (AT&T)

R1-2507796 Discussion on MIMO UE features NTT DOCOMO, INC.

R1-2507863 Discussion on UE features for NR MIMO Phase 5 Ericsson

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-1 | Enhanced Type-I SP codebook for 64 ports – Scheme-A | 1. Support of enhanced Type-I SP codebook for Scheme-A with 64 Tx ports by aggregating multiple NZP CSI-RS resources  within one slot  2. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum rank  4. Max # of CSI-RS resource in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 2-35 | yes | n/a | Enhanced Type-I SP codebook is not supported for 64 ports – Scheme-A, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {4, 5, 6, 7, 8}  Component 4 candidate value {2,4}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as show**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-1a | Enhanced Type-I SP codebook for 48 ports – Scheme-A | 1. Support of enhanced Type-I SP codebook for Scheme-A with 48 Tx ports by aggregating multiple NZP CSI-RS resources within one slot  2. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum rank  4. Max # of CSI-RS resource in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-1 | yes | n/a | Enhanced Type-I SP codebook is not supported for Scheme-A for 48 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {4, 5, 6, 7, 8}  Component 4 candidate value {~~1:8~~2,3}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-1b | Enhanced Type-I SP codebook for 128 ports – Scheme-A | 1. Support of enhanced Type-I SP codebook for Scheme-A with 128 Tx ports by aggregating multiple NZP CSI-RS resources within one slot  2. A list of supported combinations, each combination is Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum rank  4. Support 4 CSI-RS resources in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-1 | yes | n/a | Enhanced Type-I SP codebook is not supported for Scheme-A for 128 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {4, 5, 6, 7, 8}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-1c | Enhanced Type-I SP codebook for 64 ports – Scheme-B | 1. Support of enhanced Type-I SP codebook for Scheme-B with 64 Tx ports by aggregating multiple NZP CSI-RS resources within one slot  2. A list of supported combinations, each combination is Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum rank  4. Max # of CSI-RS resource in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 2-35 | yes | n/a | Enhanced Type-I SP codebook is not supported for Scheme-B for 64 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {4, 5, 6, 7, 8}  Component 4 candidate value {2,4}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-1d | Enhanced Type-I SP codebook for 48 ports – Scheme-B | 1. Support of enhanced Type-I SP codebook for Scheme-B with 48 Tx ports by aggregating multiple NZP CSI-RS resources within one slot  2. A list of supported combinations, each combination is Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum rank  4. Max # of CSI-RS resource in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-1c | yes | n/a | Enhanced Type-I SP codebook is not supported for Scheme-B for 48 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {4, 5, 6, 7, 8}  Component 4 candidate value {2,3}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-1e | Enhanced Type-I SP codebook for 128 ports – Scheme-B | 1. Support of enhanced Type-I SP codebook for Scheme-B with 128 Tx ports by aggregating multiple NZP CSI-RS resources within one slot  2. A list of supported combinations, each combination is Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum rank  4. Support 4 CSI-RS resources in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-1c | yes | n/a | Enhanced Type-I SP codebook is not supported for Scheme-B for 128 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {4, 5, 6, 7, 8}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-2 | Enhanced Type-I MP codebook for 64 ports | 1. Support of enhanced Type-I MP codebook for 64 ports within 1 slot  2. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum number of panels  4. Max # of CSI-RS resource in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 2-35 | yes | n/a | Enhanced Type-I MP codebook is not supported for 64 ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {2, 4}  Component 4 candidate value {2,4}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-2a | Enhanced Type-I MP codebook for 48 ports | 1. Support of enhanced Type-I MP codebook for 48 ports within 1 slot  2. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum number of panels  4. Max # of CSI-RS resource in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-2 | yes | n/a | Enhanced Type-I MP codebook is not supported for 48 ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {2, 4}  Component 4 candidate value {2,3}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-2b | Enhanced Type-I MP codebook for 128 ports | 1. Support of enhanced Type-I MP codebook for 128 ports within 1 slot  2. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. Supported maximum number of panels  4. Support 4 CSI-RS resources in a resource set  5. Supported processing capability  6. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-2 | yes | n/a | Enhanced Type-I MP codebook is not supported for 128 ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 3 candidate value {2, 4}  Component 5 candidate value {Capability 1, Capability 2}  Component 6 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU =1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-3 | Extended Rel-16 eType-II codebook for 64 Tx ports | 1. Support of extended Rel-16 eType-II codebook for 64 Tx ports by aggregating multiple NZP CSI-RS resources within 1 slot  2. Support of parameter combination 1-6  3. Support of rank 1-2  4. Support R=1  5. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with R=1  6. supported processing capability  7. Max # of CSI-RS resource in a resource set  8. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 16-3a | yes | n/a | Extended Rel-16 eType-II codebook is not supported for 64 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 5 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 6 candidate value {Capability 1, Capability 2}  Component 7 candidate value {2,4}  Component 8 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-3a | Extended Rel-16 eType-II codebook for 48 Tx ports | 1. Support of extended Rel-16 eType-II codebook for 48 Tx ports by aggregating multiple NZP CSI-RS resources within 1 slot  2. Support of parameter combination 1-6  3. Support of rank 1-2  4. Support R=1  5. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with R=1  6. supported processing capability  7. Max # of CSI-RS resource in a resource set  8. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-3 | yes | n/a | Extended Rel-16 eType-II codebook is not supported for 48 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 5 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 6 candidate value {Capability 1, Capability 2}  Component 7 candidate value {2,3}  Component 8 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-3b | Extended Rel-16 eType-II codebook for 128 Tx ports | 1. Support of extended Rel-16 eType-II codebook for 128 Tx ports by aggregating multiple NZP CSI-RS resources within 1 slot  2. Support of parameter combination 1-6  3. Support of rank 1-2  4. Support R=1  5. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with R=1  6. supported processing capability  7. Support 4 CSI-RS resources in a resource set  8. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-3 | yes | n/a | Extended Rel-16 eType-II codebook is not supported for 128 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 5 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 6 candidate value {Capability 1, Capability 2}  Component 8 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = 1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-3-1 | PMI sub-bands with R=2 for extended Rel-16 eType-II codebook for up to 128 ports | 1. Support of PMI sub-bands with R=2 for extended Rel-16 eType-II codebook for up to 128 ports  2. A list of supported combinations, each combination is {Max # of Tx ports in a report, Max # of ~~sets of aggregated~~ resources, and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with R=2 | 59-2-1-3 | Yes | n/a | PMI sub-bands with R=2 for extended Rel-16 eType-II codebook for up to 128 ports is not supported | Per band and Per BC | n/a | n/a | n/a | Component 2 candidate values  a. {48, 64, 128}  b. {1, …, 64, 128, 256}  c. {64, …, 256, 512, 768, 1024} | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-3-3 | Rank 3,4 for extended Rel-16 eType-II codebook for up to 128 ports | 1. Support of Rank 3,4 for extended Rel-16 eType-II codebook for up to 128 ports  4. Support R=1  5. A list of supported combinations, each combination is {Max # of Tx ports in a report, Max # of ~~sets of aggregated~~ resources, and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with R=1 | 59-2-1-3 | Yes | n/a | Rank 3,4 for extended Rel-16 eType-II codebook for up to 128 ports is not supported | Per band and Per BC | n/a | n/a | n/a | Component 5 candidate values  a. {48, 64, 128}  b. {1, 2, …, 64}  c. {64, …, 256, 512, 768, 1024} | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-4 | Extended Rel-17 FeType-II codebook with 64 Tx ports | 1. Support of extended Rel-17 FeType-II codebook for 64 Tx ports by aggregating multiple NZP CSI-RS resources within 1 slot  2. Support of parameter combinations with M=1  3. Support of rank 1-2  4. Support R=1  5. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with M=1 and R=1  6. Supported processing capability  7. Max # of CSI-RS resource in a resource set  8. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 23-9-1 | yes | n/a | Extended Rel-17 FeType-II codebook is not supported with 64 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 5 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 6 candidate value {Capability 1, Capability 2}  Component 7 candidate value {2,4}  Component 8 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources OCPU = 1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-4a | Extended Rel-17 FeType-II codebook with 48 Tx ports | 1. Support of extended Rel-17 FeType-II codebook for 48 Tx ports by aggregating multiple NZP CSI-RS resources within 1 slot  2. Support of parameter combinations with M=1  3. Support of rank 1-2  4. Support R=1  5. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with M=1 and R=1  6. Supported processing capability  7. Max # of CSI-RS resource in a resource set  8. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-4 | yes | n/a | Extended Rel-17 FeType-II codebook is not supported with 48 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 5 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 6 candidate value {Capability 1, Capability 2}  Component 7 candidate value {2,3}  Component 8 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Reuse legacy Z/Z’ values  OCPU = ceil(P/32)  Capability 2:  Scale the legacy timeline Z/Z’ by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources OCPU = 1 | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-5 | Extended Rel-18 eType-II Doppler codebook for 64 Tx ports | 1. Support of extended Rel-18 Type-II Doppler codebook for 64 Tx ports by aggregating multiple NZP CSI-RS resource groups within 1 slot  2. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  3. Support PMI subband R=1  4. Support parameter combinations with L=2,4  5. Support rank = 1,2  6. Support 64 ports  7. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  8. Supported processing capability  9. Value of Y for CPU occupation when P/SP-CSI-RS is configured for CMR  10. Value of Y for CPU occupation when A-CSI-RS is configured for CMR  11. Support for the size of DD-basis, N4=1  12. Scaling factor for active resource counting Kp  13. Max # of CSI-RS resource in a resource group for aperiodic CSI-RS resource set or in a resource set for periodic CSI-RS resource set  14. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 40-3-2-1 | yes | n/a | Extended Rel-18 Type-II Doppler codebook is not supported for 64 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 7 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 8 candidate value {Capability 1, Capability 2}  Component 9 candidate values: {1, 2, 3}  Component 10 candidate values: {1, 2, 3}  Component 12 candidate values: {1, 2, 4}  Component 13 candidate value {2,4}  Component 14 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Legacy timeline  OCPU = YxN4xceil(P/32) ), when P/SP-CSI-RS is configured for CMR  OCPU = Yx KDOPPxceil(P/32)), when A-CSI-RS is configured for CMR  Capability 2:  Scale the legacy timeline by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = YxN4, when P/SP-CSI-RS is configured for CMR  OCPU = Yx KDOPP, when A-CSI-RS is configured for CMR  Note: maximum OCPU is 8  Note: KDOPP is the number of CSI-RS resource groups configured for channel measurement, and each CSI-RS resource groups contain K CSI-RS resources for aggregating up to 128 ports | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-5a | Extended Rel-18 eType-II Doppler codebook for 48 Tx ports | 1. Support of extended Rel-18 Type-II Doppler codebook for 48 Tx ports by aggregating multiple NZP CSI-RS resource groups within 1 slot  2. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  3. Support PMI subband R=1  4. Support parameter combinations with L=2,4  5. Support rank = 1,2  6. Support 64 ports  7. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  8. Supported processing capability  9. Value of Y for CPU occupation when P/SP-CSI-RS is configured for CMR  10. Value of Y for CPU occupation when A-CSI-RS is configured for CMR  11. Support for the size of DD-basis, N4=1  12. Scaling factor for active resource counting Kp  13. Max # of CSI-RS resource in a resource group for aperiodic CSI-RS resource set or in a resource set for periodic CSI-RS resource set  14. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-5 | yes | n/a | Extended Rel-18 Type-II Doppler codebook is not supported for 48 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 7 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 8 candidate value {Capability 1, Capability 2}  Component 9 candidate values: {1, 2, 3}  Component 10 candidate values: {1, 2, 3}  Component 12 candidate values: {1, 2, 4}  Component 13 candidate value {2,3}  Component 14 candidate values  a. {1, …, 64}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Legacy timeline  OCPU = Y x N4 x ceil(P/32) ), when P/SP-CSI-RS is configured for CMR  OCPU = Y x KDOPP x ceil(P/32)), when A-CSI-RS is configured for CMR  Capability 2:  Scale the legacy timeline by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = Y x N4, when P/SP-CSI-RS is configured for CMR  OCPU = Y x KDOPP, when A-CSI-RS is configured for CMR  Note: maximum OCPU is 8  Note: KDOPP is the number of CSI-RS resource groups configured for channel measurement, and each CSI-RS resource groups contain K CSI-RS resources for aggregating up to 128 ports | Optional with capability signalling |

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| 59. NR\_MIMO\_Ph5 | 59-2-1-5b | Extended Rel-18 eType-II Doppler codebook for 128 Tx ports | 1. Support of extended Rel-18 Type-II Doppler codebook for 128 Tx ports by aggregating multiple NZP CSI-RS resource groups within 1 slot  2. Support X=1 CQI based on the first/earliest slot of the CSI reporting window and the first/earliest predicted PMI (TDCQI=’1-1’)  3. Support of PMI subband R=1 for extended Rel-18 eType II Doppler codebook  4. Support parameter combinations with L=2,4  5. Support for rank = 1,2  6. Support 64 ports  7. A list of supported combinations, each combination is { Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  8. Supported processing capability  9. Value of Y for CPU occupation (OCPU = Y.N4), when P/SP-CSI-RS is configured for CMR  10. Value of Y for CPU occupation (OCPU = Y. KDOPP), when A-CSI-RS is configured for CMR  11. Support for the size of DD-basis, N4=1  12. Scaling factor for active resource counting Kp  13. Support 4 CSI-RS resources in a resource group for aperiodic CSI-RS resource set or in a resource set for periodic CSI-RS resource set  14. A list of supported combinations, each combination is {Max # of resources and total # of Tx ports} per CC simultaneously | 59-2-1-5 | yes | n/a | Extended Rel-18 Type-II Doppler codebook is not supported for 128 Tx ports, aggregated CSI-RS resources within one slot | Per band and per BC | n/a | n/a | n/a | Component 7 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Component 8 candidate value {Capability 1, Capability 2}  Component 9 candidate values: {1, 2, 3}  Component 10 candidate values: {1, 2, 3}  Component 12 candidate values: {1, 2, 4}  Component 14 candidate values  a. {1, …, 64, 128, 256}  b. {64, …, 256, 512, 768, 1024}  Note: For component of processing capability  Capability 1:  Legacy timeline  OCPU = Y x N4 x ceil(P/32) ), when P/SP-CSI-RS is configured for CMR  OCPU = Y x KDOPP x ceil(P/32)), when A-CSI-RS is configured for CMR  Capability 2:  Scale the legacy timeline by ceil(P/32) where P is the total number of ports across all the K aggregated CSI-RS resources  OCPU = Y x N4, when P/SP-CSI-RS is configured for CMR  OCPU = Y x KDOPP, when A-CSI-RS is configured for CMR  Note: maximum OCPU is 8  Note: KDOPP is the number of CSI-RS resource groups configured for channel measurement, and each CSI-RS resource groups contain K CSI-RS resources for aggregating up to 128 ports | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-2-1 | Hybrid BF (CRI-based) with Rel-15 Type-I SP codebook | 1. The maximal supported number of CRI report M  2. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously.  3. The maximum value of KS | 2-36 | yes | n/a | Hybrid BF (CRI-based) with Rel-15 Type-I SP codebook is not supported | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4}  Component 2 candidate values: a. {2,4,8,12,16, 24, 32}  b. {1,2,3,4 … 256}  c. {64, …, 256, 512, 768, 1024}  Component 3 candidate values: {2,3,4,5,6,7,8} | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-2-2 | Hybrid BF (CRI-based) with Rel-16 eType-II codebook | 1. The maximal supported number of CRI report M  2. A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously.  3. The maximum value of KS | 16-3a | yes | n/a | Hybrid BF (CRI-based) with Rel-16 eType-II codebook is not supported | Per band and per BC | n/a | n/a | n/a | Component 1 candidate values: {1,2}  Component 2 candidate values: a. {2,4,8,12,16, 24, 32}  b. {1,2,3,4 … 256}  c. {64, …, 256, 512, 768, 1024}  Component 3 candidate values: {2,3,4~~,5,6,7,8~~} | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-4 | Association up to 128 CSI-RS ports and SRS for non-codebook-based PUSCH | 1. Support association between {48, 64, 128} CSI-RS ports and SRS resource set for non-codebook-based PUSCH  2. A list of supported combinations, each combination is {Max # of Tx ports in a set of aggregated resources, Max # of sets of aggregated resource, and total # of Tx ports} simultaneously | 2-15 | Yes | n/a | Association up to 128 CSI-RS ports and SRS for non-codebook-based PUSCH is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate value: Maximum size of the list is 16.  The candidate values for the max # of Tx port in in a set of aggregated resources is  {48, 64, 128}  The candidate value set of the max # of sets of aggregated resource is:  {2, …, 64}  The candidate value set of total # of ports is:  {48, …, 256, 512, 768, 1024}  Note: Component 2 is reported per BC | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-4b | M=2 and R=1 for extended Rel-17 FeType-II PS (port selection) codebook for up to 64 ports | 1. Support M=2 and R=1 for extended Rel-17 FeType-II PS (port selection) codebook for up to 64 ports  2. Support of parameter combinations with M=2  3. A list of supported combinations, each combination is {Max # of Tx ports in a report, Max # of sets of aggregated resources, and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with M=2 and R=1 | 59-2-1-4 | Yes | n/a | M=2 and R=1 for extended Rel-17 FeType-II PS (port selection) codebook for up to 64 ports is not supported | Per band and Per BC | n/a | n/a | n/a | Component 3 candidate values  a. {48, 64}  b. {1, 2, …, 64, 128, 256}  c. {64, …, 256, 512, 768, 1024} | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-4c | M=2 and R=2 for extended Rel-17 FeType-II PS (port selection) codebook for up to 64 ports | 1. Support M=2 and R=2 for extended Rel-17 FeType-II PS (port selection) codebook for up to 64ports  2. A list of supported combinations, each combination is {Max # of Tx ports in a report, Max # of sets of aggregated resources, and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with M=2 and R=2 | 59-2-1-4 | Yes | n/a | M=2 and R=2 for extended Rel-17 FeType-II PS (port selection) codebook for up to 64 ports is not supported | Per band and Per BC | n/a | n/a | n/a | Component 2 candidate values  a. {48, 64}  b. {1, 2, …, 64, 128, 256}  c. {64, …, 256, 512, 768, 1024} | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-5c | N4>1 for extended Rel-18 Type-II Doppler codebook for up to 128 ports | 1. Support for the size of DD-basis, N4>1  2. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in a report, Max # of sets of aggregated resources or groups of aggregated resource, and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously  3. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in a report, Max # of sets of aggregated resources or groups of aggregated resource, and total # of Tx ports} for one CSI report setting  4. Value of d=m for the DD unit size when A-CSI-RS is configured for CMR | 59-2-1-5 | Yes | n/a | N4>1 for extended Rel-18 Type-II Doppler  codebook for up to 128 ports is not supported | Per band and Per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1,2,4,8}  b. {48, 64,128}  c. {1, 2,3,4 … 64, 128, 256}  d. {64, …, 256, 512, 768, 1024}  Component 3 Candidate values  a. {1,2,4,8}  b. {48, 64,128}  c. {4,8,12}  d. {64, …, 256} | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-5f | PMI subband R=2 for extended Rel-18 Type-II Doppler codebook for up to 128 ports | 1. Support PMI subband R=2 for Rel-18 Type-II Doppler codebook enhancement for up to 128 ports  2. A list of supported combinations, each combination is {Max N4, Max # of Tx ports in a report, Max # of ~~sets of aggregated~~ resources or groups of aggregated resource, and total # of Tx ports} across all CCs in a band when reported per band, and across all CCs in a band combination when reported per BC simultaneously with R=2 | 59-2-1-5 | Yes | n/a | PMI subband R=2 for extended Rel-18 Type-II Doppler  codebook for up to 128 ports is not supported | Per band and Per BC | n/a | n/a | n/a | Component 2 candidate values  a. {1,2,4,8}  b. {48, 64,128}  c. {1, 2,3,4 … 64, 128, 256}  d. {64, …, 256, 512, 768, 1024} | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-2-1-9 | NES SD Type1 for Rel-19 Type-I single-panel codebook | 1. Support NES SD Type1 for Rel-19 Type-I single-panel codebook  2. Supported NES SD Type1 timeline from two timeline capabilities, for Rel-19 Type-I single-panel codebook  3 Supported number of ports for CSI report subconfig | 59-2-1-1, 1a, 1b, 1c, 1d, or 1e and 42-1,1a, 1b or 1c | Yes | n/a | NES SD Type1 for Rel-19 Type-I single-panel codebook is not supported | ~~[~~Per-band and per-BC~~]~~ | n/a | n/a | n/a | Component 2 candidate values:   * Capability 1: Reuse legacy Z/Z’ values (i.e., Z2 and Z’2) * Capability 2 timeline: Scale the legacy timeline Z/Z’ (i.e., Z2 and Z’2) by where M is the number of sub-configurations that refer to the any of the K aggregated CSI-RS resources   Component 3 candidate values: One or more values from {2, 4, 8, 12, 16, 24, 32, 48, 64, 128} | Optional with capability signaling |

**Conclusion: The following is RAN1’s understanding for Case 1 in Question 1 in the RAN2 LS on per band and per BC capability (R1-2506724):**

* **When UE indicates both per band and per BC capability, regardless of whether CA is configured or not, if the capability/component is not counted across CCs, then the minimum capability between per BC capability and per band capability should be applied for a band in case of band combination (CA)**
  + **RAN1 will continue to discuss the case(s) when the capability is counted across CCs**
* **RAN1 will review by RAN1 #123 for which FGs special rules/handling may need to be defined in Rel. 19, e.g., in some cases a clear “ranking” between capabilities may need to be clarified in the Notes**

**Conclusion: The following is RAN1’s understanding for Case 2 in Question 1 in the RAN2 LS on per band and per BC capability (R1-2506724):**

* **RAN2’s understanding is generally correct**
* **RAN1 will review by RAN1 #123 for which FGs special rules/handling may need to be defined in Rel. 19**

**Conclusion: The following is RAN1’s understanding for Case 3 in Question 1 in the RAN2 LS on per band and per BC capability (R1-2506724):**

* **RAN2’s understanding is generally correct**
* **RAN1 will review by RAN1 #123 for which FGs special rules/handling may need to be defined in Rel. 19**

**Conclusion: The following is RAN1’s understanding for Question 2 in the RAN2 LS on per band and per BC capability (R1-2506724):**

* **For per band and per BC capabilities, it is expected that UE indicates the same granularity as the pre-requisite**

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-3-3 | 3T6R Antenna switching | 1. Support of 3T6R SRS Tx port switching with port 1003 disabled when 4 port SRS resources with port 1003 disabled are configured to the UE  2. Report the entry number of the first-listed band with UL in the band combination that affects this DL  3. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL |  | yes | n/a | 3TX 3T6R antenna switching is not supported | Per FS | n/a | n/a | n/a | Component 2 candidate value: {1,2, … 32}  Component 3 candidate value: {1,2, … 32}  Note: This UE feature can be signalled together with srs-AntennaSwitching8T8R-r18, srs-AntennaSwitchingBeyond4RX-r17, supportedSRS-TxPortSwitch-v1610, ~~or~~ supportedSRS-TxPortSwitch or 59-3-3a to indicate SRS antenna switching downgrading capability. | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-4-4d | PDCCH ordered sent by one TRP triggers RACH procedure towards a different TRP based on ~~CRFA~~ CFRA for inter-cell without CORESETPoolIndex | Support of PDCCH ordered sent by one TRP triggers RACH procedure towards a different TRP based on ~~CRFA~~ CFRA for inter-cell | 59-4-4b | yes | n/a | PDCCH ordered sent by one TRP triggers RACH procedure towards a different TRP based on ~~CRFA~~ CFRA for inter-cell is not supported without CORESETPoolIndex | Per FS | No | No | n/a |  | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 59. NR\_MIMO\_Ph5 | 59-4-9a | DCI format 1\_1 to indicate one of two separate SRS closed loop indexes under separate DL/UL TCI state mode | Support of DCI format 1\_1 to indicate one ~~or~~ of two separate SRS closed loop index(es) under separate DL/UL TCI state mode | 59-4-8 | yes | n/a | DCI 1\_1 indicating one of two separate SRS closed loop indexes under separate DL/UL TCI state mode is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signalling |
| 59. NR\_MIMO\_Ph5 | 59-4-9b | DCI format 1\_1 to indicate one of two separate SRS closed loop indexes under joint TCI state mode | Support of DCI format 1\_1 to indicate one ~~or~~ of two separate SRS closed loop index(es) under joint TCI state mode | 59-4-8 | yes | n/a | DCI 1\_1 indicating one of two separate SRS closed loop indexes under joint TCI state mode is not supported | Per band | n/a | FR1 only | n/a |  | Optional with capability signalling |

**Agreement: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

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| 59. NR\_MIMO\_Ph5 | 59-4-4c | RX timing difference larger than CP length for two TAs without restriction of multi-DCI based multi-TRP operation | Support of the RX timing difference between the two DL reference timings is larger than CP length for two TAs without restriction of multi-DCI based multi-TRP | 59-4-4a or 59-4-4b | yes | n/a | RX timing difference between the two DL reference timings is no larger than CP length for two TAs without restriction of multi-DCI based multi-TRP | Per FS | n/a | n/a | n/a |  | Optional with capability signalling |

**Revised Conclusion: The following is RAN1’s understanding for Case 1 in Question 1 in the RAN2 LS on per band and per BC capability (R1-2506724):**

* **When UE indicates both per band and per BC capability, ~~regardless of whether CA is configured or not,~~ if the capability/component is not counted across CCs, then the minimum capability between per BC capability and per band capability should be applied for a band in case of band combination (CA)**
  + **RAN1 will continue to discuss the case~~(~~s~~)~~** 
    - **when the capability/component is counted across CCs regardless of whether CA is configured or not**
    - **when the capability/component is not counted across CCs and CA is not configured**
  + **RAN1 will review by RAN1 #123 for which FGs special rules/handling may need to be defined in Rel. 19, e.g., in some cases a clear “ranking” between capabilities may need to be clarified in the Notes**

## UE features for evolution of NR duplex operation: SBFD

**R1-2507966** Session Notes of AI 9.3 Ad-Hoc Chair (NTT DOCOMO, INC.)

Session notes are endorsed and incorporated the session notes below.

R1-2506773 Discussion on UE features for SBFD ZTE Corporation, Sanechips

R1-2506801 Discussion on UE features for SBFD Spreadtrum, UNISOC

R1-2506883 UE features for evolution of NR duplex operation: SBFD vivo

R1-2506949 UE features for evolution of NR duplex operation Huawei, HiSilicon

R1-2506973 UE features for Rel-19 SBFD operation Xiaomi

R1-2507074 SBFD UE features Nokia

R1-2507101 UE features for SBFD CATT

R1-2507150 Discussion on UE features for Rel-19 NR Duplex OPPO

R1-2507238 UE features for NR duplex operation Samsung

R1-2507461 Discussion on UE features for evolution of NR duplex operation: SBFD Ofinno

R1-2507575 UE features for evolution of NR duplex operation MediaTek Inc.

R1-2507638 On UE features for evolution of NR duplex operation Google

R1-2507753 UE features for evolution of NR duplex operation Qualcomm Incorporated

R1-2507760 UE features for SBFD Ericsson

R1-2507797 Discussion on UE features for evolution of NR duplex operation NTT DOCOMO, INC.

**Agreement:**

Update FG 60-7b and 60-7c as follows:

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| 60-7b | Separate UL resource muting for Type-1 CG PUSCH for CP-OFDM waveform | Support of separate UL resource muting for Type-1 CG PUSCH for CP-OFDM waveform | FFS | ~~[~~YES~~]~~ | ~~[~~n/a~~]~~ | ~~[~~Separate UL resource muting for Type-1 CG PUSCH for CP-OFDM waveform is not supported~~]~~ | ~~[~~Per Band~~]~~ | ~~[~~TDD only~~]~~ | ~~[~~n/a~~]~~ | ~~[~~n/a~~]~~ | FFS: Whether/how to capture maximum number of UL muting symbols per slot | ~~[~~Optional with capability signalling~~]~~ |
| 60-7c | Separate UL resource muting for Type-1 CG PUSCH for DFT-s-OFDM waveform | Support of separate UL resource muting for Type-1 CG PUSCH for DFT-s-OFDM waveform | FFS | ~~[~~YES~~]~~ | ~~[~~n/a~~]~~ | ~~[~~Separate UL resource muting for Type-1 CG PUSCH for DFT-s-OFDM waveform is not supported~~]~~ | ~~[~~Per Band~~]~~ | ~~[~~TDD only~~]~~ | ~~[~~n/a~~]~~ | ~~[~~n/a~~]~~ | FFS: Whether/how to capture maximum number of UL muting symbols per slot | ~~[~~Optional with capability signalling~~]~~ |

**Agreement:**

* Adopt FG 60-7 and 5-19 for prerequisite FG(s) of FG 60-7b
* Adopt FG 60-7a and 5-19 for prerequisite FG(s) of FG 60-7c

**Agreement:**

Update FG 60-8 as follows:

* Confirm “aperiodic” in FG name, and update the text for “consequence …” column accordingly
* Define no prerequisite FG
* Adopt n/a for FR1/FR2 differentiation and capability interpretation for mixture of FDD/TDD and/or FR1/FR2
* Add “[Candidate values for component 4 are {8, 16, 32, 64}]”
* Remove “FFS: whether each of components within brackets is separate FG or require reporting”
* Remove “FFS: other potential component/FG”

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| 60-8 | L1 CLI-RSSI measurement and ~~[~~aperiodic~~]~~ reporting | 1. Aperiodic L1 CLI-RSSI reporting on PUSCH  2. Support of CLI-RSSI measurement resource configured in one UL subband only, in one DL subband only, or across two DL subbands only.  3. Periodic and aperiodic CLI-RSSI measurement resource  4. Maximum number of configured L1 CLI-RSSI measurement resources (sum of aperiodic and periodic, and semi-persistent if supported) across all CCs  ~~FFS: whether each of components within brackets is separate FG or require reporting~~  ~~FFS: other potential component/FG~~ | ~~FFS~~ | YES | n/a | ~~[Aperiodic]~~ L1 CLI-RSSI measurement and aperiodic reporting is not supported | Per band | TDD only | ~~[~~n/a~~]~~ | ~~[~~n/a~~]~~ | [Candidate values for component 4 are {8, 16, 32, 64}] | Optional with capability signalling |

**Agreement:**

Update FG 60-8a as follows:

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| 60-8a | Support of periodic L1 CLI-RSSI reporting on PUCCH | 1. Periodic L1 CLI-RSSI reporting on PUCCH | 60-8 | YES | n/a | Support of periodic L1 CLI-RSSI reporting on PUCCH is not supported | Per band | TDD only | n/a | n/a |  | Optional with capability signalling |

**Agreement:**

Update FG 60-9 as follows:

* Remove “FFS: whether each of components within brackets is separate FG or require reporting”
* Define no prerequisite FG
* Revise consequence such as “~~[Aperiodic]~~ L1 SRS-RSRP measurement and aperiodic reporting is not supported”
* Add “[Candidate values for component 2 are {4, 8, 16, 32}]” in Note column
* Remove “FFS: other potential component/FG”

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| 60-9 | L1 SRS-RSRP measurement and aperiodic reporting | 1. Aperiodic L1 SRS-RSRP reporting on PUSCH, and periodic and aperiodic SRS-RSRP measurement resource  2. Maximum number of L1 SRS-RSRP measurement resources across all CCs  ~~FFS: whether each of components within brackets is separate FG or require reporting~~  ~~FFS: other potential component/FG~~ | ~~FFS~~ | YES | n/a | ~~[Aperiodic]~~ L1 SRS-RSRP measurement and aperiodic reporting is not supported | Per band | TDD only | n/a | n/a | Candidate values for component 2 are {4, 8, 16, 32} | Optional with capability signalling |

**Agreement:**

For Msg.3 repetition in SBFD symbols, RAN1 to down-select one of the following alternatives below in RAN1#123:

* Alt-1: A new FG for Msg.3 repetition in SBFD symbols is introduced as follows:

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| 60-6 | Msg.3 repetition in SBFD symbols | Support of repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI in SBFD symbols with separate power control parameter | 60-3 or 60-4, 30-6 | YES | n/a | Msg.3 repetition in SBFD symbols is not supported | Per Band | TDD only | n/a | n/a |  | Optional with capability signalling |

* Alt-2: Adopt the following updates in FG 60-3 and 60-4
  + Add a new component: “X. Support of Msg.3 repetition in SBFD symbols”
  + Add in Note column: “Component X applies only when the UE reports FG 30-6 in the same band”
* Alt-3: Neither new component nor FG is added for support of Msg.3 repetition in SBFD symbols

**Agreement:**

* Remove “[“ from Component 2 in FG 60-1
* Remove “FFS: Whether to include two DL subband support in component 2”

**Agreement:**

Regarding “FFS: details of counting” in FG 60-1, adopt Alt1.1

* Alt-1: Update candidate values for Component 11
  + Alt-1.1: Component 11 candidate values: {“with factor-of-two relaxation for CSI timeline”, “with factor-of-two relaxation for active CSI-RS resource and port counting”, “no relaxation”}

**Agreement:**

Update FG 60-2 as follows:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 60-2 | Reception across SBFD symbols and non-SBFD symbols in different slots (Configuration 2) | 1. Support of PDSCH reception across SBFD symbols and non-SBFD symbols (Configuration 2)  ~~FFS: Other component(s)~~  ~~FFS: whether component 2 is defined as separate FG~~ | 60-1 | YES | n/a | Reception across SBFD symbols and non-SBFD symbols in different slots (Configuration 2) is not supported | Per Band | TDD only | n/a | n/a |  | Optional with capability signalling |

**Agreement:**

Update FG 60-2a as follows:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 60-2a | Transmission across SBFD symbols and non-SBFD symbols in different slots (Configuration 2) | 1. Support of UL transmission across SBFD symbols and non-SBFD symbols (Configuration 2) | ~~FFS~~ 60-1 | ~~[~~YES~~]~~ | ~~[~~n/a~~]~~ | ~~[~~Transmission across SBFD symbols and non-SBFD symbols in different slots (Configuration 2) is not supported~~]~~ | ~~[~~Per band~~]~~ | ~~[~~TDD only~~]~~ | ~~[~~n/a~~]~~ | ~~[~~n/a~~]~~ |  | ~~[~~Optional with capability signalling~~]~~ |

**Agreement:**

* Remove “FFS: other component (which may be separate FG)” from FG 60-1

## UE features for enhancements of network energy savings for NR

**R1-2508082** Session Notes of AI 9.4 Ad-Hoc Chair (AT&T)

Withdraw.

R1-2507135 Discussion on UE features for enhancements of network energy savings for NR OPPO

R1-2507640 UE features for R19 NES Ericsson

R1-2507659 Views on UE features for Rel-19 NES Apple

(Withdrawn)

R1-2507740 Summary of UE features for enhancements of network energy savings for NR Moderator (AT&T)

## UE features for LP-WUS/WUR for NR

**R1-2507968** Session Notes of AI 9.5 Ad-Hoc Chair (NTT DOCOMO, INC.) Ad-Hoc Chair (NTT DOCOMO, INC.)

Session notes are endorsed and incorporated the session notes below.

R1-2506826 Discussion on WUR features ZTE Corporation, Sanechips

R1-2506884 UE feature for Rel-19 LP-WUS/WUR vivo

R1-2506922 UE features for Rel-19 LP-WUS Huawei, HiSilicon

R1-2507075 LP-WUS/WUR UE features Nokia

R1-2507164 Discussion for UE features of LP-WUS/WUR OPPO

R1-2507239 UE features for LP-WUS/WUR for NR Samsung

R1-2507268 UE features for LP-WUS/WUR for NR Ericsson

R1-2507660 Views on Rel-19 LP-WUS/WUR UE features Apple

R1-2507706 UE features for LP-WUS/WUR for NR Qualcomm Incorporated

R1-2507798 Discussion on UE features for LP-WUS/WUR for NR NTT DOCOMO, INC.

**Agreement:**

Adopt Per FS for FG 62-2/2a/3’s type:

**Conclusion:**

There is no consensus to support the following limitation for Component 5 between FG 62-1 and 62-1a:

* Same value should be reported for component 5 between FG 62-1 and FG 62-1a, when a UE reports both FG 62-1 and 62-1a

**Conclusion:**

There is no consensus to support the following limitation for Component 3 between FG 62-2 and 62-2a:

* Same value should be reported for Component 3 between FG 62-2 and 62-2a, when a UE reports both FG 62-2 and 62-2a

## UE features for NR mobility enhancements Phase 4

**R1-2508083** Session Notes of AI 9.6 Ad-Hoc Chair (AT&T)

Session notes are endorsed and incorporated the session notes below.

R1-2506943 UE features for NR mobility enhancements phase 4 Huawei, HiSilicon

R1-2507039 Discussion on UE features for NR mobility enhancements Phase 4 ZTE Corporation, Sanechips

R1-2507076 NR mobility enhancements Phase 4 UE features Nokia

R1-2507128 Discussion on UE features for NR mobility enhancements Phase 4 CATT

R1-2507162 Discussion on UE features for NR mobility enhancements OPPO

R1-2507273 Remaining issues on UE features for Rel-19 LTM Samsung

R1-2507475 UE features for NR mobility enhancements phase 4 Ericsson

R1-2507741 Summary of UE features for NR mobility enhancements Phase 4 Moderator (AT&T)

R1-2507799 Discussion on UE features for NR mobility enhancemens Phase4 NTT DOCOMO, INC.

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 63. NR\_Mob\_Ph4 | 63-1 | NW triggered intra-frequency L1-RSRP measurement based on periodic CSI-RS (s) for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of intra-frequency L1- RSRP measurement and reporting based on periodic CSI-RS(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for intra-frequency L1-RSRP measurement on CSI-RS resource  3. Support of up to L candidate cells and M beams in one report where a CRI-RSRP pair is used for each beam report for intra-frequency L1-RSRP measurement  4. Maximum number of LTM CSI report configs using periodic CSI-RS as measurement resource | 45-1 | Yes | No | NW triggered intra-frequency L1-RSRP measurement based on periodic CSI-RS (s) for L1-L2 Triggered Mobility (LTM) procedure is not supported | Per BC | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 3 candidate values:  L: {1, 2,3,4}  M: {1, 2,3,4}  M × L: {1,2,3,4, 6, 8, 9, 12, 16}  Component 4 candidate values:  Aperiodic: {0,1,2,3,4}  Periodic: {1,2,3,4}  Semi-persistent: {0,1,2,3,4} | Optional with capability signaling |
| 63. NR\_Mob\_Ph4 | 63-1a | NW triggered inter-frequency L1-RSRP measurement based on periodic CSI-RS (s) for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of inter-frequency L1- RSRP measurement and reporting based on periodic CSI-RS(s) of candidate cell(s)  2. Maximum number of RRC configured candidate cells for inter-frequency L1-RSRP measurement on CSI-RS resource  3. Support of up to L candidate cells and M beams in one report where a CRI-RSRP pair is used for each beam report for inter-frequency L1-RSRP measurement  4. Maximum number of LTM CSI report configs using periodic CSI-RS as measurement resource | 45-1a | Yes | No | NW triggered inter-frequency L1-RSRP measurement based on periodic CSI-RS (s) for L1-L2 Triggered Mobility (LTM) procedure is not supported | Per BC | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 3 candidate values:  L: {1, 2,3,4}  M: {1, 2,3,4}  M × L: {1,2,3,4, 6, 8, 9, 12, 16}  Component 4 candidate values:  Aperiodic: {0,1,2,3,4}  Periodic: {1,2,3,4}  Semi-persistent: {0,1,2,3,4} | Optional with capability signaling |
| 63. NR\_Mob\_Ph4 | 63-2 | NW triggered intra-frequency L1-RSRP measurement based on semi-persistent CSI-RS (s) for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of intra-frequency L1- RSRP measurement and reporting based on semi-persistent CSI-RS(s) of candidate cell(s)  2. Maximum number of LTM CSI report configs using semi-persistent CSI-RS as measurement resource | 63-1 | Yes | No | NW triggered intra-frequency L1-RSRP measurement based on semi-persistent CSI-RS (s) for L1-L2 Triggered Mobility (LTM) procedure is not supported | Per BC | n/a | n/a | n/a | Component 2 candidate values:  Aperiodic: {0,1,2,3,4}  Semi-persistent: {0,1,2,3,4}  Note: For component 4, the UE must support a non-zero value for at least one of aperiodic and semi-persistent | Optional with capability signaling |
| 63. NR\_Mob\_Ph4 | 63-2a | NW triggered inter-frequency L1-RSRP measurement based on semi-persistent CSI-RS (s) for L1-L2 Triggered Mobility (LTM) procedure | 1. Support of inter-frequency L1- RSRP measurement and reporting based on semi-persistent CSI-RS(s) of candidate cell(s)  2. Maximum number of LTM CSI report configs using semi-persistent CSI-RS as measurement resource | 63-1a | Yes | No | NW triggered inter-frequency L1-RSRP measurement based on semi-persistent CSI-RS (s) for L1-L2 Triggered Mobility (LTM) procedure is not supported | Per BC | n/a | n/a | n/a | Component 2 candidate values:  Aperiodic: {0,1,2,3,4}  Semi-persistent: {0,1,2,3,4}  Note: For component 4, the UE must support a non-zero value for at least one of aperiodic and semi-persistent | Optional with capability signaling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 63. NR\_Mob\_Ph4 | 63-6 | ~~Intra-frequency~~ CSI-RS and CSI-IM measurement and CSI reporting for cell indicated in CSC MAC CE after reception of LTM CSC MAC CE based on periodic CSI-RS and CSI-IM resource | 1. Support of CSI-RS and CSI-IM measurement and CSI reporting after reception of LTM CSC MAC CE based on periodic CSI-RS(s) and CSI-IM resources of cell indicated in CSC MAC CE  3. Maximum number of CSI-RS resources for CMR associated with CSI report configuration for a candidate cell  4. Max number of ports of CSI-RS resource(s) associated with a CSI report configuration for CSI reporting for a candidate cell  5. Maximum number of ports in one NZP CSI-RS resource  6. Max rank for CSI reporting for a candidate cell  7. Maximum number of CSI-IM resources for interference measurement associated with CSI report configuration for a candidate cell | ~~FFS~~ RAN2 FG for LTM in Rel-18 | Yes | No | ~~Intra-frequency~~ Periodic CSI-RS and CSI-IM measurement and CSI reporting for cell indicated in CSC MAC CE after reception of LTM CSC MAC CE is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values: {1,2,3,4,5,6,7,8}  Component 4 candidate values: {1,2,4,8,12,16,24,32,48,64,128}  Component 5 candidate values: {1, 2, 4, 8, 12, 16, 24, 32}  Component 6 candidate values: {1,2,3,4,5,6,7,8}  Component 7 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signaling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 63. NR\_Mob\_Ph4 | 63-6a | ~~Intra-frequency~~ CSI-RS and CSI-IM measurement and CSI reporting for cell indicated in CSC MAC CE after reception of LTM CSC MAC CE based on semi-persistent CSI-RS and CSI-IM resource | 1. Support of CSI-RS and CSI-IM measurement and CSI reporting after reception of LTM CSC MAC CE based on ~~periodic~~ semi-persistent CSI-RS(s) and CSI-IM resources of cell indicated in CSC MAC CE  3. Maximum number of CSI-RS resources for CMR associated with CSI report configuration for a candidate cell  4. Max number of ports of CSI-RS resource(s) associated with a CSI report configuration for CSI reporting for a candidate cell  5. Maximum number of ports in one NZP CSI-RS resource  6. Max rank for CSI reporting for a candidate cell  7. Maximum number of CSI-IM resources for interference measurement associated with CSI report configuration for a candidate cell | ~~FFS~~ 63-6 | Yes | No | ~~Intra-frequency~~ Semi-persistent CSI-RS and CSI-IM measurement and CSI reporting for cell indicated in CSC MAC CE after reception of LTM CSC MAC CE is not supported | Per band | n/a | n/a | n/a | Component 3 candidate values: {1,2,3,4,5,6,7,8}  Component 4 candidate values: {1,2,4,8,12,16,24,32,48,64,128}  Component 5 candidate values: {1, 2, 4, 8, 12, 16, 24, 32}  Component 6 candidate values: {1,2,3,4,5,6,7,8}  Component 7 candidate values: {1,2,3,4,5,6,7,8} | Optional with capability signaling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 63. NR\_Mob\_Ph4 | 63-7 | Intra-frequency CSI-RS and CSI-IM measurement for candidate cell before reception of LTM CSC MAC CE based on periodic CSI-RS(s) and CSI-IM resources of candidate cells | 1. Support of intra-frequency CSI-RS and CSI-IM measurement before reception of CSC MAC CE based on periodic CSI-RS(s) and CSI-IM resources of candidate cells  2. Maximum number of RRC configured candidate cells for CSI measurement before LTM CSC MAC CE  3. Maximum number of RRC configured CSI-RS resources across candidate cells RRC configured for CSI measurement before LTM CSC MAC CE  4. Max number of ports of CSI-RS resource(s) associated with a CSI report configuration for CSI reporting for a candidate cell  5. Maximum number of ports in one NZP CSI-RS resource associated with a CSI report configuration for CSI reporting for a candidate cell  6. Maximum number of RRC configured CSI-IM resources across candidate cells RRC configured for CSI measurement before LTM CSC MAC CE | 63-6 | Yes | No | Intra-frequency periodic CSI-RS and CSI-IM measurement for candidate cell before reception of LTM CSC MAC CE is not supported | Per BC | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 3 candidate values: {1,2,...64}  Component 4 candidate values: {1,2,4,8,12,16,24,32,48,64,128}  Component 5 candidate values: {1,2,4,8,12,16,24,32}  Component 6 candidate values: {1,2,…64} | Optional with capability signaling |
| 63. NR\_Mob\_Ph4 | 63-7c | Inter-frequency CSI-RS and CSI-IM measurement for candidate cell before reception of LTM CSC MAC CE based on periodic CSI-RS(s) and CSI-IM resources of candidate cells | 1. Support of inter-frequency CSI-RS and CSI-IM measurement before reception of CSC MAC CE based on periodic CSI-RS(s) and CSI-IM resources of candidate cells  2. Maximum number of RRC configured candidate cells for CSI measurement before LTM CSC MAC CE  3. Maximum number of RRC configured CSI-RS resources across candidate cells RRC configured for CSI measurement before LTM CSC MAC CE  4. Max number of ports of CSI-RS resource(s) associated with a CSI report configuration for CSI reporting for a candidate cell  5. Maximum number of ports in one NZP CSI-RS resource associated with a CSI report configuration for CSI reporting for a candidate cell  6. Maximum number of RRC configured CSI-IM resources across candidate cells RRC configured for CSI measurement before LTM CSC MAC CE | 63-6 | Yes | No | Inter-frequency periodic CSI-RS and CSI-IM measurement for candidate cell before reception of LTM CSC MAC CE is not supported | Per BC | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 3 candidate values: {1,2,...64}  Component 4 candidate values: {1,2,4,8,12,16,24,32,48,64,128}  Component 5 candidate values: {1,2,4,8,12,16,24,32}  Component 6 candidate values: {1,2,…64} | Optional with capability signaling |
| 63. NR\_Mob\_Ph4 | 63-7a | Intra-frequency CSI-RS and CSI-IM measurement for candidate cell before reception of LTM CSC MAC CE based on semi-persistent CSI-RS(s) and CSI-IM resources of candidate cells | 1. Support of intra-frequency CSI-RS and CSI-IM measurement before reception of CSC MAC CE based on semi-persistent CSI-RS(s) and CSI-IM resources of candidate cells  2. Maximum number of RRC configured candidate cells for CSI measurement before LTM CSC MAC CE  3. Maximum number of RRC configured CSI-RS resources across candidate cells RRC configured for CSI measurement before LTM CSC MAC CE  4. Max number of ports of CSI-RS resource(s) associated with a CSI report configuration for CSI reporting for a candidate cell  5. Maximum number of ports in one NZP CSI-RS resource associated with a CSI report configuration for CSI reporting for a candidate cell  6. Maximum number of RRC configured CSI-IM resources across candidate cells RRC configured for CSI measurement before LTM CSC MAC CE | 63-6a | Yes | No | Intra-frequency semi-persistent CSI-RS and CSI-IM measurement for candidate cell before reception of LTM CSC MAC CE is not supported | Per BC | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 3 candidate values: {1,2,...64}  Component 4 candidate values: {1,2,4,8,12,16,24,32,48,64,128}  Component 5 candidate values: {1,2,4,8,12,16,24,32}  Component 6 candidate values: {1,2,...64} | Optional with capability signaling |
| 63. NR\_Mob\_Ph4 | 63-7d | Inter-frequency CSI-RS and CSI-IM measurement for candidate cell before reception of LTM CSC MAC CE based on semi-persistent CSI-RS(s) and CSI-IM resources of candidate cells | 1.. Support of inter-frequency CSI-RS and CSI-IM measurement before reception of CSC MAC CE based on semi-persistent CSI-RS(s) and CSI-IM resources of candidate cells  2. Maximum number of RRC configured candidate cells for CSI measurement before LTM CSC MAC CE  3. Maximum number of RRC configured CSI-RS resources across candidate cells RRC configured for CSI measurement before LTM CSC MAC CE  4. Max number of ports of CSI-RS resource(s) associated with a CSI report configuration for CSI reporting for a candidate cell  5. Maximum number of ports in one NZP CSI-RS resource associated with a CSI report configuration for CSI reporting for a candidate cell  6. Maximum number of RRC configured CSI-IM resources across candidate cells RRC configured for CSI measurement before LTM CSC MAC CE | 63-6a | Yes | No | Inter-frequency semi-persistent CSI-RS and CSI-IM measurement for candidate cell before reception of LTM CSC MAC CE is not supported | Per BC | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4,5,6,7,8}  Component 3 candidate values: {1,2,...64}  Component 4 candidate values: {1,2,4,8,12,16,24,32,48,64,128}  Component 5 candidate values: {1,2,4,8,12,16,24,32}  Component 6 candidate values: {1,2,...64} | Optional with capability signaling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 63. NR\_Mob\_Ph4 | 63-10 | ~~Intra-frequency~~ CSI-RS~~-RS~~ measurement and CSI reporting without CSI-IM reception | 1. Support of CSI-RS measurement and CSI reporting for candidate cells without CSI-IM resource configuration | 63-6 or 63-6a or 63-7 or 63-7a or 63-11 | Yes | No | ~~Intra-frequency~~ CSI-RS~~-RS~~ measurement and CSI reporting without CSI-IM reception is not supported | Per band | n/a | n/a | n/a |  | Optional with capability signaling |

## UE features for XR for NR Phase 3

Without submitted contributions.

## UE features for NTN for NR Phase 3

**R1-2507970** Session Notes of AI 9.8 Ad-Hoc Chair (NTT DOCOMO, INC.)

Session notes are endorsed and incorporated the session notes below.

**Agreement:**

Update FG 65-3-1 as follows:

* Type column is per band
* Confirm “Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 in TS 38.101-5”, i.e., FG 65-3-1 is applicable only to FR1-NTN bands

**Agreement:**

Adopt Alt-1a for FG 65-3-1.

* Alt-1a: Confirm Component 4 with the following update:
  + ~~[~~4. Support of keeping phase continuity and power consistency across one OCC group as per requirements defined by RAN4~~]~~

**Agreement:**

Regarding FG 65-3-1,

* Support GSO/NGSO differentiation
* Adopt Alt-1 below
  + Alt-1: Add component 6 of “Supported satellite orbit for PUSCH with OCC” in components column and add “Component 6 candidate values: {(GSO), (NGSO), (GSO and NGSO)}” in note column

**Agreement:**

For FG 65-3-1,

* Put 26-1 and at least one of {5-14, 5-16, 5-17} in prerequisite column

**Agreement:**

Update FG 65-2-1 as follows:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 65-2-1 | Handling collision Case 3 ~~[~~and collision Case 4~~]~~ for half-duplex FDD operation for (e)RedCap UE | 1. Support handling collision Case 3  ~~[~~2. Support handling collision Case 4~~]~~  ~~FFS: whether to divide this FG into two separate FGs between case 3 and case 4~~ | ~~FFS:~~ 26-1, ~~26-4, 28-1,~~ 28-3, ~~48-1, 48-2~~ | YES | N/A | Handling collision Case 3 and collision Case 4 for half-duplex FDD operation for (e)RedCap UE is not supported | Per band | N/A | N/A | N/A | Note: This UE feature group is applicable only for bands in Tables 5.2.2-1 in TS 38.101-5  Note: collision Case 3: Semi-statically configured DL reception collides with semi-statically configured UL transmission  ~~[~~Note: collision Case 4: Dynamically scheduled DL reception collides with dynamic scheduled UL transmission~~]~~  Note: this FG is for FR1 FDD only  Note: collision Case 3 handling is for RRC CONNECTED and INACTIVE states~~[~~, and collision Case 4 is for RRC CONNECTED state only~~]~~ | Optional with capability signaling  ~~FFS: A UE that supports FG 28-3 in NTN band must support this FG~~ |

**Agreement:**

For FG 65-1-1,

* Put “see Note” in “Need for the gNB to know if the feature is supported” column
* Confirm “Optional with capability signalling” in mandatory/optional column
* Add in the Note column: “Note: The capability signalling is introduced to allow the NW to collect the statistics about the percentage of UEs that support this feature”

**Agreement:**

Regarding FG 65-1-5:

* Remove “[FFS other components]”

**Agreement:**

Remove [A UE that includes [XXX (signaling to be defined in 38.321)] must support FG 65-1-5] from the Note column

R1-2506787 On UE features for NR-NTN Phase 3 Ericsson

R1-2506802 Discussion on UE features for NTN Spreadtrum, UNISOC

R1-2506885 UE features for NTN for NR Phase 3 vivo

R1-2506913 Discussion on the UE feature for NR-NTN Phase-3 ZTE Corporation, Sanechips

R1-2506938 UE features for NTN for NR phase 3 Huawei, HiSilicon

R1-2506974 UE features for NTN for NR Phase 3 Xiaomi

R1-2507005 Discussion on UE features for NTN for NR Phase 3 CMCC

R1-2507077 NR-NTN phase 3 UE features Nokia

R1-2507102 Discussion on UE features for NTN for NR Phase 3 CATT

R1-2507136 Discussion on UE features for NTN for NR Phase 3 OPPO

R1-2507240 UE features for NR NTN Phase 3 Samsung

R1-2507495 Discussion on UE features for NR NTN Phase 3 ETRI

R1-2507625 Discussions on UE Features NR NTN Ph3 MediaTek Inc.

R1-2507661 Views on UE features for Rel-19 NR-NTN Apple

R1-2507707 UE features for NTN for NR Phase 3 Qualcomm Incorporated

R1-2507800 Discussion on UE features for R19 NR NTN NTT DOCOMO, INC.

## UE features for NTN for Internet of Things (IoT) Phase 3

**R1-2507972** Session Notes of AI 9.9 Ad-Hoc Chair (NTT DOCOMO, INC.)

Session notes are endorsed and incorporated the session notes below.

**Agreement:**

Adopt the following changes in FG 1-1 and 1-2

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1-1 | OCC for single-tone NPUSCH format 1 with 3.75 kHz SCS in RRC\_CONNECTED | 1. Support of symbol-level length-2 OCC for single-tone NPUSCH format 1 with 3.75 kHz SCS in RRC\_CONNECTED  2. Support of TDM DMRS over 4 slots where DMRS are transmitted in the first 2 slots and DMRS REs are blanked in the next 2 slots, or vice-versa  3. Dynamic activation/deactivation of OCC feature via DCI  4. Whether to support combined operation of OCC and interleaved multi-TB scheduling | Rel-17 2-1b | Yes | N/A | UE does not support OCC for single-tone NPUSCH format 1 with 3.75 kHz SCS in RRC\_CONNECTED | Per UE | FDD only | N/A | Note: This FG is applicable only to IoT-NTN FDD band  Component 4 candidate values: {support, not support} | Optional with capability signalling |
| 1-2 | OCC for single-tone NPUSCH format 1 with 15 kHz SCS in RRC\_CONNECTED | 1. Support of slot-level length-2 OCC for single-tone NPUSCH format 1 with 15 kHz SCS in RRC\_CONNECTED  2. Support of CDM DMRS for NPUSCH format 1 with 15 kHz SCS  3. Dynamic activation/deactivation of OCC feature via DCI  4. Whether to support combined operation of OCC and interleaved multi-TB scheduling | Rel-17 2-1b | Yes | N/A | UE does not support OCC for single-tone NPUSCH format 1 with 15 kHz SCS in RRC\_CONNECTED | Per UE | FDD only | N/A | Note: This FG is applicable only to IoT-NTN FDD band  Component 4 candidate values: {support, not support} | Optional with capability signalling |

R1-2506914 Discussion on the UE feature for NTN for Internet of Things (IoT) Phase 3 ZTE Corporation, Sanechips

R1-2506939 UE features for IoT-NTN Phase 3 Huawei, HiSilicon

R1-2507103 Discussion on UE features for NTN for Internet of Things (IoT) Phase 3 CATT

R1-2507137 Discussion on UE features for NTN for Internet of Things Phase 3 OPPO

R1-2507260 On UE features for IoT-NTN Phase 3 Ericsson

R1-2507276 UE features for IoT NTN Phase 3 Samsung

## UE features for IoT-NTN TDD mode

**R1-2507974** Session Notes of AI 9.10 Ad-Hoc Chair (NTT DOCOMO, INC.)

Withdraw

R1-2506940 UE features for IoT-NTN TDD mode Huawei, HiSilicon

R1-2507126 Discussion on UE features for IoT-NTN TDD mode CATT

R1-2507138 Discussion on UE features for IoT-NTN TDD mode OPPO

R1-2507275 UE features for IoT NTN TDD mode Samsung

## UE features for MCE for NR Phase 3

**R1-2507976** Session Notes of AI 9.11 Ad-Hoc Chair (NTT DOCOMO, INC.)

Session notes are endorsed and incorporated the session notes below.

**Agreement:**

For FG 66-3 and 66-4:

* Adopt “Per BC” for Type column
* Adopt “n/a” for FDD/TDD differentiation, FR1/FR2 differentiation and capability interpretation columns
* Add the following note in FG 66-3 Note column
  + “Note: Only cell(s) with {120kHz SCS, FR2-1} among the set of cells can be scheduled with more than one PDSCH”
* Add the following note in FG 66-4 Note column
  + “Note: Only cell(s) with {120kHz SCS, FR2-1}, {15kHz SCS, FR1} and/or {30kHz SCS, FR1} among the set of cells can be scheduled with more than one PUSCH”
* Remove the following FFS in FG 66-3 and 66-4
  + FFS: Whether to limit this FG to particular FR and/or SCS
  + FFS: Whether to separate this FG per FR and/or SCS
  + FFS: other component(s)
* For FG 66-3, define “at least one of {49-1, 49-1b, 66-1}” as prerequisite FGs
* For FG 66-4, define “at least one of {49-2, 49-2b, 66-2}” as prerequisite FGs

**Agreement:**

Update FG 66-1 as follows:

* Change FR2 to FR2-1 for Component 2 (as agreed in RAN1#122)
* Introduce the following new components:
  + “Scheduling cell is PCell if set of cells includes PCell, and scheduling cell is PCell or an SCell if set of cells includes only SCells.”
  + “Max number of co-scheduled cells per set of cells supported by UE is reported with candidate value set of {2, 3, 4}”
  + “Max number of sets of cells supported by UE across PUCCH groups: Candidate value set of {1, 2, 3, 4, 5, 6, 7, 8}”
  + “Max number of sets of cells supported by UE for a same scheduling cell: Candidate value set of {1, 2, 3, 4}”
  + “Supported HARQ feedback types, candidate values: {type 1, type2, type 1 and type 2}, Note: the UE shall report the same value for all supported BC for FG 66-1”
  + “Supported co-scheduled cell indication schemes: Candidate value set of {FDRA field based, co-scheduled cell indicator field based, both}”
  + “Support Type-2 for ‘Antenna port(s)’ field”

**Agreement:**

Update FG 66-2 as follows:

* Change FR2 to FR2-1 for Component 2 (as agreed in RAN1#122)
* Introduce the following new components:
  + “Scheduling cell is PCell if set of cells includes PCell, and scheduling cell is PCell or an SCell if set of cells includes only SCells”
  + “Max number of co-scheduled cells per set of cells supported by UE is reported with candidate value set of {2, 3, 4}”
  + “Max number of sets of cells supported by UE across PUCCH groups: Candidate value set of {1, 2, 3, 4, 5, 6, 7, 8}”
  + “Max number of sets of cells supported by UE for a same scheduling cell: Candidate value set of {1, 2, 3, 4}”
  + “Supported co-scheduled cell indication schemes: Candidate value set of {FDRA field based, co-scheduled cell indicator field based, both}”
  + “Support Type-2 for ‘Antenna port(s)’ field”

**Agreement:**

* Introduce the following new component in FG 66-1:

|  |
| --- |
| Monitoring SS set(s) for DCI format 1\_3 for a set of cells for the following cases   * 1) Search space set configuration for DCI format 1\_3 for the set of cells is provided only on the scheduling cell, or; * 2) Search space set configurations for DCI format 1\_3 for the set of cells with the same searchSpaceId are provided on both the scheduling cell and a serving cell in the set of cells with the scheduling cell being NOT in the set of cells * UE supporting FG 66-1 can additionally report whether the UE support following case   + 3) Search space set configurations for DCI format 1\_3 for the set of cells with the same searchSpaceId are provided on both the scheduling cell and a serving cell in the set of cells with the scheduling cell being in the set of cells |

* Introduce the following new component in FG 66-2:

|  |
| --- |
| Monitoring SS set(s) for DCI format 0\_3 for a set of cells for the following cases   * 1) Search space set configuration for DCI format 0\_3 for the set of cells is provided only on the scheduling cell, or; * 2) Search space set configurations for DCI format 0\_3 for the set of cells with the same searchSpaceId are provided on both the scheduling cell and a serving cell in the set of cells with the scheduling cell being NOT in the set of cells * UE supporting FG 66-2 can additionally report whether the UE support following case   + 3) Search space set configurations for DCI format 0\_3 for the set of cells with the same searchSpaceId are provided on both the scheduling cell and a serving cell in the set of cells with the scheduling cell being in the set of cells |

**Agreement:**

Introduce the following new component in FG 66-1:

|  |
| --- |
| The number of unicast DL DCIs to process per N consecutive slots of scheduling cell for a set of cells configured for multi-cell PDSCH scheduling by DCI format 1\_3   * One DCI format 1\_3 for the set of cells and, * One unicast DL DCI formats 1\_0/1\_1/1\_2 (if supported) for each of the cells that are not scheduled by DCI 1\_3   + FFS support of more than one unicast DL DCI for the case when the UE indicates support of more than one unicast DCI per slot based on Rel-16 capability * SCS1 is the SCS of scheduling CC, and SCS2 is the smallest SCS among all cells in the cell set   + For SCS1 smaller than or equal to SCS2, N = 1   + For SCS1 larger than SCS2: N=2 for (SCS1 equal to 30kHz, SCS2 equal to 15kHz) |

**Agreement:**

Introduce the following new component in FG 66-2:

|  |
| --- |
| The number of unicast UL DCIs to process per N consecutive slots of scheduling cell for a set of cells configured for multi-cell PUSCH scheduling by DCI format 0\_3   * For FDD scheduling cell   + Up to one DCI format 0\_3 for the set of cells and,   + Up to one unicast UL DCI formats 0\_0/0\_1/0\_2 (if supported) for each of the cells     - FFS support of more than one unicast UL DCI for the case when the UE indicates support of more than one unicast DCI per slot based on Rel-16 capability   + For a cell in a set of cells, no more than one DCI scheduling PUSCH for the cell     - FFS support of more than one unicast UL DCI for the case when the UE indicates support of more than one unicast DCI per slot based on Rel-16 capability * For TDD scheduling cell   + Up to two DCI format 0\_3 for the set of cells and,   + Up to two unicast UL DCI formats 0\_0/0\_1/0\_2 (if supported) for each of the cells     - FFS support of more than one unicast UL DCI for the case when the UE indicates support of more than one unicast DCI per slot based on Rel-16 capability   + For a cell in a set of cells, no more than two DCI scheduling PUSCH for the cell     - FFS support of more than one unicast UL DCI for the case when the UE indicates support of more than one unicast DCI per slot based on Rel-16 capability * SCS1 is the SCS of scheduling CC, and SCS2 is the smallest SCS among all cells in the cell set   + For SCS1 smaller than or equal to SCS2, N = 1   + For SCS1 larger than SCS2: N=2 for (SCS1 equal to 30kHz, SCS2 equal to 15kHz) |

**Agreement:**

Adopt the following updates in FG 66-1/2:

* Consequence if the feature is not supported by the UE
  + For FG 66-1: “Multi-cell PDSCH scheduling by DCI format 1\_3 with different SCS and/or different carrier type of cells in the cell set is not supported”
  + For FG 66-2: “Multi-cell PUSCH scheduling by DCI format 0\_3 with different SCS and/or different carrier type of cells in the cell set is not supported”
* Remove “FFS: Other component(s)” in FG 66-1/2 Component column
* Remove FFS in FG 66-1/2 Note column

**Agreement:**

Update the FG for “Support of three sets of (carrier type, SCS) for the cells in the set for multi-cell PDSCH scheduling by DCI format 1\_3 with different SCS and/or different carrier type” as follows:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 66-1a | Support of three sets of (carrier type, SCS) for the cells in the set for multi-cell PDSCH scheduling by DCI format 1\_3 with different SCS and/or different carrier type | ~~FFS~~  Supported applicable combinations of the following from the band combination:  - Three sets of (carrier type, SCS) for the cells in the set: {(FR1 licensed FDD, 15kHz), (FR1 licensed TDD, 30kHz), (FR2-1, 60kHz), (FR2-1, 120kHz)}  - A set of (carrier type, SCS) for scheduling cell: {(FR1 licensed FDD, 15kHz), (FR1 licensed TDD, 30kHz)}, Note: the UE shall report the same value(s) as for FG 66-1 | ~~FFS~~ 66-1 | ~~FFS~~ Yes | ~~FFS~~ n/a | ~~FFS~~ Three sets of (carrier type, SCS) for the cells in the set for multi-cell PDSCH scheduling by DCI format 1\_3 with different SCS and/or different carrier type of cells in the cell set is not supported | ~~FFS~~ Per BC | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ | ~~FFS~~ Optional with capability signalling |

**Agreement:**

Update FG 66-2a as follows:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 66-2a | Support of three sets of (carrier type, SCS) for the cells in the set for multi-cell PUSCH scheduling by DCI format 0\_3 with different SCS and/or different carrier type | ~~FFS~~  Supported applicable combinations of the following from the band combination:  - Three sets of (carrier type, SCS) for the cells in the set: {(FR1 licensed FDD, 15kHz), (FR1 licensed TDD, 30kHz), (FR2-1, 60kHz), (FR2-1, 120kHz)}  - A set of (carrier type, SCS) for scheduling cell: {(FR1 licensed FDD, 15kHz), (FR1 licensed TDD, 30kHz)}, Note: the UE shall report the same value(s) as for FG 66-2 | ~~FFS~~ 66-2 | ~~FFS~~ Yes | ~~FFS~~ n/a | ~~FFS~~ Three sets of (carrier type, SCS) for the cells in the set for multi-cell PUSCH scheduling by DCI format 0\_3 with different SCS and/or different carrier type of cells in the cell set is not supported | ~~FFS~~ Per BC | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ n/a | ~~FFS~~ | ~~FFS~~ Optional with capability signalling |

**Agreement:**

Ask RAN2 to feedback if it is possible to update prerequisite FG(s) for Rel-18 RAN1 FG 49-4a/4b/4c/4d/5a/5b/6/7/8/9/10/12/12a/13/14 in Rel-19 as follows (red fonts):

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 49-4a | Nominal RBG size of Configuration 3 for FDRA type 0 for DCI format 1\_3 | 1) Support of nominal RBG size of Configuration 3 for FDRA type 0 for DCI format 1\_3 | At least one of {49-1, 49-1b, 66-1} |
| 49-4b | Nominal RBG size of Configuration 3 for FDRA type 0 for DCI format 0\_3 | 1) Support of nominal RBG size of Configuration 3 for FDRA type 0 for DCI format 0\_3 | At least one of {49-2, 49-2b, 66-2} |
| 49-4c | Configurable Type-1A fields for DCI format 0\_3/1\_3 | 1) Support Type-1A for ‘Antenna port(s)’ field for DCI format 1\_3  2) Support Type-1A for ‘Antenna port(s)’, ‘Precoding information and number of layers’ and ‘SRS resource indicator’ fields for DCI format 0\_3 | At least one of {49-1, 49-1b, 49-2, 49-2b, 66-1, 66-2} |
| 49-4d | FDRA Type 1 granularity of 2, 4, 8, or 16 consecutive RBs based RIV for DCI format 1\_3/0\_3 | 1) Support of FDRA Type 1 granularity of 2, 4, 8, or 16 consecutive RBs based RIV for DCI format 0\_3  2) Support of FDRA Type 1 granularity of 2, 4, 8, or 16 consecutive RBs based RIV for DCI format 1\_3 | At least one of {49-1, 49-1b, 49-2, 49-2b, 66-1, 66-2} |
| 49-5a | Trigger Type 3 HARQ CB based feedback using DCI format 1\_3 | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_3 scheduling at least a PDSCH  2. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_3 without scheduling a PDSCH using a reserved FDRA value | At least one of {49-1, 49-1b, 66-1} |
| 49-5b | Trigger enhanced Type 3 HARQ CB based feedback using DCI format 1\_3 | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_3  2. Support configuration of up to 8 enhanced type 3 HARQ-ACK codebooks.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook based on triggering information in DCI 1\_3  4. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 49-6)  5. Supported maximum number of actual PUCCH transmissions for type 3 or enhanced type 3 HARQ-ACK codebook feedback within a slot | At least one of {49-1, 49-1b, 66-1} |
| 49-6 | Two HARQ-ACK codebooks with up to one sub-slot based HARQ-ACK codebook simultaneously constructed for supporting HARQ-ACK codebooks with different priorities by DCI format 1\_3 | 1. Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed with the restriction up to one sub-slot based HARQ-ACK codebook.  2. Supports separate PUCCH configuration for different HARQ-ACK codebooks.  3. Supports 2-level priority of HARQ-ACK for dynamically scheduled PDSCH and SPS PDSCH.  4. Supports a DCI format 1\_3 scheduling PDSCH with different HARQ-ACK priorities when only DCI format 0\_3/1\_3 is configured per BWP.  5. Supports separate configuration of parameters PDSCH-HARQ-ACK-Codebook, UCI-OnPUSCH and 'codeBlockGroupTransmission" for different HARQ-ACK codebooks.  6. Supported maximum number of actual PUCCH transmissions for HARQ-ACK within a slot   * Candidate values for the component 6 of this FG is: For NCP, {4, 5, 6, 7} for 2-symbol\*7 sub-slot configuration; For ECP, the candidate value is {4,5,6} for 2-symbol\*6 sub-slot configuration   7. Support intra-UE multiplexing/prioritization of UL overlapping channels/signals with two priority levels for HARQ-ACK | At least one of {49-1, 49-1b, 66-1} |
| 49-7 | UL intra-UE multiplexing/prioritization of overlapping channel/signals with two priority levels in physical layer for DCI format 1\_3/0\_3 | Support intra-UE multiplexing/prioritization of overlapping PUCCH/PUCCH and PUCCH/PUSCH with two priority levels in physical layer (PHY) for DCI format 1\_3/0\_3  1) Configuration of PHY priority level for CG PUSCH and SR, and dynamic indication of priority level for dynamic PUSCH with a single DCI format 0\_3  2) Multiplexing/prioritization between UL channels/signals with the same PHY priority level  3) Prioritization between UL channels/signals with different PHY priority levels  4) Additional number of symbols (d1) needed beyond the PUSCH preparation time for cancelling a low priority UL transmission.  5) Additional number of symbols (d2) of the preparation time needed for the high priority UL transmission that cancels a low priority UL transmission | At least one of {49-1, 49-1b, 49-2, 49-2b, 66-1, 66-2} |
| 49-8 | Triggered HARQ-ACK codebook re-transmission for DCI format 1\_3 | 1. Support HARQ-ACK re-transmission from an earlier PUCCH slot based on the triggering information in DCI format 1\_3  2. Support the related PHY priority handling in terms of HARQ-ACK codebook selection and the applicable PUCCH configuration (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 49-6)  3. Supported minimum value M for the HARQ re-tx offset  4. Supported maximum value N for the HARQ re-tx offset | at least one of {49-1, 49-1b, 66-1} |
| 49-9 | SCell dormancy indication within active time in DCI format 0\_3/1\_3 | Support for SCell dormancy indication sent within the active time on PCell with DCI format 0\_3/1\_3 | 6-5, at least one of {49-1, 49-1b, 49-2,49-2b, 66-1, 66-2} |
| 49-10 | Dynamic indication of applicable minimum scheduling restriction by DCI format 0\_3/1\_3 | 1) Dynamic indication of applicable minimum scheduling restriction by DCI format 0\_3 and 1\_3  2) minimumSchedulingOffset K0 configuration for PDSCH and aperiodic CSI-RS triggering offset  3) minimumSchedulingOffset K2 configuration for PUSCH  4) Support of extended value range for aperiodic CSI-RS triggering offset | At least one of {49-1, 49-1b, 49-2,49-2b, 66-1, 66-2} |
| 49-12 | Unified TCI with joint DL/UL TCI update by DCI format 1\_3 for intra-cell and inter-cell beam management with more than one MAC-CE activated joint TCI state per CC | 1: TCI state indication for update and activation   1. MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_3 with DL assignment for at least one serving cell in a scheduledCellListDCI-1-3 to provide indicated unified TCI state(s) for the CC(s) in the scheduledCellListDCI-1-3)   2: The minimum beam application time in Y symbols per SCS  3: The maximum number of MAC-CE activated joint TCI states per CC in a band | 23-1-1, At least one of {49-1, 49-1b, 66-1} |
| 49-12a | Unified TCI with separate DL/UL TCI update by DCI format 1\_3 for intra-cell beam management with more than one MAC-CE activated separate TCI state per CC | 1. TCI state indication for update and activation 2. MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_3 with DL assignment for at least one serving cell in a scheduledCellListDCI-1-3 to provide indicated unified TCI state(s) for the CC(s) in the scheduledCellListDCI-1-3)   2. The minimum beam application time in Y symbols per SCS  3. The maximum number of MAC-CE activated DL TCI states per CC in a band  4. The maximum number of MAC-CE activated UL TCI states per CC in a band | 23-10-1, At least one of {49-1, 49-1b, 66-1} |
| 49-13 | Default QCL assumption for multi-cell scheduling by DCI format 1\_3 | Indicates whether the UE can be configured with enabledDefaultBeamFormultiCellScheduling for default QCL assumption for multi-cell scheduling by DCI format 1\_3 for same/different numerologies   * Candidate values are {different only, both}   + When "both" is reported, the UE supports this feature for same SCS and for different SCS combination(s) (low-to-high, high-to-low or both) reported for 49-1b | At least one of {49-1, 49-1b, 66-1} |
| 49-14 | Support of BWP switch indication by DCI format 0\_3/1\_3 | Support of BWP switch indication by DCI format 0\_3/1\_3 | At least one of {49-1, 49-1b, 49-2, 49-2b, 66-1, 66-2} for the BC  At least one of {6-2, 6-3, 6-4} for at least one band of the BC |

Conclusion

Update a component in FG 66-2 “Support Type-2 for ‘Antenna port(s)’ field” as follows:

“Support Type-2 for ‘Antenna port(s)’, ‘Precoding information and number of layers’ and ‘SRS resource indicator’ fields”

R1-2506886 UE features for MCE for NR Phase 3 vivo

R1-2506929 UE features for Rel-19 Multi-carrier enhancements Huawei, HiSilicon

R1-2506975 Discussion on UE feature for Rel-19 Multi-carrier enhancements Xiaomi

R1-2507078 NR Multi-carrier Enhancements Phase 2 UE features Nokia

R1-2507151 Discussion on UE feature for multi-cell scheduling with a single DCI OPPO

R1-2507198 Discussion on UE features for MCE for NR Phase 3 ZTE Corporation, Sanechips

R1-2507272 UE features for multi-carrier enhancements Samsung

R1-2507615 MCE UE features Phase 3 MediaTek Inc.

R1-2507662 Views on UE features for Rel-19 MCE Apple

R1-2507708 UE features for MCE for NR Phase 2 Qualcomm Incorporated

R1-2507801 Discussion on UE features for multi-cell PUSCH/PDSCH scheduling with a single DCI NTT DOCOMO, INC.

R1-2507860 UE features for MCE for NR Phase 3 Ericsson Inc.

## UE features for low band CA via switching

R1-2506930 UE features for low band CA via switching Huawei, HiSilicon

R1-2506976 Discussion on UE feature for low band CA via switching Xiaomi

R1-2507199 Discussion on UE features for for low band CA via switching ZTE Corporation, Sanechips

R1-2507265 UE features for low band carrier aggregation via switching Samsung

R1-2507878 UE features for Low Band Carrier Aggregation via switching Google

## UE features for LTE based 5G broadcast Phase 2

**R1-2508084** Session Notes of AI 9.13 Ad-Hoc Chair (AT&T)

Session notes are endorsed and incorporated the session notes below.

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3. LTE\_terr\_bcast\_Ph2 | 3-1a | Cyclic shift of PMCH – ~~fixed~~ alpha1 | 1. Support of cyclic shift for the bit sequence in Section 6.3.1 of TS 36.211 for the i^th subframe of the time-interleaved TB by X\_i bits | 3-1 | Yes | N/A | UE is not able to support time-interleaving with the cyclic shift and alpha1 | Per band | No | N/A | , with   * + - is the number of bits in the codeblock within a subframe (as defined in TS 36.212) | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3. LTE\_terr\_bcast\_Ph2 | 3-1b | Cyclic shift of PMCH – alpha2 | 1. Support of cyclic shift for the bit sequence in Section 6.3.1 of TS 36.211 for the i^th subframe of the time-interleaved TB by X\_i bits | 3-1 | Yes | N/A | UE is not able to support time-interleaving with the cyclic shift and alpha2 | Per band | No | N/A | , with   * + - denotes the number of OFDM symbols within a subframe     - denotes the number of CBs in the time-interleaved (scaled) TB     - is the number of bits in the codeblock within a subframe (as defined in TS 36.212) | Optional with capability signalling |

**Agreement: Introduce the following Rel. 19 UE FGs (yellow highlighting, if any, shows text that’s not yet agreed)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3. LTE\_terr\_bcast\_Ph2 | 3-1c | Cyclic shift of PMCH - alpha3 | 1. Support of cyclic shift for the bit sequence in Section 6.3.1 of TS 36.211 for the i^th subframe of the time-interleaved TB by X\_i bits | 3-1 | Yes | N/A | UE is not able to support time-interleaving with the cyclic shift and alpha3 | Per band | No | N/A | where   * the pseudo-random sequence is defined by clause 7.2 and shall be initialized with at the beginning of each radio frame for which , * is the number of subcarriers available in one OFDM symbol for PMCH, * is the modulation order, * denotes the subframe to which the transport block is mapped,   - is the number of subframes to which the transport block is mapped | Optional with capability signalling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3. LTE\_terr\_bcast\_Ph2 | 3-1 | Time-interleaving | 1. Support of PMCH transmission pattern, excluding MCCH and MSI, with time interleaving for a set of PMCH numerologies  2. Support of TBS determination for the scaled TB up to a maximum TBS  3. Support of determining the starting point for reading from the circular buffer (k0) for each subframe  4. Support of the extended MSI periodicities | Support of fembmsDedicatedCell | Yes | N/A | UE is not able to support time-interleaving for LTE-based 5G broadcast | Per band | No | N/A | For component 1, the UE indicates a bitmap [b15, b7dot5, b2dot5, b1dot25] where each bit indicates whether the UE supports time-interleaving for the corresponding numerology  For component 2, the maximum TBS a UE supports for the scaled TB is derived based on the UE’s unicast capability  Note: One TB is mapped to N non-consecutive subframes. Two transmissions of the same TB are separated by (M-1) subframes. | Optional with capability signalling |

R1-2506915 Discussion on UE features for LTE based 5G broadcast ZTE Corporation, Sanechips

R1-2506977 UE features for LTE based 5G broadcast Xiaomi

R1-2507241 UE features for LTE broadcast Samsung

R1-2507709 UE features for LTE based 5G broadcast Phase 2 Qualcomm Incorporated

R1-2507742 Summary of UE features for LTE based 5G broadcast Phase 2 Moderator (AT&T)

## Others

**R1-2507978** Session Notes of AI 9.14 for common PDCCH repetition for TN [Common\_PDCCH\_rep\_TN] Ad-Hoc Chair (NTT DOCOMO, INC.)

Withdraw

**R1-2508085** Session Notes of AI 9.14 Ad-Hoc Chair (AT&T)

Session notes are endorsed and incorporated the session notes below.

R1-2507079 PDCCH repetition TN features Nokia

R1-2507195 UE features for positioning SRS frequency hopping for non-RedCap UE ZTE Corporation, Sanechips

R1-2507274 UE features for Other topics Samsung

R1-2507477 UE features for early CSI acquisition for L3 handover Ericsson

R1-2507743 Summary of UE features for Rel-19 TEI and other relevant issues Moderator (AT&T)

R1-2507936 UE features for common PDCCH repetiton (Rel-19 NTN) for TN Huawei, HiSilicon

**Agreement:**

* **Delete/remove the following Rel. 19 NR UE FG**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ~~67. TEI19 [5GB\_CASMuting]~~ | ~~67-7~~ | ~~5GB\_CAS Muting~~ | ~~Muting of always-on signals in 5G broadcast~~ |  | ~~Yes~~ | ~~n/a~~ | ~~UE continually detects CAS subframes which may be muted by NW~~ | ~~CAS Muting cannot be used~~ | ~~Per band~~ | ~~No~~ | ~~No~~ | ~~No~~ | ~~For a MBMS-dedicated cell, there is no RAN4 impact from the above TEI proposal.~~ |

* **Introduce the following Rel. 19 LTE UE FG**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4. TEI19 [5GB\_CASMuting] | 4-1 | 5GB\_CAS Muting | Muting of always-on signals in 5G broadcast |  | Yes | n/a | UE continually detects CAS subframes which may be muted by NW | Per band | No | No | For a MBMS-dedicated cell, there is no RAN4 impact from the above TEI proposal. | Optional with capability signaling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 67. TEI19 [Simul\_SRSCS] | 67-4 | Support of simultaneous SRS carrier switching [Simul\_SRSCS] | 1.- Support simultaneous SRS carrier switches. Two SRS carrier switches are considered to be simultaneous if the SRS transmission (including RF retuning time) in both CCs overlap in time | 2-56 | Yes | N/A | Simultaneous SRS CS across multiple CC is not supported | Per band pair per band combination | N/A | N/A | N/A | For each target band, the UE can indicate with which other target bands in the band combination can SRS carrier switching be simultaneously triggered | Optional with capability signaling |

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 67. TEI19 [Pos\_SRSHop] | 67-2b | UL Time Window and transmission of SRS for positioning with Tx Frequency hopping within the window for non-RedCap UEs [Pos\_SRSHop] | Support of UL Time Window and transmission of SRS for positioning with Tx Frequency hopping within the window | 67-2 | ~~No~~ Yes | N.A. | UE does not support the UL time window for SRS for positioning with Tx frequency hopping | Per band | N.A. | N.A. | N.A. |  | Optional with capability signaling |

# Release 20 NR

***The maximum number of contributions per company/organization/university is limited to 1 per agenda item unless stated otherwise.***

## Artificial Intelligence (AI)/Machine Learning (ML) for NR air interface enhancements

*Please refer to RP-252445 for detailed scope of the WI.*

[122bis-R20-AI/ML] Email discussion on Rel-20 AI/ML – Chenxi (Qualcomm)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508151** Session notes for 10.1 (Artificial Intelligence (AI)/Machine Learning (ML) for NR air interface enhancements) Ad-Hoc Chair (Ericsson)

Session notes are endorsed and incorporated the session notes below.

### CSI spatial/frequency compression without temporal aspects (“Case 0”)

#### Inference related aspects

*Including target CSI type, measurement and report configuration, CQI RI determination, payload determination, quantization configuration codebook, UCI mapping, CSI processing criteria and timeline, priority rules for CSI reports.*

R1-2506743 Discussion on inference related aspects for CSI spatial/frequency compression without temporal aspects (“Case 0”) FUTUREWEI

R1-2506774 Discussion on inference related aspects of CSI compression ZTE Corporation, Sanechips

R1-2506781 Discussion on interference related aspects for CSI compression TCL

R1-2506792 AI/ML CSI Spatial/Frequency Compression: Inference Aspects InterDigital, Inc.

R1-2506803 Discussion on AIML for CSI compression inference related aspects Spreadtrum, UNISOC, BUPT

R1-2506832 Inference related aspects of AI/ML for CSI compression Ericsson

R1-2506887 Discussion on inference related aspects for CSI compression vivo

R1-2506931 Discussion on Inference related aspects for CSI compression Huawei, HiSilicon

R1-2506978 Discussion on inference related aspects of two-sided AI/ML model based CSI feedback Xiaomi

R1-2507006 Discussion on inference related aspects of CSI compression CMCC

R1-2507108 Discussion on inference related aspects of AI/ML-based CSI compression CATT

R1-2507165 Inference related aspects for AI/ML CSI compression OPPO

R1-2507183 Discussion on inference related aspects for CSI compression KT Corp.

R1-2507205 Inference related aspects for CSI compression HONOR

R1-2507242 Views on inference related aspects of CSI compression Samsung

R1-2507280 Discussion on inference related aspects in CSI compression with AI/ML Fujitsu

R1-2507301 Discussion on inference aspects of CSI compression NEC

R1-2507389 CSI Compression: Inference Related Aspects Nokia

R1-2507396 Discussion on inference related aspects for CSI compression LG Electronics

R1-2507415 Discussion on inference aspects for AI/ML-based CSI compression Panasonic

R1-2507443 Inference related aspects for CSI compression Lenovo

R1-2507462 Discussion on Inference related aspects for AI CSI compression Ofinno

R1-2507496 Discussion on inference related aspects of CSI compression ETRI

R1-2507517 Inference for AI/ML based CSI Compression Google

R1-2507552 Discussion on Inference Related Aspects for CSI Compression Sharp

R1-2507616 CSI spatial/frequency compression without temporal aspects (“Case 0”)- Inference related aspects MediaTek Inc.

R1-2507630 Discussion on inference related aspects of CSI compression Transsion Holdings

R1-2507663 On inference related aspects for AI based CSI spatial/frequency domain compression Apple

R1-2507710 Specification of inference aspects of AIML CSI compression Qualcomm Incorporated

R1-2507733 Inference Related Aspects of AI/ML for CSI Compression TOYOTA Info Technology Center

R1-2507802 Discussion on the inference-related aspects of AI/ML CSI compression NTT DOCOMO, INC.

R1-2507897 Discussion on AI/ML for CSI compression inference related aspects CEWiT

**R1-2508021 FL summary 1 on AIML inference related aspects Moderator (Qualcomm)**

Agreement:

Support precoding matrix with port-subband domain representation as target CSI type.

* For a certain layer , a precoding matrix on N\_sb subband and P CSI-RS ports is with being a vector***.***
* Note: Only sub-band PMI reporting is supported.

Agreement:

For determining the payload parameters combinations or across all layers and ranks, consider following general principles for precoding matrix-based target CSI

* Rank-common and layer-common model with payload-scalable design is considered as the baseline implementation for discussion purpose.
  + Note: layer-specific / rank-specific (if supported) payload parameters are supported by this rank-common and layer-common model with payload-scalable design.
* Limiting the total number of (per-layer) payload parameters combinations or across all layers and all ranks.
* At least for medium to high per-layer payload regime, the total payload size of rank 2, rank 3 and 4 are comparable to each other.
* Spectral efficiency or system throughput and trade-off with feedback overhead are considered as the performance metric.

**R1-2508022 FL summary 2 on AIML inference related aspects Moderator (Qualcomm)**

Agreement:

When the Target CSI is precoder matrix, in order to down-select to N per-layer payload parameter combinations (PC) of or based on performance, overhead and complexity trade-off results, consider the following candidate values:

* Candiate values for : 32, 64, 96, 128, 192
* Candidate values for : 1, 2, 3, 4, (8, 10 only for VQ)
  + 2 is considered as the baseline assumption for SQ.
* Candidate values for L: L=2, 4,
* Candidate values for N: 4, 5, 6
* Note: These N payload PCs of or are considered as the pool for the payload PC for each layer and each rank.
* Note: The above is for discussion purpose, how to configure the PCs (across layers and ranks) is a separate discussion.
* Note: Rank-common and layer-common model with payload scalable design is considered.
* Note: The above does not mean support of both SQ and VQ.
* Note: The number of parameters combinations configurations (Y) does not exceed 8.

Agreement:

For payload parameter combinations (PC), consider followings

* Support Y configurable PCs (across layers and ranks) as below, where X\_n, Xn\_31, Xn\_32, Xn\_33, Xn\_41, Xn\_42, Xn\_43, Xn\_44 represent a pair of or a triplet of chosen from the per-layer PC pool.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Rank1 | Rank2 | Rank3 | Rank4 |
| PC1 | X1 | X1, X1 | X1\_31, X1\_32, X1\_33 | X1\_41, X1\_42, X1\_43, X1\_44 |
| PC2 | X2 | X2, X2 | X2\_31, X2\_32, X2\_33 | X2\_41, X2\_42, X2\_43, X2\_44 |
| … |  |  |  |  |

* For rank 1 and rank 2, layer-common and rank-common payload is supported.
* For rank 3, consider alternatives of {Xn\_31, Xn\_32, Xn\_33} = {a, a, a}, {a, a, b}, {a, b, b} for potential down selection.
* For rank 4, consider alternatives of {Xn\_41, Xn\_42, Xn\_43, Xn\_44} = {a, a, a, a}, {a, a, b, b}, {a, b, b, c}, {a, a, b, c} or {a, b, c, c} for potential down selection.
* Note: The table is for discussion purpose, how to configure the PCs (across layers and ranks) is a separate discussion.
* Note: a, b values in rank3 can be different from that in rank 4.

**R1-2508023 FL summary 3 on AIML inference related aspects Moderator (Qualcomm)**

Agreement:

Consider following for evaluation:

* For down-selection of per-layer pairs of or a triplets of , ~~average~~ SGCS ~~across~~ per layer can be considered as performance metric.
* For down-selection of the rank-specific and layer-specific patterns (e.g., {Xn\_31, Xn\_32, Xn\_33} and {Xn\_41, Xn\_42, Xn\_43, Xn\_44}), spectral efficiency or throughput should be considered.

Agreement:

For CSI feedback via two-sided AIML models, reuse legacy CSI reporting framework

* Support CSI report based on periodic, semi-persistent and aperiodic CSI-RS resources with legacy measurement resource configurations.
* Support aperiodic report and semi-persistent CSI report on PUSCH and reuse legacy triggering mechanism.

#### Other aspects

*Including NW and UE data collection for training, performance monitoring, as well as model pairing related issues.*

R1-2506744 Discussion on other aspects for CSI spatial/frequency compression without temporal aspects (“Case 0”) FUTUREWEI

R1-2506775 Discussion on other aspects of CSI compression ZTE Corporation, Sanechips

R1-2506782 Discussion on other aspects for CSI compression TCL

R1-2506793 AI/ML CSI Spatial/Frequency Compression: Other Aspects InterDigital, Inc.

R1-2506804 Discussion on AIML for CSI compression other aspects Spreadtrum, UNISOC

R1-2506833 Other aspects of AI/ML for CSI compression Ericsson

R1-2506888 Discussion on other aspects for CSI compression vivo

R1-2506932 Discussion on other aspects for CSI compression Huawei, HiSilicon

R1-2506979 Discussion on other aspects of CSI spatial/frequency compression Xiaomi

R1-2507007 Discussion on other aspects of CSI compression CMCC

R1-2507109 Discussion on other aspects of AI/ML-based CSI compression CATT

R1-2507166 Other aspects for AI/ML CSI compression OPPO

R1-2507184 Discussion on other aspects of CSI compression KT Corp.

R1-2507206 Other aspects for CSI compression HONOR

R1-2507243 Views on other aspects of CSI compression Samsung

R1-2507281 Discussion on other aspects of CSI compression Fujitsu

R1-2507303 Discussion on other aspects of CSI compression NEC

R1-2507390 CSI Compression: Other Aspects Nokia

R1-2507397 Discussion on other aspects for CSI compression LG Electronics

R1-2507416 Discussion on other aspects for AI/ML-based CSI compression Panasonic

R1-2507444 Other aspects for CSI compression Lenovo

R1-2507478 Other aspects Tejas Network Limited

R1-2507497 Discussion on other aspects of CSI compression ETRI

R1-2507518 Other Aspects for AI/ML based CSI Compression Google

R1-2507587 Discussion on other aspects for CSI compression Sony

R1-2507617 CSI spatial/frequency compression without temporal aspects (“Case 0”)- Other aspects MediaTek Inc.

R1-2507664 On other aspects for AI based CSI spatial/frequency domain compression Apple

R1-2507711 Specification of other aspects of AIML CSI compression Qualcomm Incorporated

R1-2507775 Discussions on other aspects for NR air interface enhancements Sharp

R1-2507778 Discussion on performance monitoring for CSI compression Shanghai Jiao Tong University, Toyota

R1-2507803 Discussion on other aspects of AI/ML CSI compression NTT DOCOMO, INC.

R1-2507868 Discussion on AIML based CSI compression ASUSTeK

**R1-2508028 FL summary#1 for other aspects of CSI compression Moderator (Huawei)**

Agreement:

For NW side data collection with higher layer reporting, for further study of Option 1 (scalar quantization), consider the following definition for evaluation:

* **Content**: for a number of S=1 (as baseline) Target CSI samples each with the dimensions of 2N1N2 ports, N3 subbands, *v* layers for precoding matrix, and real+imaginary (or amplitude+phase) parts, which has overall 2N1N2\*N3\**v* complex elements, and any complex element has a real (or amplitude) part of *x1* and an imaginary (or phase) part of *x2*.
  + Note: Companies to report whether real value and imaginary value are quantized, or amplitude value and phase value are quantized.
* **Format**: *x1* is quantized to k1 bits within range of [T1min, T1max], and *x2* is quantized to k2 bits within range of [T2min, T2max]. E.g., for Scalar8, k1=8 bits for quantizing the real part, and k2=8 bits for quantizing the imaginary part. Uniform quantization is assumed.
  + Note: Companies to report whether/how the normalization is performed, and whether it is normalized within or across 2N1N2 ports/ N3 subbands/ *v* layers/ real and imaginary (or amplitude and phase) parts.
* Fixed parameter values of k1/k2/T1min/T1max/T2min/T2max across complex elements, as a baseline for evaluations. Companies to report the values.
* Note: It is up to company to use number of samples S>1 in their evaluations. In this case, companies need to provide information how S samples are quantized in their evaluation.

**R1-2508030 FL summary#3 for other aspects of CSI compression Moderator (Huawei)**

**Agreement:**

For NW side data collection with higher layer reporting, regarding Option 4 (eType II like codebook with new parameter), further study the following candidate enhanced parameter values with potential down selection.

* L= 4/6/12/16/(N1\*N2), pv=0.6/0.75/1, Beta = 0.5/0.8/1. Reference amplitude = 4bits/6bits, differential amplitude = 3bits/4bits, and phase = 4bits/6bits
  + Company to report the quantization step for reference amplitude for 6bits.
* No restriction to the total number of non-zero coefficients for a specific rank.
* Other combinations can be considered and reported by companies.

**Agreement:**

For the study of NW side data collection with higher layer reporting, following evaluation assumptions are considered:

* Benchmark#1: FP32 (k1=k2=32 bits)
* Benchmark#2: legacy eType II with PC6 (for layer 1/2/3/4), PC8(for layer 1/2)
* CSI payload size: at least consider large CSI payload Z ≥ 230 bits per layer, optionally consider low/medium CSI payload size X/Y per layer.
* Tx port: 32, 64, or 128 up to companies.
* Subband number: 13, or 19 up to companies.
* Performance metric:
  + Metric#1: SGCS for specific layer(s) between Target CSI of FP32 and recovery CSI, for a model trained with quantized Target CSI with a specific quantization option.
  + Metric#2: SGCS for specific layer(s) between the Target CSI of FP32 with its quantized version subject to a specific quantization solution
  + Overhead per sample and per layer SGCS results are reported ~~per layer~~
* Note: Complexity should be analysed.
* For Option 1, consider k1+k2=4, 6 ,7, 8, 16, 32
* Other assumptions follow R18 study EVM

**R1-2508031 FL summary#4 for other aspects of CSI compression Moderator (Huawei)**

Agreement

For CPU counting of UE side data collection,

* OCPU=1
* FFS: The CPU occupancy duration

### Inter-vendor training collaboration for two-sided AI/ML models

*Including specification of standardized dataset format/content plus dataset exchange (“Direction A, sub-option 4-1”), as well as RAN4-triggered issues.*

R1-2506745 Discussion on inter-vendor training collaboration for two-sided AI/ML models FUTUREWEI

R1-2506776 Discussion on inter-vendor training collaboration for two-sided AI/ML models ZTE Corporation, Sanechips

R1-2506783 Discussion on inter-vendor collaboration for CSI compression TCL

R1-2506794 AI/ML CSI Spatial/Frequency Compression: Inter-vendor Collaboration InterDigital, Inc.

R1-2506805 Discussion on Inter-vendor training collaboration for two-sided AI/ML models Spreadtrum, UNISOC

R1-2506834 Inter-vendor training collaboration for two-sided AI/ML models Ericsson

R1-2506889 Discussion on inter-vendor training collaboration for two-sided AI/ML models vivo

R1-2506933 Discussion on Inter-vendor training collaboration for two-sided AI/ML models Huawei, HiSilicon

R1-2506980 Discussion on inter-vendor training collaboration for two-sided AI/ML models Xiaomi

R1-2507008 Discussion on inter-vendor training collaboration for CSI compression CMCC

R1-2507110 Inter-vendor training collaboration for CSI compression CATT

R1-2507167 Inter-vendor training collaboration for AI/ML CSI compression OPPO

R1-2507244 Views on inter-vendor training collaboration for two-sided AI/ML models Samsung

R1-2507282 Discussion on inter-vendor training collaboration for two-sided AI/ML models Fujitsu

R1-2507324 Discussion on Inter-vendor training collaboration for two-sided AI/ML models China Telecom

R1-2507391 Inter-vendor training collaboration for two-sided AI/ML models Nokia

R1-2507398 Discussion on Inter-vendor training collaboration for two-sided models LG Electronics

R1-2507414 Discussion on Inter-vendor Training Collaboration for two-sided AI/ML models NEC

R1-2507417 Discussion on inter-vendor training collaboration for two-sided AI/ML models Panasonic

R1-2507487 Inter-vendor training collaboration for two-sided AI/ML models Lenovo

R1-2507498 Discussion on inter vendor training collaboration for two-sided AI/ML models ETRI

R1-2507519 Inter-Vendor Collaboration for AI/ML based CSI Compression Google

R1-2507553 Discussions on Inter-vendor training collaboration Sharp

R1-2507588 Inter-vendor training collaboration for two-sided AI/ML models Sony

R1-2507618 Inter-vendor training collaboration for two-sided AI/ML models MediaTek Inc.

R1-2507665 Discussion on inter-vendor training collaboration for two sided AI/ML models Apple

R1-2507666 FL summary # 1 for inter-vendor training collaboration Moderator (Apple)

R1-2507667 FL summary # 2 for inter-vendor training collaboration Moderator (Apple)

R1-2507668 FL summary # 3 for inter-vendor training collaboration Moderator (Apple)

R1-2507712 Inter-vendor training collaboration for two-sided CSI compression use case Qualcomm Incorporated

R1-2507732 Discussion on inter-vendor training collaboration for two-sided models Indian Institute of Tech (M)

R1-2507764 Discussion on inter-vendor training collaboration Continental Automotive

R1-2507804 Discussion on the inter-vendor training collaborations for two-sided AI/ML models NTT DOCOMO, INC.

R1-2507828 Views on inter-vendor training collaboration for two-sided AI/ML models BUPT, ZGC Institute of Ubiquitous-X Innovation and Application

**R1-2507666 FL summary # 1 for inter-vendor training collaboration Moderator (Apple)**

**Conclusion:**

For Option 4-1 under Direction A in AI/ML based CSI compression, there is no consensus to further study the necessity of sharing assisted information to align model design aspects.

Agreement:

* For Option 4-1 under Direction A in AI/ML based CSI compression, both average SGCS and average NMSE as performance target in the exchanged dataset are supported. Both average SGCS and average NMSE are provided.
  + NW side can optionally send NMSE and/or SGCS values at X-percentiles.

**R1-2507668 FL summary # 3 for inter-vendor training collaboration Moderator (Apple)**

Agreement:

For Option 4-1 under Direction A in AI/ML based CSI compression, for the association between target CSI and CSI feedback in the exchanged dataset.

* Support 1:M mapping between one target CSI sample/set of samples to M CSI feedback samples/sets of samples associated with different CSI payload size configurations
* FFS: Association between Target CSI and CSI feedback, including scalability related information for different number of Tx port, sub bands related information.
* FFS: Whether/how Target CSI samples/set of samples within an exchanged dataset, with different Tx port and sub-band related information are organized.
* FFS: Whether the Target CSI is per layer or per rank when Target CSI is precoder matrix.
* FFS: Whether and how to support CSI feedback structure with different payload scalability options
* FFS: Other details

## NR MIMO Phase 6

*Please refer to RP-252936 for detailed scope of the WI.*

[122bis-R20-MIMO] Email discussion on Rel-20 MIMO – Darcy (MTK)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508152** Session notes for 10.2 (NR Phase 6) Ad-Hoc Chair (Ericsson)

Session notes are endorsed and incorporated the session notes below.

### Improvement of SRS capacity and coverage

*Including a) Multiple frequency-domain starting positions for SRS repetition, and b) Cross-slot SRS between one U slot and one adjacent S slot.*

R1-2506795 NR MIMO Phase 6: SRS Enhancement InterDigital, Inc.

R1-2506806 Discussion on improvement of SRS capacity and coverage Spreadtrum, UNISOC

R1-2506836 Improvement of SRS capacity and coverage MediaTek Inc.

R1-2506845 Discussion on improving of SRS capacity and coverage TCL

R1-2506890 Discussion on improvement of SRS capacity and coverage vivo

R1-2506925 Improvement of SRS capacity and coverage Huawei, HiSilicon

R1-2506981 Discussion on the improvement of SRS capacity and coverage Xiaomi

R1-2507026 Improvement of SRS capacity and coverage Tejas Network Limited

R1-2507040 Discussion on improvement of SRS capacity and coverage ZTE Corporation, Sanechips

R1-2507111 Discussion on improvement of SRS capacity and coverage CATT

R1-2507168 Discussion on enhancement of SRS capacity and coverage for MIMO phase 6 OPPO

R1-2507207 Discussion on improvement of SRS capacity and coverage HONOR

R1-2507245 Views on improvement of SRS capacity and coverage Samsung

R1-2507283 Discussion on improvement of SRS capacity and coverage Fujitsu

R1-2507315 Discussion on improvement of SRS capacity and coverage NEC

R1-2507325 Discussion on SRS capacity and coverage improvement China Telecom

R1-2507406 Improvement of SRS Capacity and Coverage Nokia

R1-2507438 Improvement of SRS capacity and coverage Lenovo

R1-2507499 Discussion on improvement of SRS capacity and coverage for NR MIMO Phase 6 ETRI

R1-2507529 Discussion on improvement of SRS capacity and coverage Panasonic

R1-2507543 Discussion on Improvement of SRS Capacity and Coverage Rakuten Mobile, Inc

R1-2507589 Further discussions on improvements of SRS capacity and coverage Sony

R1-2507632 Improvement of SRS capacity and coverage Transsion Holdings

R1-2507669 On Rel-20 MIMO SRS capacity and coverage improvement Apple

R1-2507713 SRS enhancements in 5G MIMO Phase 6 Qualcomm Incorporated

R1-2507769 Improvement of SRS capacity and coverage Sharp

R1-2507805 Discussion on Improvement of SRS capacity and coverage NTT DOCOMO, INC.

R1-2507880 On Rel-20 improvement of SRS capacity and coverage Ericsson

R1-2507881 Views on enhancements for Improvement of SRS capacity and coverage KDDI Corporation

R1-2507908 Discussion on improvement of SRS capacity and coverage NICT

**R1-2507994 Moderator summary on improvement of SRS capacity and coverage: Round 1 Moderator (CATT)**

**Agreement**:

For intra-repetition hopping for SRS repetition symbols within each SRS frequency hop and K=R (i.e., each subgroup includes symbol (or 1 pair of consecutive symbols for 8-Tx SRS with *ports8tdm*))), the following configuration combinations and basic starting position patterns are supported

* when PF=K=2, support pattern {0,1}
* when PF=4 and K=2, select one of the following patterns:
  + Alt 1: {0,2}
  + Alt 2: {0,1}
* when PF=K=4, select one of the following patterns:
  + Alt 1: {0,2,1,3}
  + Alt 2: {0,1,2,3}

Note: exact pattern(s) are deduced from the basic patterns. FFS details.

**Agreement**:

For intra-repetition hopping for SRS repetition symbols within each SRS frequency hop and K<R (i.e., each subgroup includes symbol (or >1 pair of consecutive symbols for 8-Tx SRS with *ports8tdm*)), support the following configuration combinations and basic starting position patterns

* when PF=K=2, select at least one of the following basic patterns:
  + Alt 1 (consecutive mapping): {0,…,0,1,…,1}
  + Alt 2 (non-consecutive mapping): {0,1,,…,0,1}
* when PF=4 and K=2, down select from the following basic patterns:
  + Alt 1-1 (consecutive mapping):{0,…,0,2,…,2}
  + Alt 1-2 (consecutive mapping):{0,...,0,1,…,1}
  + Alt 2-1 (non-consecutive mapping):{0,2,…,0,2}
  + Alt 2-2 (non-consecutive mapping): {0,1,…,0,1}
* when PF=K=4, down select from the following basic patterns:
  + Alt 1-1 (consecutive mapping): {0,…,0,2,…,2,1,…,1,3,…,3}
  + Alt 1-2 (consecutive mapping): {0,…,0,1,…,1,2,…2,3,…,3}
  + Alt 2-1 (non-consecutive mapping): {0,2,1,3,…,0,2,1,3}
  + Alt 2-2 (non-consecutive mapping): {0,1,2,3,…,0,1,2,3}

Note: exact patterns are deduced from the basic patterns. FFS details.

**R1-2508045 Moderator summary on improvement of SRS capacity and coverage: Round 2 Moderator (CATT)**

Agreement

To determine the time-domain location of a cross-slot SRS resource,

* ‘’ is interpreted as the starting symbol in the starting slot for an SRS resource.
* ‘’ is interpreted as the symbol index in a slot or two consecutive S and U slots.
* The restriction ‘’ is removed.

Agreement

* For intra-repetition hopping for SRS repetition symbols within each SRS frequency, support periodic, semi-persistent and aperiodic SRS.
* For intra-repetition hopping for SRS repetition symbols within each SRS frequency hop, support all SRS usages (i.e., codebook, nonCodebook, antennaSwitching and beamManagement)

Agreement:

* Support cross-slot SRS for all SRS resource types, i.e., for periodic, semi-persistent, and aperiodic SRS.
* Support cross-slot SRS for usages of codebook, non-codebook, antenna switching, beam management

**R1-2508087 Moderator summary on improvement of SRS capacity and coverage: Round 3 Moderator (CATT)**

**Agreement:**

For intra-repetition hopping for SRS repetition symbols within each SRS frequency hop, support Alt-1 from the agreement in RAN1#122bis as the following:

* when PF=4 and K=2, select one of the following patterns:
  + Alt 1: {0,2}
* when PF=K=4, select one of the following patterns:
  + Alt 1: {0,2,1,3}

**R1-2508105 Moderator summary on improvement of SRS capacity and coverage: Round 4 Moderator (CATT)**

**Agreement:**

* For an aperiodic cross-slot SRS resource set in scenario 1, the slot offset of the SRS resource set refers to the first of the two slots spanned by the SRS resource set.
* Note 1: Whether 0 or more SRS resource with time-domain resource entirely in the second slot (i.e. U slot) can be supported in scenario 1 is discussed separately.
* Note 2: If the transmission of 0 or more SRS resource with time-domain resource entirely in the second slot (i.e. U slot) is supported, for the resource(s) in the second slot, whether/how to utilize the slot offset configured for the SRS resource set is discussed separately.
* Note 3: 0 or more SRS resource with time-domain resource entirely in the first slot (i.e. S slot) can be supported in scenario 1.

**Working Assumption:**

For intra-repetition hopping for SRS repetition symbols within each SRS frequency hop, support Alt-2:

* when PF=K=2, select at least one of the following basic patterns:
  + Alt 1 (consecutive mapping): {0,…,0,1,…,1}
  + Alt 2 (non-consecutive mapping): {0,1,,…,0,1}
* when PF=4 and K=2, down select from the following basic patterns:
  + Alt 1 (consecutive mapping):{0,…,0,2,…,2}
  + Alt 2 (non-consecutive mapping):{0,2,…,0,2}
* when PF=K=4, down select from the following basic patterns:
  + Alt 1 (consecutive mapping): {0,…,0,2,…,2,1,…,1,3,…,3}
  + Alt 2 (non-consecutive mapping): {0,2,1,3,…,0,2,1,3}

### Enhancing DL CSI acquisition

*Including a) Early SRS/CSI/CSI-RS triggering, and b) CSI-RS density reduction for 48, 64, and 128 CSI-RS ports.*

R1-2506746 Enhancing DL CSI acquisition FUTUREWEI

R1-2506759 Configuring CSI-RS Resources with Different Densities Kyocera Corporation

R1-2506796 NR MIMO Phase 6: DL CSI Enhancement InterDigital, Inc.

R1-2506807 Discussion on enhancing DL CSI acquisition Spreadtrum, UNISOC

R1-2506837 Enhancing DL CSI acquisition MediaTek Inc.

R1-2506838 Moderator summary on enhancing DL CSI acquisition (Round 0) Moderator (MediaTek Inc.)

R1-2506839 Moderator summary on enhancing DL CSI acquisition (Round 1) Moderator (MediaTek Inc.)

R1-2506840 Moderator summary on enhancing DL CSI acquisition (Round 2) Moderator (MediaTek Inc.)

R1-2506844 Discussion on enhancing DL CSI acquisition TCL

R1-2506891 Discussion on enhancing DL CSI acquisition vivo

R1-2506926 DL CSI acquisition enhancment Huawei, HiSilicon

R1-2506953 On DL CSI Acquisition Enhancements for FR1 Nokia

R1-2506982 Discussion on enhancing DL CSI acquisition Xiaomi

R1-2507027 Enhancing DL CSI acquisition Tejas Network Limited

R1-2507033 Discussion on Early DL CSI Acquisition Enhancements Panasonic

R1-2507041 Discussion on enhancing DL CSI acquisition ZTE Corporation, Sanechips

R1-2507112 Discussion on enhancements for DL CSI acquisition CATT

R1-2507169 Discussions on Enhancing DL CSI Acquisition OPPO

R1-2507208 Discussion on enhancing DL CSI acquisition HONOR

R1-2507246 Views on enhancing DL CSI acquisition Samsung

R1-2507284 Discussion on enhancing DL CSI acquisition Fujitsu

R1-2507304 Discussion on Enhancing DL CSI acquisition NEC

R1-2507399 Discussion on enhancing DL CSI acquisition LG Electronics

R1-2507410 DL CSI acquisition enhancements for Rel. 20 MIMO Fraunhofer IIS, Fraunhofer HHI

R1-2507500 Discussion on enhancing DL CSI acquisition for NR MIMO Phase 6 ETRI

R1-2507542 Discussion on Enhancement of CSI DL Acquisition Rakuten Mobile, Inc

R1-2507551 Enhancing DL CSI acquisition Lenovo

R1-2507561 Discussions on enhancing DL CSI acquisition China Telecom

R1-2507579 Discussion on enhancing DL CSI acquisition Google

R1-2507590 Further discussions on DL CSI acquisition enhancements Sony

R1-2507670 On Rel-20 MIMO CSI enhancement Apple

R1-2507714 DL CSI acquisition enhancements in 5G MIMO Phase 6 Qualcomm Incorporated

R1-2507744 DL CSI Enhancements for NR Rel-20 AT&T

R1-2507757 On Rel-20 enhanced DL CSI acquisition Ericsson

R1-2507770 Enhancing DL CSI acquisition Sharp

R1-2507777 Discussion on early DL CSI acquisition design Fainity Innovation

R1-2507806 Discussion on Enhancing DL CSI acquisition NTT DOCOMO, INC.

R1-2507830 Discussion on DL CSI acquisition ITRI, Acer Incorporated

R1-2507898 Views on DL Channel acquisition enhancements CEWiT

R1-2507909 Discussion on enhancing DL CSI acquisition NICT

R1-2507945 Discussion on enhancing DL CSI acquisition IIT Kanpur

**R1-2506838 Moderator summary on enhancing DL CSI acquisition (Round 0) Moderator (MediaTek Inc.)**

**Agreement:**

For early triggering of SRS-AS when SCell transition from a dormant BWP to a non-dormant BWP, support aperiodic SRS-AS transmission on the non-dormant BWP, triggered via a DCI indicating switching out of SCell dormancy.

* Legacy DCI format(s) for switching out of SCell dormancy is reused without introducing new DCI field or resizing the existing DCI field
* FFS: Which DCI format(s) from DCI format 0\_1/0\_3/1\_1/1\_3/2\_6 is supported
* FFS: Triggering mechanism(s)
* FFS: Timeline of the aperiodic SRS-AS transmission (requirement is up to RAN4)

**Agreement:**

For early triggering of CSI/CSI-RS when SCell transition from a dormant BWP to a non-dormant BWP, support aperiodic CSI reporting for the non-dormant BWP, triggered via a DCI indicating switching out of SCell dormancy.

* The aperiodic CSI reporting is associated with aperiodic CSI-RS for CSI on the non-dormant BWP
* Legacy DCI format(s) for switching out of SCell dormancy is reused without introducing new DCI field or resizing the existing DCI field
* FFS: Which DCI format(s) from DCI format 0\_1/0\_3/1\_1/1\_3/2\_6 is supported
* FFS: Triggering mechanism(s)
* FFS: Timeline of the aperiodic CSI reporting and corresponding aperiodic CSI-RS for CSI (requirement is up to RAN4)

**Agreement:**

For UE transition from IDLE/INACTIVE to CONNECTED mode, support the followings for aperiodic CSI reporting triggered by MSG4:

* For PMI-based reporting, support the report quantity ‘CRI-RI-PMI-CQI’
  + FFS: ‘CRI-RI-LI-PMI-CQI’
* For PMI-free reporting, support the report quantity ‘CRI-RI-CQI’

**Agreement:**

For early TRS reception when UE transition from IDLE/INACTIVE to CONNECTED mode, down-select one from the followings in RAN1#123 meeting:

* Alt-1: Support aperiodic TRS triggered by MSG4 only
* Alt-2: Support periodic TRS triggered by MSG4 and aperiodic TRS triggered by MSG4
* Alt-3: Support periodic TRS triggered by MSG4 only

**R1-2506839 Moderator summary on enhancing DL CSI acquisition (Round 1) Moderator (MediaTek Inc.)**

**Agreement**

For UE transition from IDLE/INACTIVE to CONNECTED mode, using MAC-CE in the PDSCH for MSG4 to trigger early aperiodic SRS-AS/CSI-RS/CSI

* Note: How to determine the PUSCH for aperiodic CSI reporting is separately discussed.

**Agreement**

For SCell transition from deactivation to activation, support the followings for aperiodic CSI reporting triggered based on legacy SCell activation command:

* For PMI-based reporting, support the report quantity ‘CRI-RI-PMI-CQI’
  + FFS: ‘CRI-RI-LI-PMI-CQI’
* For PMI-free reporting, support the report quantity ‘CRI-RI-CQI’

**Agreement**

For SCell transition from dormant-BWP to non-dormant BWP, support the followings for aperiodic CSI reporting triggered via a DCI indicating switching out of SCell dormancy:

* For PMI-based reporting, support the report quantity ‘CRI-RI-PMI-CQI’
  + FFS: ‘CRI-RI-LI-PMI-CQI’
* For PMI-free reporting, support the report quantity ‘CRI-RI-CQI’

**Agreement**

For early aperiodic SRS-AS/CSI-RS/CSI triggering (i.e., early triggering of aperiodic SRS-AS transmission, aperiodic CSI-RS reception, aperiodic CSI reporting) when UE transition from INACTIVE to CONNECTED mode, reuse the procedure for UE transition from IDLE to CONNECTED mode.

**Agreement**

For early triggering of SRS-AS when UE transition from IDLE/INACTIVE to CONNECTED mode, support Option-2 as follows:

* In Step-1, SIBx provides one or multiple SRS configurations based on one or multiple ‘xTyR’ UE capability assumptions.
  + At least one SRS configuration(s) ~~resource sets~~ for SRS-AS ~~in an SRS configuration~~ is provided for a same ‘xTyR’
  + FFS: Information to be provided in SRS configuration(s)
  + FFS: Whether Configuration information could be SRS configuration or the CSI report configuration for PMI-free report.
  + FFS: Whether SRS configuration can be associated with CSI report configuration for PMI-free report.
* In Step-2, UE reports through MSG3 which/whether the SRS configuration(s) provided in SIBx is/are supported.
  + FFS: How to report which/whether the SRS configuration(s) provided in SIBx is/are supported.

**R1-2506840 Moderator summary on enhancing DL CSI acquisition (Round 2) Moderator (MediaTek Inc.)**

**Agreement:**

For early triggering of aperiodic CSI reporting and the associated CSI-RS for CSI when UE transition from IDLE/INACTIVE to CONNECTED mode, support Option-2 as follows:

* In Step-1, SIBx provides one or multiple CSI report configurations based on one or multiple UE capability assumptions
  + Each CSI reporting configuration is associated with a CSI resource configuration for channel measurement.
    - The CSI-RS resource set(s) in the CSI resource configuration for channel measurement is provided with a same number of CSI-RS ports
  + Each CSI reporting configuration is associated with a CSI resource configuration for CSI-IM based interference measurement.
  + FFS: Support of NZP CSI-RS based interference measurement
  + FFS: Information to be provided in a CSI report/resource configuration
* In Step-2, UE reports through MSG3 which/whether the CSI report configuration(s) provided in SIBx is/are supported.
  + FFS: How to report which/whether the CSI report configuration(s) provided in SIBx is/are supported.

**R1-2508115 Moderator summary on enhancing DL CSI acquisition (Round 3) Moderator (MediaTek Inc.)**

**Agreement:**

On PUSCH allocation for MSG4-triggered aperiodic CSI reporting associated with aperiodic CSI-RS for CSI, when UE transition from IDLE/INACTIVE to CONNECTED mode, down select one from the following alternatives to determine PUSCH for carrying the aperiodic CSI report by RAN1#123:

* Alt-1: The PUSCH is scheduled by MAC CE in MSG4 along with the aperiodic CSI report triggering.
* Alt-2: The PUSCH is scheduled by a legacy DCI after MSG4
* Alt-3: The PUSCH is configured by SIBx providing resource/reporting configuration for early triggering of aperiodic CSI reporting.

Note: The timeline of PUSCH for aperiodic CSI reporting is separately discussed.

**Agreement:**

On triggering mechanism for early aperiodic SRS-AS transmission on a SCell and early aperiodic CSI reporting for a SCell, based on the legacy SCell activation activating the SCell, down-select one from the followings in RAN1#123 meeting:

* Alt-1 (Implicit mechanism):
  + For early aperiodic SRS-AS transmission, the SRS resource set(s) triggered for the SCell is determined according to RRC configuration.
  + For early aperiodic CSI reporting, the CSI report configuration(s) triggered for the SCell is determined according to RRC configuration
* Alt-2 (Explicit mechanism):
  + For early aperiodic SRS-AS transmission, the SRS resource set(s) triggered for the SCell is determined according to an indication in SCell activation command.
  + For early aperiodic CSI reporting, the CSI report configuration(s) triggered for the SCell is determined according to an indication in SCell activation command.

## Study of Enhancements for solutions for Ambient IoT (Internet of Things) in NR outdoor for active devices

*Please refer to* [*RP-252964*](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_107/Docs/RP-250796.zip) *for detailed scope of the SI*

[122bis-R20-A-IoT] Email discussion on Rel-20 A-IoT – Jay (LGE)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508157** Session notes for 10.3 (Study of Enhancements for solutions for Ambient IoT (Internet of Things) in NR outdoor for active devices) Ad-Hoc Chair (Huawei)

Session notes are endorsed and incorporated the session notes below.

[Post-122bis-R20-AIoT-evaluation] – Zhe (Huawei)

Email discussion on coverage evaluation results of link budget analysis, link-level simulation for R20 A-IoT study from November 5th until 14th

• Companies are encouraged to provide link budget analysis and link-level simulation results until November 7th

• Zhe to collect results, provide consolidated tables, proposals for observations until November 14th

The discussions are to be carried over to RAN1#123.

R1-2507357 Updated work plan for Rel-20 Ambient IoT SI LG Electronics

### Evaluations

*Including necessary evaluation assumptions of deployment scenarios for coverage and coexistence, evaluations of achievable cell edge data rate and link budget, as well as applicability and necessity of Device 2b and Device C to given scenarios.*

R1-2506747 Discussion on Evaluation Methodology for R20 A-IoT FUTUREWEI

R1-2506788 Evaluation for Rel-20 AIoT Nokia

R1-2506808 Discussion on evaluation assumptions and results for Ambient IoT Spreadtrum, UNISOC

R1-2506827 Discussion on evaluation of active Ambient IoT device ZTE Corporation, Sanechips

R1-2506892 Evaluation methodologies, assumptions and results for R20 AIoT vivo

R1-2506944 Evaluation for active A-IoT device in outdoor scenario Huawei, HiSilicon

R1-2506983 Discussion on evaluation methodology for Ambient IoT in NR outdoor for active devices Xiaomi

R1-2507009 Discussion on evaluation assumptions CMCC

R1-2507024 Evaluation assumptions for outdoor Ambient IoT Tejas Network Limited

R1-2507066 Discussion on Rel-20 A-IoT evaluation assumptions and results Ericsson

R1-2507113 Evaluation methodology for A-IoT outdoor deployment scenarios CATT

R1-2507170 Discussion on EVM for R20 A-IoT OPPO

R1-2507209 Evaluation results for Device 2b&C for Ambient IoT HONOR

R1-2507247 Evaluation methodology and assumptions for Rel-20 Ambient IoT Samsung

R1-2507299 Evaluations for Ambient IoT NEC

R1-2507326 Discussion on evaluations for Ambient IoT China Telecom

R1-2507358 Evaluations for Rel-20 Ambient IoT SI LG Electronics

R1-2507591 Evaluation of Ambient IoT for outdoor active device Sony

R1-2507619 Ambient IoT evaluations MediaTek Inc.

R1-2507671 On Rel-20 Ambient IoT evaluations Apple

R1-2507715 Evaluations Qualcomm Incorporated

R1-2507755 Evaluations for Device 2b/C in Ambient IoT InterDigital, Inc.

R1-2507807 Study on evaluations for Ambient IoT outdoor for active device NTT DOCOMO, INC.

R1-2507839 Evaluations for outdoor AIoT devices Indian Institute of Tech (M)

R1-2507944 Evaluations for Rel-20 AIoT IIT Kanpur

**R1-2507958** FL summary #1 for Ambient IoT: “10.3.1 Evaluations” Moderator (Huawei)

**Agreement**

For Rel-20 study, values of “W” and “h” used for RMa pathloss model are clarified as follows (as per TR38.901):

* W (avg. street width) = 20m
* h (avg. building height) = 5m

**Agreement**

For the bullet of “FFS: 40dB as additional assumption for Device 2b with IF-ED” under Device 2b noise figure assumption in link budget for evaluation purpose:

~~FFS: 40dB as additional assumption for Device 2b with IF-ED~~

**Agreement**

For Rel-20 study, the value of X dBm/Hz for “Receiver interference density (dBm/Hz)” in the link budget template is from the followings:

* For R2D, X = -169.3 dBm/Hz
* For D2R, X = -165.7 dBm/Hz
* Companies can also report other higher value(s) for R2D or -999dBm/Hz along with their assumption

**Agreement**

For reference data rate in LLS assumption for evaluation purpose, RAN1 select one option from the followings:

* Option 1: Remove the FFS bullet, i.e.
  + ~~FFS whether to add additional value(s)~~

**Agreement**

For message size in LLS assumption for evaluation purpose, update the previous agreement as follows:

* ~~FFS whether to add value of 800 bits.~~

**Agreement**

For the SFO and CFO in LLS assumption of Device C, update the previous RAN1 agreement (in RAN1#122) as follows,

**Agreement**

For Rel-20 study, SFO and CFO in LLS assumption for evaluation purpose is from the followings:

* Device C is smaller than Device 2b

|  |  |  |
| --- | --- | --- |
|  | **Device 2b** | **Device C** |
| Initial SFO | Randomly select a value from the range of 10^3~10^4 ppm | ~~[~~50~~]~~ ppm |
| SFO after clock sync/calibration | 10^2 (O), 10^3 (M) ppm | ~~[~~10~~]~~ ppm |
| Initial CFO | Randomly select a value from the range of 10^3~10^4 ppm | ~~[~~50~~]~~ ppm |
| CFO after clock sync/calibration | 100 (M), 200 (O), 50 (O) ppm | ~~[~~10~~]~~ ppm |

**Agreement**

For Rel-20 study, following template is used for companies to report energy harvesting/storage assumptions to obtain the reported data rates,

|  |  |
| --- | --- |
| **Source** | **Energy harvesting/storage assumptions** |
| Source [x] | Energy source:  FL notes: Company to report energy source e.g. RF energy source and/or solar etc.  Energy storage capacity:  FL notes: Company to report energy storage capacity values in Joules or in farad with a voltage value.  Reported data rate:  FL notes: Company to report data rate for R2D and/or D2R respectively.  Other information (if any):  FL notes: In addition, companies can also report any related information they would like to indicate e.g. message size, reception/transmission duration, device power consumption, voltage, etc. Companies can also report how they derive the reported energy storage capacity. |

**R1-2507959** FL summary #2 for Ambient IoT: “10.3.1 Evaluations” Moderator (Huawei)

**Agreement**

For Rel-20 study, “Link budget template” is updated as followings,

Link budget template for Rel-20 study

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Item | Reader-to-Device | Device-to-Reader |
| **(0) System configuration** | | | |
| **[0A]** | Scenarios | Deployment scenario 4 with topology 1 with no external carrier wave | Deployment scenario 4 with topology 1 with no external carrier wave |
| **[0B]** | Device 2b/C | Device 2b/C | Device 2b/C |
| **[0C]** | Center frequency (MHz) | 900MHz (M), 2GHz (O) | 900MHz (M), 2GHz (O) |
| **[0D]** | Pathloss model | UMa NLOS defined in TR38.901  RMa NLOS defined in TR38.901  Note: companies can also report to use RMa LOS defined in TR38.901  UMi NLOS defined in TR38.901 | UMa NLOS defined in TR38.901  RMa NLOS defined in TR38.901  Note: companies can also report to use RMa LOS defined in TR38.901  UMi NLOS defined in TR38.901 |
| **(1) Transmitter** | | | |
| **[1D]** | Number of Tx antenna elements / TxRU/ Tx chains modelled in LLS | Refer to LLS table [0h1] and [0h2] | 1 |
| **[1E]** | Total Tx Power (dBm) | For standalone: 43 dBm  For in-band:  38 or 33 dBm over R2D transmission BW  Note: companies should report any PSD limitation they assume in their RAN1 evaluations | Device 2b: {-10, -20} dBm  Device C: {-3, 0, 5} dBm |
| **[1F]** | Transmission Bandwidth used for the evaluated channel (Hz) | Refer to LLS table [1a] | Refer to LLS table [2a1] |
| **[1G]** | Tx antenna gain (dBi) | 17dBi | For A-IoT device, 0dBi |
| **[1J]** | Ambient IoT on-object antenna penalty | N/A | 0dB or 0.9dB or 4.7dB |
| **[1N]** | Cable, connector, combiner, body losses, etc. (dB) | 3dB | N/A |
| **[1M]** | EIRP (dBm) | Calculated (see Note 1) | Calculated (see Note 1) |
| **(2) Receiver** | | | |
| **[2A]** | Number of receive antenna elements / TxRU / chains modelled in LLS | Same as [1D]-D2R | Same as [1D]-R2D |
| **[2B]** | Bandwidth used for the evaluated channel (Hz) | Refer to LLS table [1b] ED bandwidth | Refer to LLS table [2a3] |
| **[2C]** | Receiver antenna gain (dBi) | same as [1G]-D2R | Same as [1G]-R2D |
| **[2X]** | Cable, connector, combiner, body losses, etc. (dB) | N/A | Same as [1N]-R2D |
| **[2D]** | Receiver Noise Figure (dB) | Device 2b: 15 dB  ~~FFS: 40dB as additional assumption for Device 2b with IF-ED~~  Device C: 13 dB | For BS as reader: 5dB |
| **[2E]** | Thermal Noise power spectrum density (dBm/Hz) | -174 | -174 |
| **[2E1]** | Receiver interference density (dBm/Hz) | -169.3 dBm/Hz  Companies can also report other higher value(s) for R2D or -999 dBm/Hz along with their assumption | -165.7 dBm/Hz  Companies can also report -999 dBm/Hz along with their assumption |
| **[2F]** | Effective Noise Power (dBm) | Calculated (see Note 1) | Calculated (see Note 1) |
| **[2G]** | Required SNR/CNR | Reported by companies for Budget-Alt2 | Reported by companies for Budget-Alt2 |
| **[2H]** | Ambient IoT on-object antenna penalty | 0dB or 0.9 dB or 4.7 dB | Not applicable |
| **[2J]** | Budget-Alt1/ Budget-Alt2 | Budget-Alt2 | Budget-Alt2 |
| **[2L]** | Receiver Sensitivity (dBm) | Calculated (see Note 1) | Calculated (see Note 1) |
| **(3) System margins** | | | |
| **[3A]** | Shadow fading margin (dB) | For UMa NLOS: 6dB  For RMa NLOS: 8dB  For UMi NLOS: 7.82dB | For UMa NLOS: 6dB  For RMa NLOS: 8dB  For UMi NLOS: 7.82dB |
| **[3B]** | polarization mismatching loss (dB) | 3 dB | 3 dB |
| **[3C]** | BS selection/macro-diversity gain (dB) | 0 dB | 0 dB |
| **[3D]** | Other gains (dB) (if any please specify) | Reported by companies with justification | Reported by companies with justification |
| **[3E]** | Penetration margin (dB) | {0, 20, 80} dB | {0, 20, 80} dB |
| **(4) MPL / distance** | | | |
| **[4A]** | MPL (dB) | Calculated (see Note 1) | Calculated (see Note 1) |
| **[4B]** | Distance (m) | Calculated (see Note 1) | Calculated (see Note 1) |
| **（5）Other** | | | |
| **[5A]** | Other notes | Companies to report | Companies to report |

Note 1: Calculated values are derived according to the following.

[1M]:

- For R2D,

- [1M] = [1E] + [1G] - [1N]

- For D2R

- [1M] = [1E] + [1G] - [1J]

[2F]:

- [2F] = *lin2dB*(*dB2lin*([2D] + [2E]) + *dB2lin*([2E1])) +*lin2dB*([2B])

[2G]

- For the R2D LLS for ED, CINR/CNR is reported, where CINR/CNR is defined as the ratio of signal power spectral density in the transmission bandwidth to the noise and interference (if any) power spectral density in the device ED channel bandwidth.

- For R2D ZIF receiver, report the same metrics (i.e., CNR/CINR, signal transmission bandwidth, ED bandwidth) as agreed for RF-ED/IF receiver.

- For the D2R LLS, the SINR/SNR is reported and it is defined as the ratio of signal power to noise and interference (if any) power in the receiver bandwidth. Receiver bandwidth is the bandwidth used at the reader side to filter the D2R signals for calculating noise and interference (if any) power.

[2L]:

- For R2D,

- [2L] = [2G] - lin2dB([2B] / [1F]) + [2F]

Note E: The term ‘lin2dB([2B] / [1F])’ is applied due to scaling from CNR/CINR to SNR/SINR.

- For D2R,

- [2L] = [2G] + [2F]

[4A]

- For R2D

- [4A] = [1M] + [2C] - [2H] - [2L] - [3A] - [3B] + [3C] + [3D] - [3E]

- For D2R

- [4A] = [1M] + [2C] - [2X] - [2L] - [3A] - [3B] + [3C] + [3D] - [3E]

[4B]

- [4B] is derived by assuming pathloss is [4A] and using the pathloss formula as agreed.

**Agreement**

For Rel-20 study, “Coverage evaluation assumptions for link-level simulation” is updated as followings,

Coverage evaluation assumptions for link-level simulation for Rel-20 study

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Parameters | | Assumptions |
| R2D/D2R common parameters | | | |
| **[0a]** | Carrier frequency | | Refer to link budget template |
| **[0b]** | SCS | | 15 kHz as baseline |
| **[0c]** | Block structure | | Blocks as agreed in Rel-19 with update reported by companies |
| **[0d]** | Channel model | | TDL-C |
| **[0e]** | Delay spread | | an RMS delay spread of 300 ns |
| **[0f]** | Device velocity | | 3 km/h  Companies can also report 10 km/h |
| **[0g]** | Number of Tx/Rx chains for Ambient IoT device | | 1 |
| **[0h1]** | BS | Number of antenna elements | 2 or 4 |
| **[0h2]** | Number of TXRUs | 2 or 4 |
| **[0m]** | Reference data rate | | 1 kbps (M)  5 - 7 kbps (M)  48 - 60 kbps (O)  0.1 kbps for message size of 20 bits or 96 bits (O)  Other data rates can be reported by companies  Note 1: Companies to report the exact data rate.  Note 2: The exact data rate is close to the values listed above.  Note 3: The exact data rate is calculated by dividing the ~~total~~ message size (excluding CRC) by the total transmission time including applicable overheads(e.g., CRC, pre/mid/post-ambles if present).  Note 4: The exact data rate may be related to coding scheme, repetition and etc.  Note 5: All data rates considered are for evaluation purpose only  ~~FFS whether to add additional value(s)~~ |
| **[0n]** | Message size | | {20 bits, 96 bits, 400 bits} are considered for message size.  Note 1: companies to report the M value and chip length used for each message size  Note 2: CRC is not included for the message size  ~~FFS whether to add value of 800 bits.~~ |
| **[0p]** | BLER target | | 1%, 10% |
| **[0q]** | Sampling frequency | | Companies to report the sampling frequency (e.g., 1.92Msps or other feasible values if any)  Initial SFO (Sampling Frequency Offset) (Fe):  For Device 2b: Randomly select a value from the range of 10^3~10^4 ppm  For Device C: 50 ppm  SFO after clock sync/calibration:  For Device 2b: 10^3 (M) ppm, 10^2 (O) ppm  For Device C: 10 ppm  Note: For random selection, the value is randomly selected per simulation drop, according to a uniform distribution  Note: Above values are only for sampling purpose.  Note: Above assumptions are only for LLS evaluation purpose only for R2D and D2R.  The timing drift ΔT over a time T is modelled as ΔT = ±Fe \* T.  Note: SFO after clock calibration can be applied to Fe.  Initial CFO:  For Device 2b: Randomly select a value from the range of 10^3~10^4 ppm  For Device C: 50 ppm  CFO after clock sync/calibration:  For Device 2b: 100 (M) ppm, 200 (O) ppm, 50 (O) ppm  For Device C: 10 ppm  Drift rate of 0.1 or 1 ppm/s. Companies to report which value they used.  Note: Above assumptions are for LLS evaluation purpose only |
| **[0r]** | Device 2b/C | | ZIF/IF-ED |
| **R2D specific parameters** | | | |
| **[1a]** | Transmission bandwidth | | 180kHz  Other values e.g. 360kHz, 540kHz or other multiples of 180kHz are not precluded and up to company report |
| **[1b]** | ED bandwidth | | Up to company report with considering:  R2D transmission bandwidth  Device Rx LO uncertainty (e.g. CFO ppm assumption) |
| **[1c]** | BB LPF | | [X]-order Butterworth/RC filter with cutoff frequency at half of ED bandwidth.  Companies to report X = {3, 5}. |
| **[1d]** | Waveform | | OOK waveform generated by OFDM modulator |
| **[1e]** | Modulation | | OOK-4  Companies to report M chips per OFDM symbol |
| **[1f]** | Line code | | Manchester |
| **[1g]** | FEC | | Companies who report evaluations using FEC should also report evaluations without FEC |
| **[1h]** | ADC bit width | | 4-bit |
| **[1j]** | Detection/decoding method for Line code | | Companies to report |
| **[1k]** | Repetition | | Companies who report R2D evaluations using repetition should also report R2D evaluations without repetition |
| **D2R specific parameters** | | | |
| **[2a1]** | Transmission bandwidth | | 15kHz  Other values are not precluded and up to company report  Companies to report which of 2SB or 1SB modulation is assumed for D2R transmission bandwidth |
| **[2a2]** | Chip rate | | Companies to report |
| **[2a3]** | Receiver bandwidth | | D2R receiver bandwidth is the bandwidth used at the reader side to filter out the D2R signals for calculating noise and interference (if any) power.  Assume the receiver matches the transmitter's modulation, i.e., to receiver uses 1SB when transmitter uses 1SB, receiver uses 2SB when transmitter uses 2SB.  Companies to report the value, and further down-selection of the values and 2SB/1SB is not precluded. |
| **[2d]** | Modulation | | Companies to report modulation, e.g., OOK, BPSK |
| **[2e]** | Line code | | Companies to report, e.g., Manchester encoding, no line coding |
| **[2g]** | FEC | | Companies to report, e.g., CC, No FEC |
| **[2h]** | ADC bit width | | Companies to report, e.g., 11-bit |
| **[2j]** | D2R receiver | | Companies to report, e.g., coherent receiver / non-coherent receiver |
| **[2k]** | Repetition | | Companies to report based on update of Rel-19 if any |
|  | **Other assumptions** | | |
| **[3a]** | Other assumptions | | To be reported by company |
| **[3b]** | Note: Companies to report required SINR/SNR/CINR/CNR according to BLER target. | | |

R1-2507960 FL summary #3 for Ambient IoT: “10.3.1 Evaluations” Moderator (Huawei)

### Study of air interface for Device 2b/C

*Please refer to the first paragraph of objective 1 for the given conditions. Including study necessary and feasible changes to the Rel-19 air interface for Device 2b/C.*

R1-2506748 Discussion on Air Interface for Device 2b/C FUTUREWEI

R1-2506789 Air interface for Device 2b/C for Rel-20 AIoT Nokia

R1-2506809 Discussion on study of air interface for Device 2b/C Spreadtrum, UNISOC

R1-2506828 Discussion on air interface of active Ambient IoT device ZTE Corporation, Sanechips

R1-2506893 Discussion on air interface for Device 2b/C for R20 AIoT vivo

R1-2506945 Study of air interface for A-IoT 2b/C Huawei, HiSilicon

R1-2506984 Discussion on the air interface for Device 2b/C Xiaomi

R1-2507010 Discussion on air interface for Device 2b/c CMCC

R1-2507025 Study the air interface for Device 2b and C for outdoor coverage  Tejas Network Limited

R1-2507067 Study of air interface for Device 2b/C Ericsson

R1-2507114 Study of A-IoT enhancement for device 2b/C CATT

R1-2507171 Discussion on air interface enhancement for device 2b/C OPPO

R1-2507190 Discussion on air interface for Device 2b and Device C Transsion Holdings

R1-2507210 Views on air interface for Device 2b&C for Ambient IoT HONOR

R1-2507248 Study on air interface design for active devices Samsung

R1-2507300 Study of air interface for active device NEC

R1-2507323 Discussion on air interface for Device 2b/C Lenovo

R1-2507327 Discussion on air interface for Device 2b/C for Ambient IoT China Telecom

R1-2507359 Air interface for Device 2b/C LG Electronics

R1-2507382 Discussion on A-IoT Air Interface for Device 2b/C Panasonic

R1-2507463 Views on AIoT outdoor for active devices Ofinno

R1-2507501 Discussion on air interface for device 2b and device C ETRI

R1-2507568 Discussion on air interface for active devices Sharp

R1-2507570 Discussion on Air Interface Enhancements for R20 A-IoT Fraunhofer HHI, Fraunhofer IIS

R1-2507592 Air interface for Ambient IoT device type 2b / C Sony

R1-2507620 Study of air interface for Device 2b/C MediaTek Inc.

R1-2507631 Study of air interface and power control for outdoor active ambient IoT devices ROBERT BOSCH GmbH

R1-2507672 On Rel-20 Ambient IoT air interface for device 2b/C Apple

R1-2507716 Study of air interface for Device 2b/C Qualcomm Incorporated

R1-2507754 Air interface for Device 2b/C in Ambient IoT InterDigital, Inc.

R1-2507787 Discussion on A-IoT active device ASUSTeK

R1-2507808 Study on air interface for Ambient IoT device 2b/C NTT DOCOMO, INC.

R1-2507833 Discussion on air interface for Device 2b/C Quectel

R1-2507855 Discussion on air interface for active devices for Ambient IoT TCL

R1-2507856 On AIoT air interface enhancement for Rel.20 Device 2b/C Sequans Communications

R1-2507887 Study of A-IoT air interface for device 2b/C Wiliot Ltd.

R1-2507899 Discussion on air interface for Device 2b/C CEWiT

R1-2507943 Discussion on air interface for active device types IIT Kanpur

**R1-2508046** FL summary #1 for 10.3.2 “Study of air interface for Device 2b/C Moderator (LG Electronics)

**Agreement**

Study L1 R2D control information with separate CRC for Device 2b and for Device C considering the following aspects

* Necessary information to be included in the L1 R2D control
* Details on how the L1 R2D control information is transmitted

**R1-2508047** FL summary #2 for 10.3.2 “Study of air interface for Device 2b/C” Moderator (LG Electronics)

**Agreement**

Study necessity and feasibility of R2D FDM from the same reader for Device 2b and for Device C considering at least the following aspects:

* complexity of device to support FDM
* how a device determines the frequency resource for receiving one of the FDMed R2D transmissions

**Agreement**

Study necessity and feasibility of D2R CDM(A) for Device 2b and for Device C with sequence-based Msg1 transmission and potential impact to random access procedures.

* FFS: other cases, except for data transmission

**R1-2508048** FL summary #3 for 10.3.2 “Study of air interface for Device 2b/C” Moderator (LG Electronics)

**Agreement**

For the functionality of indicating the start of the R2D transmission that contains PRDCH, study at least the following options if the functionality relies on SIP:

* Option 1: binary sequence-based SIP (e.g M-sequence or Golay sequence).
* Option 2: Reuse the Rel-19 SIP.

**Agreement**

For the functionality of indicating the end of the PRDCH, study the following option:

* Option 1: Use the L1 R2D control information to indicate the TBS.

**R1-2508049** FL summary #4 for 10.3.2 “Study of air interface for Device 2b/C” Moderator (LG Electronics)

**Agreement**

For the functionality of chip duration determination of the data payload in the PRDCH, study the following options:

* Option 1: same as the chip duration of the corresponding L1 R2D control information
* Option 2: indicated by the corresponding L1 R2D control information

**R1-2508103** FL summary #5 for 10.3.2 “Study of air interface for Device 2b/C” Moderator (LG Electronics)

**Agreement**

For the functionality of chip duration determination of the L1 R2D control information, study at least the following options:

* Option 1: Fixed chip duration. No use of CAP for chip duration determination.
* Option 2: Blind detection from a predefined set of the chip durations of L1 R2D control information. No use of CAP for chip duration determination.
* Option 3: Use CAP
  + Alt.3-1 Rel-19 CAP pattern
  + Alt.3-2 Enhanced CAP
    - Alt.3-2a: Rel-19 CAP pattern with repetition
    - Alt.3-2b: CAP pattern and the association between chip durations for CAP and chip durations of L1 R2D control information
* Option 4: Use a set of different binary sequences with fixed or variable length
  + Alt.4-1: using binary sequences for SIP. No use of CAP for chip duration determination.
  + Alt.4-2: using binary sequences for CAP
* Option 5: Use broadcast information (if any) to indicate the chip duration

**Agreement**

For the functionality of CFO estimation/LO calibration at the device side, study CFO calibration signal with the following aspects:

* Whether the signal is
  + Option a: unmodulated sinusoid single tone
  + Option b: unmodulated multiple sinusoid single tones
  + Option c: modulated multiple tones
    - Whether the CFO calibration signal is the same or different from the synchronization signal (if supported)
* Whether the CFO calibration signal is transmitted periodically and/or as needed (aperiodically)
* The time location(s) of CFO calibration signal.
  + Option 1: in relation to the L1 R2D control information
  + Option 2: in relation to the data payload of the PRDCH
  + Option 3: in relation to the PDRCH
  + Option 4: in relation to the synchronization signal (if supported)
  + Option 5: in relation to broadcast information (if supported)
  + Combination of Options is not precluded
* Other details (e.g., time duration, frequency location(s) of the CFO calibration signal)

**Agreement**

Study R2D synchronization signal at least for the functionality of frequency synchronization (including frequency acquisition) and for the functionality of timing synchronization/tracking.

* Alt1: periodic synchronization signal
* Alt2: aperiodic synchronization signal

**R1-2508104** FL summary #6 for 10.3.2 “Study of air interface for Device 2b/C” Moderator (LG Electronics)

**Agreement**

For resource allocation method for the first D2R transmission for DO-A for Device 2b and for Device C, study following options considering feasibility:

* Option 1: Periodic D2R resource allocation
* Option 2: Aperiodic D2R resource allocation

**Agreement**

For providing necessary information for the first D2R transmission for DO-A for Device 2b and for Device C, study at least following options considering feasibility:

* Option 1: necessary information provided by broadcast information
* Option 2: necessary information provided by a paging-like R2D message
* Option 3: necessary information derived from a synchronization signal and provided by broadcast information

**Agreement**

Study whether necessary information for the first D2R transmission for DO-A for Device 2b and for Device C is provided periodically and/or aperiodically by Reader.

**Agreement**

For the content of the first D2R transmission for DO-A for Device 2b and for Device C, study the following options:

* Option 1: Msg1-like content
* Option 2: DO-A data payload
  + FFS: with or without device ID
* Option 3: DO-A scheduling request

**Agreement**

The study assumes single-carrier waveform for D2R.

* FFS whether to use 2SB or 1SB for D2R

**Agreement**

Regarding D2R preamble for PDRCH, study the following aspects of the D2R preamble.

* Preamble length (e.g., longer than Rel-19 D2R preamble)
* Sequence type
* Number of sequences using the same length (e.g., for reader/device differentiation)
* Considering other factors affecting preamble design (e.g., D2R modulation and detection schemes)

**Agreement**

Regarding D2R midamble for PDRCH, study the following aspects of the D2R midamble.

* Midamble pattern(s) including the length(s) and interval(s) within (and possibly at the end of) a PDRCH
* Sequence type, and whether the same or different sequence type is used for D2R preamble and D2R midamble
* Considering other factors affecting midamble design (e.g., D2R modulation and detection schemes)

**R1-2508129** FL summary #7 for 10.3.2 “Study of air interface for Device 2b/C” Moderator (LG Electronics)

**Agreement**

Study the necessity of D2R Tx power control for Device 2b and for Device C for outdoor scenarios

* Target to agree on observations on pros and cons of D2R Tx power control vs. no Tx power control at RAN1#123

Continue studying feasibility of the following open loop power control methods considering device complexity:

* Methods of open loop power control
  + Option 1: Device calculates Tx power based on measured pathloss, a predefined formula, and some configured parameters from reader
    - Required information at the device side at least includes reader Tx power, received target power at the reader, etc.
  + Option 2: Device measures RSRP, and uses a corresponding Tx power when the RSRP falls in an RSRP range.
    - The RSRP range is based on RSRP threshold(s) configured by reader or predefined
    - Required information at the device side at least includes RSRP threshold(s), corresponding D2R Tx power related information per each RSRP range defined by the RSRP threshold(s)
  + FFS details (e.g., required measurements, required information)

Continue studying the necessity and feasibility of closed loop power control for D2R.

**Agreement**

Study interleaving for PDRCH with FEC, including the necessity and feasibility of the following:

* Alt 1: reuse both LTE sub-block interleaver and LTE bit collection scheme
* Alt 2: reuse LTE bit collection scheme without LTE sub-block interleaver
* Alt 3: based on LTE bit collection scheme with some update (e.g., for memory reduction) without LTE sub-block interleaver
* Combination of alternatives can be studied

**Agreement**

Study interleaving for PRDCH with FEC, including the necessity and feasibility of the following:

* Alt 1: reuse both LTE sub-block interleaver and LTE bit collection scheme
* Alt 2: reuse LTE bit collection scheme without LTE sub-block interleaver
* Alt 3: based on LTE bit collection scheme with some update (e.g., for memory reduction) without LTE sub-block interleaver
* Combination of alternatives can be studied

**Agreement**

For PDRCH, further study the necessity of scrambling with following details:

* Scrambling applied after block-level repetition (if applied) and channel coding (if applied, including interleaving if supported)
* Scrambling sequence type and generation method

**Agreement**

Regarding D2R modulation for device 2b and device C, further study the following:

* Option 1: BPSK
  + FFS the corresponding preamble and midamble design for coherent detection at reader side
* Option 2: OOK
  + FFS the corresponding preamble and midamble design for coherent or non-coherent detection at reader side
* Option 3: DBPSK
  + FFS the corresponding preamble and midamble design for non-coherent detection at reader side
* Option 4: MSK
  + FFS the corresponding preamble and midamble design for coherent or non-coherent detection at reader side

**Agreement**

The minimum R2D transmission bandwidth of 1 PRB is the baseline for Rel-20.

**Agreement**

For R2D signals, study the necessity for the functionality of SFO calibration, and study the feasibility of the following options:

* Option 1: Reuse CAP and/or Manchester encoding
* Option 2: sequence-based SIP with or without R2D midamble(s)
* Option 3: using the CFO calibration signal

**R1-2508130** FL summary #8 for 10.3.2 “Study of air interface for Device 2b/C” Moderator (LG Electronics)

**Agreement**

For the study of necessity and feasibility of FEC for R2D for Device 2b and for Device C, further study the following aspects:

* Coding schemes
  + LTE TBCC
  + Tailed convolutional code with the same polynomial as LTE TBCC
  + RM code
* FEC code rates: 1/2, 1/3, 1/4

**Agreement**

For R2D and D2R, study the order of channel coding (including interleaver if supported) and block-level repetition (if supported) for complexity reduction, considering necessity and feasibility.

**Agreement**

For the study of R2D binary sequence-based SIP, study the following aspects:

* Sequence type
  + Option 1: m-sequence
  + Option 2: Golay sequence
* Length of sequence
* Number of sequence(s)
* FFS: whether to apply Manchester coding to the sequence
* Note: the same aspects can be studied for R2D midamble if applied with a sequence-based SIP

**Agreement**

For the study of binary sequence-based Msg1 for the study of necessity and feasibility of D2R CDM(A) for Device 2b and for Device C, study at least the following aspects:

* Sequence type (e.g. Gold sequence, m-sequence)
* Length of the sequence
* Number of sequences

**Agreement**

For R2D, study at least the following aspects for the study of broadcast information:

* Information included in the broadcast information
* Whether to use PRDCH to carry the broadcast information
* Transmission of broadcast information:
  + Option 1: periodic
  + Option 2: aperiodic
* Time and frequency resources for transmission of the broadcast information, e.g. in relation to the synchronization signal.

**Agreement**

For the L1 R2D control information preceding and scheduling the data payload of PRDCH, study the following aspects:

* Time location of L1 R2D control information:
  + Option 1: L1 R2D control information and data payload of PRDCH are contiguous in time.
  + Option 2: L1 R2D control information and data payload of PRDCH are not contiguous in time.
* Study frequency resource of L1 R2D control information
* Whether L1 R2D control information is included in the PRDCH that carries that data payload, or in another PRDCH, or in another channel

## Coverage Enhancement Phase 3

*Please refer to* [*RP-252824*](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_107/Docs/RP-250796.zip) *for detailed scope of the WI.*

[122bis-R20-CE] Email discussion on Rel-20 CE– Hang (China Telecom)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508158** Session notes for 10.54 (Coverage Enhancement Phase 4) Ad-Hoc Chair (Huawei)

Session notes are endorsed and incorporated the session notes below.

R1-2507328 Work plan for Rel-20 WI on NR coverage enhancements Phase 3 China Telecom

### Coverage enhancement

*Including PRACH coverage enhancements, PUSCH repetition scheduled by DCI 0\_0 with C-RNTI and Extending pi/2-BPSK to more MCS entries.*

R1-2506810 Discussion on NR Coverage enhancement Phase 3 Spreadtrum, UNISOC

R1-2506894 Discussions on NR phase 3 coverage enhancements vivo

R1-2506916 Discussion on coverage enhancement ZTE Corporation, Sanechips

R1-2506947 Coverage enhancements for NR Phase 3 Huawei, HiSilicon

R1-2506985 Discussion on coverage enhancement Xiaomi

R1-2507055 NR coverage enhancement Phase 3 Tejas Network Limited

R1-2507056 Coverage enhancements for NR Phase 3 Nokia

R1-2507115 Discussion on coverage enhancement CATT

R1-2507172 Discussion on further enhancement for coverage enhancement OPPO

R1-2507187 Discussion on coverage enhancement LG Electronics

R1-2507191 Discussion on coverage enhancement Transsion Holdings

R1-2507216 Coverage enhancement for NR Phase 3 InterDigital, Inc.

R1-2507249 Discussion on Coverage Enhancement Samsung

R1-2507289 Discussions on the Rel. 20 coverage enhancement KT Corp.

R1-2507329 Discussion on NR coverage enhancements Phase 3 China Telecom

R1-2507375 Discussion on 5G NR coverage enhancement phase 3 Panasonic

R1-2507432 Discussion on coverage enhancement TCL

R1-2507464 Views on Coverage Enhancement Phase 3 Ofinno

R1-2507502 Discussion on coverage enhancements ETRI

R1-2507530 Coverage enhancements Lenovo

R1-2507554 Discussion on coverage enhancement DENSO CORPORATION

R1-2507673 Discussion on Coverage enhancements for NR Phase 3 Apple

R1-2507717 Coverage enhancement Phase 3 Qualcomm Incorporated

R1-2507783 Discussion on Rel-20 Coverage Enhancement Ericsson (China)

R1-2507809 Discussions on coverage enhancement NTT DOCOMO, INC.

R1-2507822 Discussions on further coverage enhancement for NR Sharp

R1-2507867 Discussion on coverage enhancement ASUSTeK

R1-2507900 Discussion on Coverage Enhancements Phase 3 CEWiT

**R1-2507330** FL's summary #1 on NR coverage enhancements Phase 3 China Telecom

**Agreement**

Support to use separate ROs or separate preambles on shared RO to differentiate multiple PRACH transmissions with same Tx beam and different Tx beams.

* FFS: details

**Working assumption**

The multiple PRACH transmission with different Tx beams is supported for CBRA, ReconfigurationWithSync case in CFRA and SI request.

* RAN1 assumes that all the cases are supported with a common solution

**Agreement**

Introduce RRC signaling to enable the extension of pi/2-BPSK to more MCS entries.

R1-2507331 FL's summary #2 on NR coverage enhancements Phase 3 China Telecom

**Agreement**

LLS should be conducted to decide which MCS entries pi/2-BPSK can be extended to.

* Both LLS performance gain and power boosting gain due to lower PAPR should be taken into consideration.
* Note: LLS performance gain refers to the performance gain/loss when using pi/2-BPSK compared with QPSK with same SE according to LLS; power boosting gain refers to the performance gain acquired due to the low PAPR of pi/2-BPSK compared with QPSK.

**Agreement**

Pi/2-BPSK is extended to more MCS entries in MCS tables with spectrum efficiency no larger than N (N <= 0.8770).

* FFS: value of N

**Agreement**

When extending pi/2-BPSK to more MCS entries in MCS tables, the code rate should be doubled to keep spectral efficiency the same.

**Agreement**

Reuse at least the following definitions and mechanisms in multiple PRACH transmissions with same Tx beam for multiple PRACH transmissions with different Tx beams.

* Definition and determination of RO group
* definition of time period
* SSB-to-RO mapping rule
* Note: the terminology RO group stands for the ROs for multiple PRACH transmissions as specified in TS 38.213, i.e., “set consists of valid PRACH occasions…”.

**Agreement**

Reuse the definition of time offset between RO groups in multiple PRACH transmissions with same Tx beam for multiple PRACH transmissions with different Tx beams.

**Agreement**

Reuse the PRACH power control (power ramping between different RACH attempts is FFS) rule of multiple PRACH transmissions with same Tx beam for multiple PRACH transmissions with different Tx beams.

* FFS: whether/how power ramping should be supported for multiple PRACH transmissions with different Tx beams.

**Agreement**

Support indicating the UL beam information via one or a combination of multiple options from following options, for down-selection:

* Option 1: implicitly indicated by RA-RNTI
* Option 2: explicitly indicated by DCI format 1\_0 with CRC scrambled by RA-RNTI (e.g., reserved bits)
* Option 3: explicitly indicated by repurposing field(s) in UL Grant in RAR
* Option 4: explicitly indicated by introducing new field in MAC RAR
* Option 5: explicitly indicated by repurposing bit(s) in MAC RAR

FFS: the exact content of UL beam information

**Agreement**

For the determination of Tx beam utilization for multiple PRACH transmissions with different Tx beams,

* It is up to UE implementation to determine which Tx beams to use, subject to any necessary restriction
  + FFS: any necessary restriction
* FFS: whether/how gNB can configure UE to use same Tx beams in part of the PRACH transmissions

**Agreement**

Reuse the following rules of Msg3 repetition for PUSCH repetition scheduled by DCI 0\_0 with C-RNTI.

* RV determination rule, including first RV id determination, RV sequence selection, RV cycling, etc.
* Available slot determination rule
* Only applicable to PUSCH Repetition Type A

**R1-2508116** FL Summary #3 of Coverage Enhancement for NR Phase 3 Moderator (China Telecom)

**Agreement**

Down-select one of the following options to indicate the number of repetitions of PUSCH scheduled by DCI 0\_0 with C-RNTI

* Option 1: Using at most 2 MSB of MCS field in DCI format 0\_0 with CRC scrambled by C-RNTI
* Option 2: Based on TDRA
* Option 3: Using the padding bits in DCI format 0\_0 with CRC scrambled by C-RNTI
* Option 4: Using the 2 MSB of HPN field in DCI format 0\_0 with CRC scrambled by C-RNTI
* Option 5: Using the DAI field in the DCI 1\_0 with CRC scrambled by TC-RNTI
* Other options are not precluded

**Agreement**

Strive for a single mechanism for PUSCH repetition scheduled by DCI 0\_0 with C-RNTI.

**Agreement**

Support [request or capability report] of PUSCH repetition scheduled by DCI 0\_0 with C-RNTI at least before receiving RRCReconfiguration via one of the following signalling.

* Option 1: Msg3
* Option 2: HARQ-ACK of Msg4
* FFS: whether to configure a RSRP of DL reference signal for UE to trigger the [request or capability report].

FFS: other options and details.

**Agreement**

For multiple PRACH transmissions with different Tx beams, the maximum candidate value of the total number of PRACH transmissions is 8 per RACH attempt.

* FFS: the exact candidate values and other details

## Study on Integrated Sensing And Communication (ISAC) for NR

*Please refer to* [*RP-252819*](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_105/Docs/RP-242348.zip) *for detailed scope of the SI.*

[122bis-R20-ISAC] Email discussion on Rel-20 ISAC – Yingyang (Xiaomi)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508159** Session notes for 10.5 (Study on Integrated Sensing And Communication (ISAC) for NR) Ad-Hoc Chair (Huawei)

Session notes are endorsed and incorporated the session notes below.

R1-2507421 Updated work plan for study on Integrated Sensing And Communication (ISAC) for NR Xiaomi, China Telecom

R1-2507422 Updated TR skeleton for study on Integrated Sensing And Communication (ISAC) for NR Xiaomi, China Telecom

**Agreement**

The TR skeleton in R1-2507422 is endorsed.

### Evaluation assumptions and performance evaluation

*Including study of metrics, measurements, and relevant measurement quantization for UAV use case.*

R1-2506811 Discussion on evaluation assumptions and metrics for ISAC Spreadtrum, UNISOC

R1-2506895 Evaluation methodology and assumptions for 5G-A ISAC vivo

R1-2506920 Evaluation assumptions and performance evaluation of ISAC for NR InterDigital, Inc.

R1-2506946 Performance metric, methodologies, and initial evaluation results for ISAC Huawei, HiSilicon

R1-2506986 Discussion on performance evaluation for ISAC Xiaomi

R1-2507011 Discussion on ISAC evaluation methodology and assumptions CMCC

R1-2507116 Discussion on evaluation assumptions and performance evaluation for R20 ISAC for NR CATT, CICTCI

R1-2507173 Discussion of ISAC evaluation in 5GA OPPO

R1-2507193 Discussion on 5G-A ISAC evaluation ZTE Corporation, Sanechips

R1-2507204 Associating a detected object with its true counterpart in ISAC Tejas Network Limited

R1-2507250 Discussion on ISAC evaluation assumptions and performance evaluation Samsung

R1-2507332 Joint views on ISAC measurement report China Telecom, ZTE, CAICT, CATT, Pengcheng Laboratory, Sony

(Withdrawn)

R1-2507337 Evaluation assumptions and performance evaluation for ISAC EURECOM

R1-2507367 Discussion on ISAC Performance Evaluation for 5G-A NIST

R1-2507369 Views on evaluation assumptions and performance evaluation for ISAC Sharp

R1-2507376 Discussion on evaluation assumptions and performance evaluation Panasonic

R1-2507380 Discussion on evaluation assumptions and performance evaluation for NR ISAC LG Electronics

R1-2507401 Views on R20 ISAC Study SK Telecom

R1-2507428 Views on evaluation assumptions for NR ISAC KPN N.V., TNO

R1-2507472 Evaluation assumptions and performance evaluations of ISAC for NR Nokia, Nokia Shanghai Bell

R1-2507473 On ISAC performance evaluations and assumptions Lenovo

R1-2507503 Discussion on evaluation assumptions and performance evaluation for NR ISAC ETRI

R1-2507555 Joint views on ISAC measurement report China Telecom, ZTE, CAICT, CATT, Pengcheng Laboratory

R1-2507573 Discussion on ISAC for NR Ericsson

R1-2507593 Discussion on Evaluation of ISAC for NR Sony

R1-2507627 Discussion on ISAC evaluation assumptions and performance evaluation MediaTek Inc.

R1-2507634 Discussion on Performance Evaluations for Rel-20 ISAC Google

R1-2507674 On Rel-20 Evaluation assumptions and performance evaluation for 5G-A ISAC Apple

R1-2507718 Considerations on UAV gNB-monostatic sensing Qualcomm Incorporated

R1-2507762 Views on Performance Metrics and Evaluation Methodology for ISAC Tiami Networks

R1-2507810 Evaluation assumptions and performance evaluation for ISAC NTT DOCOMO, INC.

R1-2507836 Evaluation assumptions and performance evaluation for NR ISAC Hanbat National University

**R1-2507423** Summary #1 on evaluations for NR ISAC Moderator (Xiaomi)

**Agreement**

On False alarm probability Type 2 (targets dropped in simulation area), the parameter is the number of drops with at least one detected object.

**Conclusion**

Sensing resolution is not considered as a performance metric for evaluation of NR ISAC.

**Agreement**

The following evaluation parameters are agreed for the evaluation on NR ISAC.

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Assumptions** | |
| **BS antenna configuration** | For 4GHz, 4.9GHz:   * Option 1 as optional   + Tx: (12,16, 2,1,1;2,16)   + Rx: (12,16,2,1,1;2,16) * Option 2   + Tx: (8,8,2,1,1;4,8)   + Rx: (8,8,2,1,1;4,8) | For 6GHz:   * Option 1 as optional   + Tx: (16,16, 2,1,1;4,16)   + Rx: (16,16,2,1,1;4,16) * Option 2:   + Tx: (8,8,2,1,1;4,8)   + Rx: (8,8,2,1,1;4,8) |
| Mandatory: = (0.5, 0.8)λ, +45°/-45° polarization  Optional: = (0.5, 0.5)λ, +45°/-45° polarization | |

Note: Tx antenna elements and Rx antenna elements are operating simultaneously

**Agreement**

The following evaluation parameters are agreed for the evaluation on NR ISAC.

|  |  |
| --- | --- |
| **Parameters** | **Assumptions** |
| **BS antenna radiation pattern** | Table 9 in Report ITU-R M.2412 |
| **BS antenna mechanic tilt (downtilt angle without electrical tilt)** | 90° in GCS (pointing to horizontal direction) |
| **BS antenna electrical tilt**  **(downtilt angle after mechanic and electrical tilt)** | Option 1: no electrical tilt  Option 2: 102° in GCS |
| **Polarized antenna model** | Model-2 in clause 7.3.2 in TR 38.901 |

**R1-2507424** Summary #2 on evaluations for NR ISAC Moderator (Xiaomi)

**Agreement**

The following evaluation parameters are agreed for the evaluation on NR ISAC.

|  |  |
| --- | --- |
| **Parameters** | **Assumptions** |
| **gNB-target link** | gNB-aerial UE of UMa/RMa parameters in 36.777 with Alternative 3 |
| **Concatenation of TX-target and target-RX links** | Up to company choice between two options for concatenation defined in Step 9 in section 7.9.4.1, TR 38.901 |
| **The power threshold for path dropping after concatenation for target channel** | -25dB and -40dB are respectively used for the two options for concatenation |

**Agreement**

The following evaluation parameters are agreed for the evaluation on NR ISAC.

|  |  |
| --- | --- |
| **Parameters** | **Assumptions** |
| **Co-site inter-sector interference** | Not modelled |
| **Adjacent channel interference** | Not modelled |
| **BS receiver noise figure** | 5dB |

**Agreement**

When Tx/Rx operates simultaneously (baseline case), the following parameters are used for the evaluation on NR ISAC:

|  |  |
| --- | --- |
| **Antenna isolation** | * Option 1: 65dB * Option 2: 80dB |
| **Maximum BS Tx power** | * Option 1: 37dBm * Option 2: 52dBm   The above options are calculated with BS\_maxpower = BS Rx saturation power + antenna isolation by assuming the BS Rx saturation power = -28dBm and the antenna isolation = 65dB and 80dB, respectively |

* Optionally: companies should report the maximum BS Tx power when it is assumed that Tx and Rx don’t operate simultaneously. Companies should report how the maximum BS Tx power is derived.

**Agreement**

The following evaluation parameters are agreed for the evaluation on NR ISAC.

|  |  |
| --- | --- |
| **Parameters** | **Assumptions** |
| **CPI (coherent processing interval)** | Companies to report the CPI value assumed |
| **Waveform** | CP-OFDM as baseline, other waveform is up to companies report |

**R1-2507425** Summary #3 on evaluations for NR ISAC Moderator (Xiaomi)

**Agreement**

When Tx/Rx operates simultaneously, the following evaluation parameters are agreed for the evaluation on NR ISAC.

|  |  |
| --- | --- |
| **Self-interference** | The residual leakage interference/noise is modelled e.g. by additional additive white Gaussian noise, -94+X dBm in 100 MHz, X is up to company report. Companies to provide details on their modelling.  Note: X = -Infinity corresponds to not modelling self-interference |

**R1-2507426** Summary #4 on evaluations for NR ISAC Moderator (Xiaomi)

**Agreement**

For the evaluation on NR ISAC,

* 3 kinds of resources are defined
* Type 1: resources that are used for sensing signal transmission
* Type 2: part of Type 1 resources that are used for communication purpose
  + Note: it is possible the resource type 2 doesn’t exist
* Type 3: resources that are not used for sensing signal transmission, and cannot be used for communication purpose due to sensing operation
* Both options should be reported for sensing resource ratio
* Option 1: (Type\_1 + Type\_3) resources over all radio DL and UL resources
* Option 2: (Type\_1 - Type\_2 + Type\_3) resources over all radio DL and UL resources
* Note: if Type 2 resource doesn’t exist, two options are the same

For the evaluation on NR ISAC,

* Company should report T/F RE mapping of sensing RS, assumed TDD UL/DL configuration if applicable.
* Company should report which sensing RS resources are considered as Type 2 resource and related reason.

**Agreement**

Companies are encouraged to report the high-level sensing signal/data processing method used in the evaluation, e.g., 2D FFT, MUSIC, and any other methods.

**Agreement**

Up to company to model low power cluster in the evaluation of NR ISAC

**Agreement**

Companies should report details of the Tx beam information (number of Tx beams, wide/narrow Tx beam) being used at TRP.

* The details of the Tx beam information (number of Tx beams, wide/narrow Tx beam) being used at TRP will be captured along with the corresponding evaluation results in the Rel-20 TR

**Agreement**

The following performance objectives are adopted for evaluation purpose of NR ISAC.

|  |  |
| --- | --- |
| **Metric** | **Value** |
| **Missed detection Probability** | [5]% |
| **False Alarm Probability Type 1** | [5]% |
| **False Alarm Probability Type 2** | [5]% |
| **Horizontal Positioning Accuracy** | [10] m with confidence level 90% |
| **Vertical Positioning Accuracy** | [10] m with confidence level 90% |
| **Velocity Accuracy** | [5] m/s with confidence level 90% |

R1-2507427 Summary #5 on evaluations for NR ISAC Moderator (Xiaomi)

## Non-Terrestrial Networks (NTN) for NR Phase 4

*Please refer to* [*RP-251933*](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_106/Docs/RP-243300.zip) *for detailed scope of the SI for NR-NTN Phase 4.*

[122bis-R20-NR-NTN] Email discussion on Rel-20 NR-NTN – Mohamed (Thales)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

**R1-2508153** Session notes for 10.6 (Non-Terrestrial Networks (NTN) for NR Phase 4) Ad-Hoc Chair (Ericsson)

Session notes are endorsed and incorporated the session notes below.

R1-2506850 Work plan for NR NTN Phase 4 THALES

### NR-NTN GNSS resilience

R1-2506749 Discussion on Rel-20 GNSS resilient NR NTN operation FUTUREWEI

R1-2506785 On NR-NTN GNSS resilience Ericsson

R1-2506812 Discussion on NR NTN GNSS resilience Spreadtrum, UNISOC

R1-2506842 Considerations on NR-NTN Resilience to GNSS Unavailability and Degradation THALES

R1-2506846 FL Summary #1: Study on GNSS resilient NR-NTN operation THALES

R1-2506847 FL Summary #2: Study on GNSS resilient NR-NTN operation THALES

R1-2506848 FL Summary #3: Study on GNSS resilient NR-NTN operation THALES

R1-2506849 FL Summary #4: Study on GNSS resilient NR-NTN operation THALES

R1-2506896 Discussion on NR-NTN GNSS resilience vivo

R1-2506917 Discussion on NR-NTN GNSS resilience ZTE Corporation, Sanechips

R1-2506941 GNSS resilience for NR-NTN Huawei, HiSilicon

R1-2506987 Discussion on NR-NTN GNSS resilience Xiaomi

R1-2507012 Discussion on NR-NTN GNSS resilience CMCC

R1-2507117 Discussion on NR-NTN GNSS resilience CATT

R1-2507129 Discussion on the GNSS resilient NR-NTN operation TCL

R1-2507130 Discussion on NR-NTN GNSS resilience SageRAN

R1-2507174 Discussion on NR-NTN GNSS resilience OPPO

R1-2507202 GNSS Resilient NR-NTN Operation -NR-NTN Phase 4 Tejas Network Limited

R1-2507211 Discussion on NR-NTN GNSS resilience HONOR

R1-2507217 NR-NTN GNSS resilience InterDigital, Inc.

R1-2507251 Discussion on NR-NTN GNSS resilience Samsung

R1-2507321 Discussion on NR-NTN GNSS resilience NEC

R1-2507333 Discussion on NR-NTN GNSS resilience China Telecom

R1-2507379 Discussion on GNSS resilient NR-NTN operation LG Electronics

R1-2507429 Ku band parameters and inter-SAN handover with GNSS unavailable Eutelsat Group

R1-2507465 Discussion on NR-NTN GNSS resilience Ofinno

R1-2507504 Discussion on NR-NTN GNSS resilient operations ETRI

R1-2507541 Discussion on NR-NTN GNSS resilience Fraunhofer IIS, Fraunhofer HHI

R1-2507550 Discussion on GNSS resilient NR-NTN Panasonic

R1-2507557 Discussion on NR-NTN GNSS resilience Lenovo

R1-2507560 Discussion on GNSS resilient operation for NR over NTN Nokia

R1-2507586 Discussion on NR-NTN GNSS resilience CCU

R1-2507594 Discussion on GNSS resilient NR-NTN operation Sony

R1-2507624 GNSS resilient operations in NR NTN MediaTek Inc.

R1-2507642 Discussion on GNSS resilient NR-NTN operation Toyota ITC

R1-2507643 Preamble transmission and detection in NR NTN GNSS resilient operation Sharp

R1-2507675 Considerations of NR-NTN GNSS Resilient Operations Apple

R1-2507719 NR-NTN GNSS resilience Qualcomm Incorporated

R1-2507761 Discussion on Rel-20 GNSS resilient NR NTN operation ESA, Airbus, Thales

R1-2507782 Discussion on GNSS-resilient NR-NTN operation ISSDU, NYCU

R1-2507784 Discussion of NR-NTN GNSS Resilience Johns Hopkins University APL

R1-2507811 Discussion on NR-NTN GNSS resilience NTT DOCOMO, INC.

R1-2507845 Discussion on NR-NTN GNSS resilience CAICT

R1-2507850 Discussion on GNSS resilience for NR-NTN CSCN

R1-2507857 Discussion on NR-NTN GNSS resilience Google Korea LLC

R1-2507901 Discussion on GNSS Resilient Operation for NR NTN CEWiT

R1-2507937 Considerations for GNSS-resilient NR-NTN operation ST Engineering iDirect

**R1-2506846 FL Summary #1: Study on GNSS resilient NR-NTN operation THALES**

**Agreement:**

For the evaluation of GNSS resilient NR-NTN operation, consider the following assumptions:

* For scenario 1 and 2
  + The following time/frequency differences should be evaluated:
    - The differential one-way delay (in µs) as calculated between the largest UE-Sat delay and smallest UE sat delay within the uncertainty area.
      * For UL performance evaluation 2 times differential one-way delay should be considered.
    - The differential one-way Doppler/frequency offset (in ppm) is calculated between the largest UE-sat Doppler/frequency offset and smallest UE-sat Doppler/frequency offset within the uncertainty area.
      * For UL performance evaluation, scaled one-way differential Doppler/frequency offset to determine UL differential Doppler/frequency offset should be considered. Scaling factor should be reported.

**R1-2506847 FL Summary #2: Study on GNSS resilient NR-NTN operation THALES**

**R1-2506848 FL Summary #3: Study on GNSS resilient NR-NTN operation THALES**

**Agreement:**

For PRACH performance evaluation for existing PRACH preamble formats based on analytical characterization, adopt the following criteria:

* PRACH tolerance is exceeded if
  + min (, Sequence duration) Differential RTT, where;



* + - Ncp is cyclic prefix duration
    - max is given by Tables 6.3.3.1-5, 6.3.3.1-6 and 6.3.3.1-7 of TS 38.211
    - L is the ZC sequence length
    - is an additional timing error.
      * Companies to report how Te is derived.
    - Differential RTT is 2 time one-way delay.
    - Note: the delay spread is neglected
    - GP can be considered and reported for the case of consecutive RO.
  + Or (scaling factor\*(Differential Doppler) +2\* fe×fc) ≥



* + - For restricted set A, For restricted set B, . For non-restricted set,
      * Note: In practice, the detection performance degrades at frequency offsets exceeding 1 SCS and 2 SCS with restricted set A and B, respectively.
      * Othe values of can be used and reported with justification
    - ppm
    - is the uplink carrier frequency
    - Note: The scaling factor\*Differential Doppler is equal to the UL differential Doppler/frequency offset.
    - The same scaling factor as per the previous agreement is to be reported

Note: the above is applicable to single PRACH transmission.

**Agreement:**

RAN1 to assess the impacts on connected mode during NR NTN GNSS-resilient operation, including at least:

* Impact on signalling overhead.

**R1-2506849 FL Summary #4: Study on GNSS resilient NR-NTN operation THALES**

**Observation:**

For the study on GNSS resilient NR-NTN operation, the following solutions for initial access to increase PRACH tolerance and reducing time/frequency uncertainty are listed based on inputs/discussions in RAN1#122bis:

* Solution 1: To improve robustness:
  + Solutions based on modified random access procedures, using existing PRACH formats:
    - Solution 1A: Multiple PRACH transmissions ~~(~~e.g. with different roots or different formats or with different time/frequency pre-compensation using multiple reference locations within the uncertainty area) using existing PRACH formats
    - Solution 1B: New PRACH restricted sets.
    - Solution 1C: Single PRACH transmission with multiple TAC/FAC commands in RAR
    - Solution 1D: Signalling enhancements for Msg2 (e.g. enhanced TA command, frequency adjustment command, reference point adjustment command)
    - Solution 1E: Selection of a set of existing PRACH root
    - Solution 1F: Using TA margin and RO masking.
    - Other solutions are not precluded
* Solution 2: Solutions based on reducing time-frequency uncertainty
  + Solution 2A: Single/multi-satellite DL-TDOA based on current specifications.
  + Solution 2B: multiple PRACH attempts based on different time/frequency pre-compensation hypotheses (e.g. based on multiple reference points within the uncertainty area)
  + Solution 2C: Solutions based on broadcasting DL timestamp(s)
  + Solution 2D: UE side time/frequency pre-compensation based on reference location.
  + Solution 2E: service link time/frequency pre-compensation based on last acquired GNSS position
  + Solution 2F: UE side time/frequency pre-compensation based on reference signal.
  + Other solutions are not precluded
* Solution 3: Implementation-based techniques e.g. using a long enough PRACH processing window and multiple timing hypotheses for PRACH preamble reception with large max differential delay.
* Other Solutions are not precluded

**Agreement:**

In RAN1#123, based on the following alternatives representing two calculation methodologies, select a calculation methodology with potential adjustments, including correction of equations:

**Alt 1:**

For the calculation of the differential one-way delay and the differential one-way Doppler/frequency offset the following could be considered:

Geometry model and equations could be considered. For the variables in the equations, refer to Figure below.

For non-nadir beam

|  |  |
| --- | --- |
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|  |  |
|  |  |
|  |  |
|  |  |
|  | **For nadir beam** |

## Non-Terrestrial Networks (NTN) for Internet of Things (IoT) Phase 4

*Please refer to RP-251867 for detailed RAN1 scope of the WI (Placeholder only, will start from RAN1#124)*

### Semi-persistent scheduling for DL/UL data transmission for voice packets

# Rel-20 Study of 6GR

***Please refer to RP-252912 for the scope of the SI. The maximum number of contributions per company/organization/university is limited to 1 per agenda item unless stated otherwise.***

***Note: Additional more guidance/information, please refer to R1-25xxxxx (Highlights from RAN#109)***

R1-2507812 Workplan for Rel-20 Study of 6GR NTT DOCOMO, China Mobile, AT&T, Vodafone

R1-2507813 Skeleton for TR 38.760-1 “Study on 6G Radio RAN1 aspects” v0.0.1 NTT DOCOMO, INC.

## [Overview of 6G](#_Toc450829434)R air interface

***High level design proposals/principles/target, including scalable 6GR design (e.g., what design is scalable, what design is unscalable), support of minimum spectrum allocation, coverage, MRSS, synchronization signal structure and periodicity, operation of bandwidth/band adaptation, spectrum utilization and aggregation framework, harmonization of TN and NTN, and others (if any).***

***Note: To avoid distributing proposals of a same topic to different sub-agendas, please organize the proposals according to above highlights.***

[122bis-R20-6GR-Overall] Email discussion on Rel-20 6GR-Overall – Shinya (NTT DOCOMO)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Agreement

* RAN1 provides methodology and corresponding initial analysis of potentially achievable coverage to RAN#110 to determine the coverage target(s)

Agreement

* High-level aspects to consider for the 6GR sync signal structure include, but not limited to
  + Sync raster design
  + Spectrum allocation
  + smallest maximum supported RF and BB UE BW without spectrum aggregation
  + mobile broadband service requirements as high priority
  + Energy efficiency for both BS and UE
  + Detection/tracking performance, latency, and complexity
    - Including initial cell search
  + Coverage target
  + Common design for diverse device types
  + Consideration of the supported deployment
  + Consideration on whether the single sync signal structure is sufficient
  + Note: Aspects impacting on the periodicity is to be discussed under AI11.5

Agreement

* The aspects to consider for supporting NTN include, but not limited to
  + Initial access, including cell search and SSB periodicity
  + Coverage
  + Duplexing
  + Capacity
  + Signalling overhead
  + GNSS-less/resilient/based operation
  + Large/varying doppler and propagation delay
  + Beamforming / beam management / beam hopping

Note:

* High-level aspects to consider to enable lower CAPEX/OPEX with respect to current networks include, but not limited to
  + UE/NW implementation complexity
  + UE/NW energy efficiency
  + MRSS
  + Spectrum efficiency

R1-2508141 FL summary#4 on overview of 6GR air interface Moderator (NTT DOCOMO)

R1-2508102 FL summary#3 on overview of 6GR air interface Moderator (NTT DOCOMO)

R1-2508079 FL summary#2 on overview of 6GR air interface Moderator (NTT DOCOMO)

R1-2507985 FL summary#1 on overview of 6GR air interface Moderator (NTT DOCOMO)

R1-2506738 High level views on 6GR air interface FUTUREWEI

R1-2506750 Nokia Views on Selected Aspects of 6G Radio Air Interface Nokia

R1-2506813 Overview of 6GR air interface Spreadtrum, UNISOC

R1-2506841 Overview of the 6G air interface Ericsson Telecom S.A. de C.V.

R1-2506843 Overview of the 6G air interface TCL

R1-2506897 Overview of 6GR air interface vivo

R1-2506918 High-level views on 6GR ZTE Corporation, Sanechips

R1-2506988 6GR air interface design overview Xiaomi

R1-2507013 Overview of 6GR air interface CMCC

R1-2507057 Overview of 6GR air interface Huawei, HiSilicon

R1-2507065 Enhancements for 6G Fixed Wireless Access T-Mobile USA Inc.

R1-2507104 Outline and highlight of 6GR air interface CATT, CICTCI

R1-2507175 Overview of 6GR air interface OPPO

R1-2507201 Overview on 6G Air interface Tejas Network Limited

R1-2507212 Discussion on overview of 6GR air interface HONOR

R1-2507252 Design of 6GR air interface Samsung

R1-2507311 Overview of 6GR air interface NEC

R1-2507334 Overview of 6GR air interface China Telecom

R1-2507343 Overview of 6GR air interface THALES, Airbus, ESA, EchoStar, Eutelsat Group, Novamint, TNO, Fraunhofer IIS, Iridium

R1-2507360 Views on overall design and techniques for 6GR air interface LG Electronics

R1-2507366 Overview of 6GR air interface NVIDIA

R1-2507371 Discussion on 6GR Air Interface for NTN C-DOT

R1-2507373 Overview proposal of 6GR air interface Panasonic

R1-2507402 Discussion on overview of 6GR air interface Fujitsu

R1-2507407 Overview of 6GR air interface SK Telecom

R1-2507466 Discussion on 6GR Air Interface Ofinno

R1-2507480 Overview of 6GR air-interface Lenovo

R1-2507490 Design consideration of 6GR air interface Verizon Sweden

R1-2507505 Overview of the 6GR air interface ETRI

R1-2507520 Overview of 6GR Air Interface Google

R1-2507538 Overview of 6GR Air Interface Fraunhofer IIS, Fraunhofer HHI

R1-2507544 Discussion on the Overview of 6GR Air Interface Rakuten Mobile, Inc

R1-2507585 IMU Views on 6G Radio Air Interface IMU

R1-2507595 Overview of 6GR air interface Sony

R1-2507602 Positioning, Navigation and Timing (PNT) in 6G NTN-TN harmonization Airbus, ESA, Fraunhofer IIS, Thales, Iridium

R1-2507606 Overview of 6GR air interface MediaTek Inc.

R1-2507629 Discussion on Overview of 6GR air interface China Unicom

R1-2507676 Overview of 6GR air interface Apple

R1-2507720 Overview of 6GR air interface Qualcomm Incorporated

R1-2507730 Views on device types, min channel BW and MRSS Intel

R1-2507734 Overview of 6GR air interface InterDigital, Inc.

R1-2507745 Lessons Learned from the 5G NR Air Interface Design AT&T

R1-2507763 Views on 6GR air interface Tiami Networks

R1-2507765 Overview of 6GR air interface Sharp

R1-2507768 Views on 6GR air interface Fainity Innovation

R1-2507780 Discussion on 6GR Air Interface for NTN C-DOT

(Revision of R1-2507371, Withdrawn)

R1-2507814 Discussion on overview of 6GR air interface NTT DOCOMO, INC.

R1-2507823 Views on 6GR sync signal structure NICT

R1-2507843 Overview of 6G Radio air interface ITL

R1-2507846 Overview of 6G Radio air interface WILUS Inc.

R1-2507851 Views on 6GR air interface CSCN

R1-2507862 Overview of 6GR air interface KDDI Corporation

R1-2507879 General aspects of 6G IoT and NTN Nordic Semiconductor ASA

R1-2507884 Operator considerations on performance gains and migration complexity trade-offs in 6G Radio design BT plc, AT&T, Bouygues Telecom, Deutsche Telekom, Orange, Vodafone

R1-2507938 On 6GR Frame Structure and Waveform Boost Mobile Network

R1-2507941 IIT Kanpur’s views on 6GR air interface IIT Kanpur

## [Evaluation assumptions for 6G](#_Toc450829434)R air interface

*Discussions on models, scenarios, parameters, and methodology, metrics/criteria, as well as traffic model that can be commonly used for evaluating technology proposals.*

[122bis-R20-6GR-Evaluation] Email discussion on Rel-20 6GR-Evaluation – Jinhuan (Huawei)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Agreement

For around 700MHz, for TXRU mapping at base station, it is adopted as mandatory option for simulation campaign that a single TXRU is mapped per panel per subarray per polarization.

Note: Companies can provide results optionally, assuming fully connected TXRU mapping within a panel per polarization.

Agreement

* For around 700MHz, 32 for total number of antenna element at base station, 4 for total number of TXRU at base station, (8, 2, 2, 1, 1; 1, 2) for (M,N,P,Mg,Ng; Mp, Np), and (0.5, 0.5)λ for (dH,dV) are assumed as the baseline combination.
* For around 700MHz, 64 for total number of antenna element at base station, 8 for total number of TXRU at base station, (8, 4, 2, 1, 1; x, y) for (M,N,P,Mg,Ng; Mp, Np), and (0.5, 0.5)λ for (dH,dV) are assumed as the optional combination.

Note: Other values/combinations are up to company to report

Agreement

For around 2GHz carrier frequency, for BS antenna modelling

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BS antenna modelling** | Total number of antenna elements | Total number of TXRU | (M, N, P, Mg , Ng; Mp, Np) | (dH,dV) |
| **Indoor** | | | | |
| Combination 1(Optional) | 8 | 4 | (2, 2, 2, 1, 1; 1, 2) | (0.5, 0.5)λ |
| Combination 2 (Baseline) | 32 | 8 | (4, 4, 2, 1, 1; 1, 4) | (0.5, 0.5)λ |
|  |  |  |  |  |
| **Outdoor** | | | | |
| Combination 1(Optional) | 32 | 4 |  | (0.5, 0.8)λ |
| Combination 2 (Baseline) | 192 | 64 | (12, 8, 2, 1, 1; 4, 8) | (0.5, 0.5)λ |
| Note1: A single TXRU is mapped per panel per subarray per polarization as mandatory option. Companies can provide results optionally, assuming fully connected TXRU mapping within a panel per polarization.  Note2: Other combinations used in the simulation results are up to company to report. | | | | |

Conclusion

The following existing traffic models could be used for 6GR performance evaluations,

* Full buffer
* FTP Model 1 (in TR 36.814)
* FTP Model 3 (in TR 36.872)
* XR Traffic models (in TR 38.838)
* VoIP model (as in TR 36.814)
* Instant message (as in TR 38.840)
* Note that which model(s) will be used can be further decided when performing simulations in each individual topic.

Agreement

For the study traffic model(s) for 6GR AI/ML services:

* + A representative AI/ML service is the generative AI, e.g., as defined in TR22.870.

Send LS to SA4 (cc RAN2, SA1, SA2) requesting input if any on traffic characteristics for AI/ML services.

Note: RAN1 is discussing the following options for the model:

* + Option-1a: The model is parameterized by Token, e.g., Token size, Token arrival rate, and Token delay budget.
    - Token is the minimum unit of data generated in the application layer.
    - How to associate Tokens to PHY layer packets.
    - How to reflect the variable importance of tokens.
    - Whether other parameters are additionally needed when tokens are encapsulated together into a packet, e.g., packet arrival rate, packet success rate, and packet delay.
  + Option-1b: The model is characterized by the parameters of PHY layer packet, including e.g., packet size, arrival rates, latency requirement, reliability requirement, etc.
  + Option-1c: reusing or extending the FTP-3/XR traffic model.
  + FFS other models/options need to be defined for other AI/ML services.

Agreement

Study traffic modelling for evaluations related to immersive communication services including but not limited to advanced XR [e.g., TR22.870] and haptics services,

* XR traffic models (in TR 38.838) are considered as starting point.
  + FFS the detailed modifications on the parameters to the XR traffic model, e.g., higher packet size, higher packet arrival rate, higher packet size deviation, PDB, etc.
* FFS how many models need to be defined and the corresponding representative use cases.
* FFS how to incorporate haptics traffic (TR26.854).

Send LS to SA4 requesting input if any on the relevant traffic characteristics, RAN1 can continue the study before SA4 potential response.

Agreement

Study extensions to FTP Model 1/FTP Model 3 to incorporate the following:

* Multiple packet sizes and associated time-domain behaviors (e.g., inter arrival time)
  + FFS number of packet sizes (e.g., 2 or 3).
  + FFS whether to have fixed or variable packet size and packet arrival rate for a given UE.
  + FFS applicability of multiple packet sizes to only one or both of FTP Model 1/FTP Model 3.
  + FFS packet size and arrival rate characteristics.
* Packet delay budget (PDB) related parameters
  + FFS PDB applicability to packets (e.g., one PDB parameter for only one traffic flow or different PDB parameters for different traffic flows).
  + FFS how to consider the PDB, e.g., whether to drop packets when exceeding the budget, PDB aware metric.
* Note consider the following for PDB:
  + Applicability to the extension to FTP Model 1/ FTP Model 3 with one packet size.
  + Applicability or not to the extension to FTP Model 1/ FTP Model 3 with multiple packet sizes.

Agreement

The attached templates for NTN in R1-2507956 are endorsed in principle.

Agreement

The following configurations for system-level simulations could be used for 6GR evaluation:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Indoor Hotspot** | **Dense Urban** | **Rural** | **Urban Macro** | **Sub-urban macro** |
| Carrier frequency | Around 2 GHz  Around 4 GHz  Around 7 GHz  Around 15 GHz  Around 30 GHz | Around 700 MHz  Around 2 GHz  Around 4 GHz  Around 7 GHz  Around 15 GHz  Around 30 GHz | Around 700 MHz  Around 2 GHz  Around 4 GHz  Around 7 GHz | Around 700 MHz  Around 2 GHz  Around 4 GHz  Around 7 GHz  Around 15 GHz  Around 30 GHz | Around 700 MHz  Around 2 GHz  Around 4 GHz  Around 7 GHz  Around 15 GHz  Around 30 GHz |
| Aggregated BW | Follow system bandwidth per carrier frequency in TR 38.914 as 1) Around 700 MHz: Up to 60 MHz 2) Around 2GHz: Up to 200 MHz 3) Around 4GHz: Up to 300 MHz  4) Around 7GHz: Up to 400MHz 5) Around 15GHz: Up to 400MHz  6) Around 30GHz: Up to 1GHz | | | | |
| Simulation BW | Around 700 MHz: 20MHz, 60MHz | | | | |
| Around 2 GHz: 20MHz, 100MHz, 200MHz | | | | |
| Around 4 GHz: 20MHz, 100MHz, 200MHz, 300MHz | | | | |
| Around 7 GHz: 20MHz, 100MHz, 200MHz, 400MHz | | | | |
| Around 15 GHz: 20MHz, 100MHz, 200MHz, 400MHz | | | | |
| Around 30GHz: 100MHz, 400MHz, 800MHz | | | | |
| Note: other simulation BW could be considered. | | | | |
| **Note: The layout for each scenario will be separately discussed, including the carrier frequency combination for single layer and/or two layers.** | | | | | |

Agreement

Draft LS R1-2508183 is endorsed in principle.

Agreement

Final LS R1-2508184 is endorsed.

Agreement

For link budget template, consider the following candidates:

* Candidate 1: Reusing the link budget template from TR38.830, i.e., the following table with notes as follows:
* The values of the parameters are TBD.
* MCL in row (22bis) is TBD.
* FFS: whether/how/why to update

|  |  |
| --- | --- |
| System configuration | |
| Channel for evaluation |  |
| Scenarios and Carrier frequency (GHz) |  |
| BS antenna heights (m) |  |
| UT antenna heights (m) |  |
| Cell area reliability (%) |  |
| Lognormal shadow fading std deviation (dB) |  |
| Tx Diversity |  |
| Number of SSB |  |
| Transmitter | |
| (1) Number of transmit antenna elements |  |
| (2) Number of transmit TxRUsNote: this row is void (left empty) for uplink |  |
| (2a) Number of transmit chains modelled in LLS |  |
| (3) Total transmit power (dBm) Note: total transmit power for system bandwidth |  |
| (3a) System bandwidth for downlink, or occupied bandwidth for uplink (Hz) |  |
| (3b) Power Spectrum Density = (3) - 10 log( (3a) / 1000000 ) (dBm/MHz)  Note: no PSD constraint for uplink |  |
| (3c) Bandwidth used for the evaluated channel (Hz) Note: (3c) is identical to the number of PRBs assigned to the channel evaluated. For uplink, (3a) = (3c) |  |
| (3bis) Total transmit power for occupied bandwidth = (3b) + 10 log ((3c) /1000000) (dBm) |  |
| (4) Total antenna gain at antenna gain component 3 & antenna gain component 4 of transmitter = (4a) – (4b) (dB) |  |
| (4a) Antenna gain at antenna gain component 3 & antenna gain component 4 of transmitter = (4c) + 10 log ((1) / (2)) (dB) for downlink, and = (4c) + 10 log ((1) / (2a)) (dB) for uplink |  |
| (4b) Antenna gain correction factor at antenna gain component 3 & antenna gain component 4 of transmitter (dB) |  |
| (4c) Gain of antenna element (dBi) |  |
| (5) Total antenna gain at antenna gain component 2 of transmitter = (5a) - (5b) (dB) Note: zero for uplink |  |
| (5a) Antenna gain at antenna gain component 2 of transmitter = 10 log((2)/(2a)) (dB) Note: zero for uplink |  |
| (5b) Antenna gain correction factor at antenna gain component 2 of transmitter (dB) Note: zero for uplink |  |
| (8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for downlink) |  |
| (9) EIRP = (3bis) + (4) + (5) – (8) dBm |  |
| Receiver | |
| (10) Number of receive antenna elements |  |
| (10a) Number of receive TxRUs Note: this row is void (empty) for downlink |  |
| (10b) Number of receive chains modelled in LLS |  |
| (11) Total antenna gain at antenna gain component 3 & antenna gain component 4 of receiver = (11a) - (11b) (dB) |  |
| (11a) Antenna gain at antenna gain component 3 & antenna gain component 4 of receiver  = (11c) + 10 log ((10)/(10a)) (dB) for uplink  = (11c) + 10 log ((10)/(10b)) (dB) for downlink |  |
| (11b) Antenna gain correction factor at antenna gain component 3 & antenna gain component 4 of receiver (dB) |  |
| (11c) Gain of antenna element (dBi) |  |
| (11bis) Total antenna gain at antenna gain component 2 of receiver = (11bis-a) - (11bis-b) (dB) Note: zero for downlink |  |
| (11bis-a) Antenna gain at antenna gain component 2 of receiver = 10 log((10a)/(10b)) (dB) Note: zero for downlink |  |
| (11bis-b) Antenna gain correction factor at antenna gain component 2 of receiver (dB) Note: zero for downlink |  |
| (12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink) |  |
| (13) Receiver noise figure (dB) |  |
| (14) Thermal noise density (dBm/Hz) |  |
| (15) Receiver interference density (dBm/Hz) |  |
| (16) Total noise plus interference density = 10 log (10^(( (13) + (14))/10) + 10^((15)/10)) (dBm/Hz) |  |
| (18) Effective noise power = (16) + 10 log ((3c)) (dBm) |  |
| (19) Required SNR (dB) |  |
| (20) Receiver implementation margin (dB) |  |
| (21) H-ARQ gain (dB) Note: Only applicable if HARQ is not considered in LLS |  |
| (22) Receiver sensitivity = (18) + (19) + (20) – (21) (dBm) |  |
| (22bis) MCL = (3bis) – (22) + (5) + (11bis) (dB) |  |
| (23) Hardware link budget, a.k.a. MIL = (9) + (11) + (11bis) − (12) − (22) (dB) Note: MIL can also be derived by (22bis) + (4) – (8) + (11) − (12) |  |
| Calculation of available pathloss | |
| (25) Shadow fading margin (function of the cell area reliability and lognormal shadow fading std deviation) (dB) |  |
| (26) BS selection/macro-diversity gain (dB) |  |
| (27) Penetration margin (dB) |  |
| (28) Other gains (dB) (if any please specify) |  |
| (29) Available path loss = (23) – (25) + (26) – (27) + (28) (dB) |  |
| Range/coverage efficiency calculation | |
| FFS: (30) Maximum range (based on (29) and according to the system configuration section of the link budget) (m) |  |

* Candidate 2: Template as Table 7.10.1-1 from TR38.913.
  + FFS: whether/how/why to update.

|  |  |
| --- | --- |
| Item | Value |
| Transmitter |  |
| (1) Tx power  (dBm) |  |
| Receiver |  |
| (2) Thermal noise density (dBm/Hz) |  |
| (3) Receiver noise figure (dB) |  |
| (4) Interference margin (dB) |  |
| (5) Occupied channel bandwidth (Hz) |  |
| (6) Effective noise power           = (2) + (3) + (4) + 10 log(5)  (dBm) |  |
| (7) Required SINR (dB) |  |
| (8) Receiver sensitivity           = (6) + (7) (dBm) |  |
| (9) MaxCL           = (1) - (8) (dB) |  |

Agreement

**For around 4GHz carrier frequency:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BS antenna modelling** | Total number of antenna elements | Total number of TXRU | (M, N, P, Mg, Ng; Mp, Np) | (dH,dV) |
| **Indoor** | | | | |
| Combination 1 | 32 | 32 | (4, 4, 2, 1, 1; 4, 4) | (0.5, 0.5)λ |
| Combination 2 | 128 | 32 | (8, 8, 2, 1, 1; 2, 8) | (0.5, 0.5)λ |
| ~~Combination 3~~ | ~~256~~ | ~~64~~ | ~~(16, 8, 2, 1, 1;4, 8)~~ | ~~(0.5, 0.5)λ~~ |
| **Outdoor** | | | | |
| Combination 1 | 192 | 64 | (12, 8, 2, 1, 1; 4, 8) | (0.5, 0.8)λ |
| Combination 2 | 256 | 64 | (16, 8, 2, 1, 1; 4, 8) | (0.5, 0.8)λ |
| Combination 3 | 512 | 128 | (16, 16, 2, 1, 1; 4, 16) | (0.5, 0.5)λ |
| Note1: A single TXRU is mapped per panel per subarray per polarization as mandatory option. Companies can provide results optionally, assuming fully connected TXRU mapping within a panel per polarization.  Note2: Other combinations used in the simulation results are up to company to report. | | | | |

**For around 7GHz carrier frequency:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BS antenna modelling** | Total number of antenna elements | Total number of TXRU | (M, N, P, Mg, Ng; Mp, Np) | (dH,dV) |
| **Indoor** | | | | |
| Combination 1 | 64 | 32 | (4, 8, 2, 1, 1; 2, 8) | (0.5, 0.5)λ |
| Combination 2 | 256 | 64 | (16, 8, 2, 1, 1; 4, 8) | (0.5, 0.5)λ |
| Combination 3 | 512 | 128 | (16, 16, 2, 1, 1; 8, 8) | (0.5, 0.5)λ |
| **Outdoor** | | | | |
| Combination 1 | 768 | 128 | TBD | (0.5, 0.8)λ |
| Combination 2 | 1024 | 256 | (32, 16, 2, 1, 1; 8, 16) | (0.5, 0.8)λ |
| Combination 3 | 1536 | 256 | TBD | (0.5, 0.8)λ |
| Combination 4 | 2048 | 256 | (32, 32, 2, 1, 1, 8, 16) | (0.5, 0.5)λ |
| Combination 5 | 2048 | 512 | (64, 16, 2, 1, 1; 16, 16) | (0.5, 0.5)λ |
| Note1: A single TXRU is mapped per panel per subarray per polarization as mandatory option. Companies can provide results optionally, assuming fully connected TXRU mapping within a panel per polarization.  Note2: Other combinations used in the simulation results are up to company to report. | | | | |

**For around 30GHz carrier frequency:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BS antenna modelling** | Total number of antenna elements | Total number of TXRU | (M, N, P, Mg, Ng; Mp, Np) | (dH,dV) |
| **Indoor** | | | | |
| Combination 1 | 128 | 8 | (4, 4, 2, 2, 2; 1, 1) | (0.5, 0.5)λ |
| Combination 2 | 512 | 8 | (8, 8, 2, 2, 2; 1, 1) | (0.5, 0.5)λ |
| Combination 3 | 1024 | 8 | (16, 8, 2, 2, 2; 1, 1) | (0.5, 0.5)λ |
| Combination 4 | 768 | 2 | (24, 16, 2, 1, 1; 1, 1) | (0.5, 0.5)λ |
| **Outdoor** | | | | |
| Combination 1 | 2048 | 16 | (16, 8, 2, 4, 2; 1, 1) | (0.5, 0.5)λ |
| Combination 2 | 4096 | 32 | (16, 8, 2, 4, 4; 1, 1) | (0.5, 0.5)λ |
| Combination 3 | 1024 | 4 | (16, 16, 2, 2, 1; 1, 1) | (0.5, 0.5)λ |
| Note1: A single TXRU is mapped per panel per polarization as mandatory option. Companies can provide results optionally, assuming a single TXRU is mapped per panel per subarray per polarization as mandatory option.  Note2: Other combinations used in the simulation results are up to company to report. | | | | |

Agreement

At least the following carrier frequencies could be considered (from RAN1 perspective) for 6GR NTN evaluations:

* L-band (i.e., 1.5GHz)
* S-band (i.e. 2 GHz)
* Ku-band (FFS detailed frequency range)
* Ka-band (i.e. 30 GHz for UL, 20GHz for DL)

R1-2508183 Draft LS on traffic model study in RAN1 Huawei, [RAN WG1]

R1-2507957 FLS#5 on evaluation assumptions for 6GR air interface Moderator (Huawei)

R1-2507956 FLS#4 on evaluation assumptions for 6GR air interface Moderator (Huawei)

R1-2507955 FLS#3 on evaluation assumptions for 6GR air interface Moderator (Huawei)

R1-2507954 FLS#2 on evaluation assumptions for 6GR air interface Moderator (Huawei)

R1-2507953 FLS#1 on evaluation assumptions for 6GR air interface Moderator (Huawei)

R1-2507292 Post-122 email discussion on 6GR common evaluation assumptions Moderator (Huawei)

R1-2506739 Evaluation assumptions for 6GR air interface FUTUREWEI

R1-2506751 On Evaluation Assumptions for Study of 6G Radio Air Interface Nokia

R1-2506814 Discussion on evaluation assumption for 6GR Spreadtrum, UNISOC

R1-2506898 Evaluation methodology and assumptions for 6GR air interface vivo

R1-2506989 Discussion on evaluation assumptions for 6GR air interface Xiaomi

R1-2507014 Discussion on evaluation assumptions for 6GR air interface CMCC

R1-2507022 Evaluation assumptions for 6GR Tejas Network Limited

(Withdrawn)

R1-2507042 Discussion on evaluation assumptions for 6GR air interface ZTE Corporation, Sanechips

R1-2507058 Evaluation assumptions for 6GR air interface Huawei, HiSilicon

R1-2507105 On evaluation assumptions for 6GR air interface CATT

R1-2507176 Evaluation assumption for 6GR air interface OPPO

R1-2507215 Considerations on channel modeling and evaluation assumptions for 6GR air interface BUPT, CMCC, vivo, X-Net

R1-2507253 Evaluation assumptions for 6GR Samsung

R1-2507361 Discussion on evaluation assumptions for 6GR air interface LG Electronics

R1-2507411 Discussion on 6G Evaluation Requirements NEC

R1-2507434 Evaluation assumptions for 6GR air interface NVIDIA

R1-2507467 Discussion on Evaluation assumptions for 6GR air interface Ofinno

R1-2507479 Evaluation assumptions for 6GR air interface InterDigital, Inc.

R1-2507481 Evaluation assumptions for 6GR air interface Lenovo

R1-2507506 Discussion on evaluation assumptions for 6GR air interface ETRI

R1-2507571 Satellite Access Node Characteristics for the Evaluation Assumptions for 6GR air interface ESA, Thales, Viasat

R1-2507596 Evaluation assumptions for 6GR air interface Sony

R1-2507607 Evaluation assumptions for 6GR air interface MediaTek Inc.

R1-2507635 On Evaluation Assumptions for the 6GR air interface Google

R1-2507677 Evaluation assumptions for 6GR air interface Apple

R1-2507721 Evaluation assumptions for 6GR air interface Qualcomm Incorporated

R1-2507731 Views on evaluation assumptions for 6GR Intel

R1-2507746 Evaluation Assumptions for 6GR Air Interface AT&T

R1-2507766 Evaluation assumptions for 6GR air interface for NTN Ka/Ku band Sharp

R1-2507815 Discussion on Evaluation assumptions for 6GR air interface NTT DOCOMO, INC.

R1-2507825 Evaluation assumptions for 6GR Ericsson AB.

R1-2507853 Views on evaluation assumptions for 6GR air interface CSCN

R1-2507895 Evaluation assumptions for 6GR Tejas Network Limited

R1-2507939 BOOST Mobile Network Boost Mobile Network

## Waveform and frame structure for 6GR air interface

R1-2506905 Discussion on waveform for 6GR air interface THALES, University of Bologna, CTTC, DLR, ESA

### [Waveform](#_Toc450829436)

*Including proposals for improving spectrum efficiency, power efficiency, coexistence and coverage, etc.*

[122bis-R20-6GR-Waveform] Email discussion on Rel-20 6GR-Waveform – Karri (Nokia)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Agreement

Draft LS R1-2508068 is endorsed with following revision:

1. removing “Additionally, if time permits, any feedback for CP-OFDM PAPR reduction/MPR values achievable by implementation is also appreciated.”

Agreement

Final LS R1-2508069 is endorsed.

Agreement

* For uplink low-PAPR proposals, the link level performance evaluation criterion is Net Gain assuming same spectrum efficiency as the reference
  + Net Gain [dB] = Tx power gain relative to the reference – SNR degradation relative to the reference @10% BLER
    - A realistic PA model should be used
    - When calculating the Tx power gain, the RAN4 metrics on the Tx power should be taken into account.
    - For SNR degradation, fading channel and non-ideal channel estimation, including DMRS configuration, and equalization is encouraged.
    - FFS: Other evaluation metrics
    - Note: Companies to report how to calculate the Tx power gain, modulation and coding

Agreement

* Study the evaluation method for evaluating DFT-s-OFDM for UL with number of layers > 1.

R1-2508043 Feature Lead summary #3 on 6G waveform

R1-2508042 Feature Lead summary #2 on 6G waveform

R1-2508041 Feature Lead summary #1 on 6G waveform

R1-2506752 Waveform for 6G Radio Air Interface Nokia

R1-2506815 Discussion on waveform for 6GR Spreadtrum, UNISOC

R1-2506899 Discussion on Waveform for 6GR air interface vivo

R1-2506919 Views on the waveform for 6G ZTE Corporation, Sanechips

R1-2506952 Considerations for 6GR DL waveform Kyocera

R1-2506990 Discusson on 6GR Waveform Xiaomi

R1-2507015 Discussion on the waveform design for 6G radio CMCC

R1-2507028 Discussions on 6G Waveforms Lekha Wireless Solutions

R1-2507052 Waveform design for 6GR air interface Tejas Network Limited

R1-2507059 Waveform for 6GR air interface Huawei, HiSilicon

R1-2507118 Discussions on waveform for 6GR CATT

R1-2507131 On waveforms for 6GR Beijing University of Posts and Telecommunications (BUPT)

R1-2507177 Discussion on waveform and multiple access for 6G Radio OPPO

R1-2507185 Discussion on waveform for 6GR LG Electronics

R1-2507254 Discussion on waveform for 6GR Samsung

R1-2507344 Waveform for 6GR air interface InterDigital, Inc.

R1-2507368 Waveform for 6GR Air Interface Cohere Technologies

R1-2507381 Discussion on Uplink Waveform Enhancements in 6G KT Corp.

R1-2507412 Discussion on 6G Waveform NEC

R1-2507418 Discussion on waveform for 6GR air interface Panasonic

R1-2507468 Discussion on waveform for 6GR air interface Ofinno

R1-2507482 Discussion on 6GR Waveform Lenovo

R1-2507507 Discussion on 6GR waveform ETRI, University of Surrey

R1-2507513 On 6G waveforms Ericsson

R1-2507521 Waveform for 6GR Air Interface Google

R1-2507526 New waveform for 6GR Shanghai Jiao Tong University, NERCDTV

R1-2507532 Evaluation of 6G BTS Energy, Coverage and Cost Trade-offs: OFDM vs Dual-Waveform (Low-PAPR + OFDM) in Downlink Wisig, IITH

R1-2507534 Design Principles and Evaluation KPIs for 6G Candidate Waveforms Wisig, IITH

R1-2507535 Link Level Evaluation of OTFDM waveform, simulation assumptions and performance Wisig, IITH

R1-2507536 6G BTS Cost Optimization: Waveform Choices and MIMO Architecture Trade-offs Wisig, IITH

R1-2507539 Waveform Evaluation Considerations for 6G Uplink Control Channels Wisig, IITH

R1-2507545 Discussion on Waveforms of 6GR Air Interface Rakuten Mobile, Inc

R1-2507597 Considerations for 6GR waveform Sony

R1-2507603 Discussion on waveform for 6GR air interface Ruijie Networks Co. Ltd

R1-2507608 Waveform for 6GR air interface MediaTek Inc.

R1-2507678 Waveforms for 6GR air interface Apple

R1-2507722 Waveforms for 6GR Qualcomm Incorporated

R1-2507747 Requirements for 6GR Waveform Design AT&T

R1-2507767 Discussion on waveform for 6G air interface Fainity Innovation

R1-2507771 Study on waveform for 6GR Sharp

R1-2507816 Discussion on Waveform NTT DOCOMO, INC.

R1-2507824 New waveform for 6GR air interface NICT

R1-2507837 Discussion on 6GR waveform design Hanbat National University

R1-2507886 Considerations on waveform for 6GR air interface ITL

R1-2507896 Discussion on Waveform for 6GR Air Interface Indian Institute of Tech (M)

R1-2507902 Views on 6GR waveforms CEWiT

R1-2507942 IIT Kanpur’s views on 6GR waveforms IIT Kanpur

### Frame structure

*Including* [*numerology and frame structure*](#_Toc450829438) *(for all duplex types).*

[122bis-R20-6GR-Frame structure] Email discussion on Rel-20 6GR- Frame structure – Xiaodong (CMCC)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Agreement

For communication, 6GR considers NR frame structure used as a starting point for the study item,

* + Resource defined by one subcarrier and one symbol is called as resource element (RE).
  + Resource block (RB) is defined where the number of consecutive subcarriers per RB is the same for all numerologies and the number of subcarriers per RB is 12
  + Radio Frame length is 10ms
  + Each radio frame is split into 10 subframes, each with a duration of 1 ms
  + For given SCS and for given symbol, the symbol duration, normal CP length and boundary is same as NR design.
  + A slot is defined as supporting 14 consecutive symbols for normal CP case and all subcarrier spacings.

Agreement

6GR study assumes same SCS between 6GR Sync signals and other channels/signals (except PRACH) for a given band.

* FFS: same/different SCS between 6GR sync signal and other channels/signals (except PRACH) for FR2-1.
* Note: ISAC is separately discussed in ISAC session.

Agreement

* RAN1 assumes 400MHz maximum channel bandwidth at network side and 30kHz SCS around 7GHz
* Study whether and how to enable UE to support 400MHz bandwidth

R1-2508138 FL summary for Frame Structure (5th round) Moderator (CMCC)

R1-2508137 FL summary for Frame Structure (4th round) Moderator (CMCC)

R1-2508086 FL summary for Frame Structure (3rd round) Moderator (CMCC)

R1-2508075 FL summary for Frame Structure (2nd round) Moderator (CMCC)

R1-2508037 FL summary for Frame Structure (1st round) Moderator (CMCC)

R1-2506740 Discussion on 6G numerology and frame structure FUTUREWEI

R1-2506753 Frame Structure and Numerology in 6G Radio Air Interface Nokia

R1-2506777 Discussion on 6G frame structure ZTE Corporation, Sanechips

R1-2506816 Discussion on frame structure for 6GR Spreadtrum, UNISOC

R1-2506822 Discussion on Frame structure TCL

R1-2506900 Discussion on 6GR frame structure vivo

R1-2506991 Discussion on 6G frame structure Xiaomi

R1-2506996 Discussion on numerology and frame structure for 6GR air interface Lenovo

R1-2507016 Discussion on frame structure for 6GR interface CMCC

R1-2507054 On frame structure design and enhancements for 6G Radio (6GR) air interface Tejas Network Limited

R1-2507060 Numerology and frame structure for 6GR air interface Huawei, HiSilicon

R1-2507119 Frame structure for 6GR CATT

R1-2507178 Numerology and frame/slot structure for 6G Radio OPPO

R1-2507186 Discussion on frame structure for 6GR LG Electronics

R1-2507189 Discussion on 6G frame structure Transsion Holdings

R1-2507213 Views on numerology and frame structure design for 6GR HONOR

R1-2507255 Discussion on frame structure design for 6GR Samsung

R1-2507285 Discussion on frame structure for 6GR Fujitsu

R1-2507290 Discussion on 6GR frame structure KT Corp.

R1-2507308 Discussion on frame structure NEC

R1-2507335 Discussion on 6G frame structure China Telecom

R1-2507347 On 6G frame structure Ericsson

(Withdrawn)

R1-2507469 Views on 6G frame structure Ofinno

R1-2507486 6GR frame structure InterDigital, Inc.

R1-2507491 Discussion on frame structure for 6GR air interface Panasonic

R1-2507508 Discussion on 6GR frame structure ETRI

R1-2507527 Discussion on 6GR Frame structure Kyocera

R1-2507546 Discussion on Frame Structure for 6GR Air Interface Rakuten Mobile, Inc

R1-2507598 Considerations on 6GR frame structure Sony

R1-2507609 6G frame structure and numerology MediaTek Inc.

R1-2507636 Frame Structure for 6GR Air Interface Google

R1-2507679 Numerology and frame structure for 6GR air interface Apple

R1-2507723 Frame structure for 6GR Qualcomm Incorporated

R1-2507748 Requirements for 6GR Frame Structure Design AT&T

R1-2507772 Frame Structure for 6GR Sharp

R1-2507817 Discussion on Frame structure for 6GR NTT DOCOMO, INC.

R1-2507838 Discussion on 6GR frame structure Hanbat National University

R1-2507852 Views on 6GR frame structure and numerology CSCN

R1-2507876 Frame structure for 6GR ASUSTeK

R1-2507885 Considerations on frame structure for 6GR air interface ITL

R1-2507888 Discussion on the Impact of Full Duplex on 6GR Frame Structure Indian Institute of Tech (M)

R1-2507903 View on 6GR frame structure CEWiT

R1-2507946 On 6G frame structure Ericsson

## [Channel coding and modulation for 6GR interface](#_Toc450829439)

*Including metrics/criteria that can be used for evaluating technology proposals and for down selecting proposals*

### [Channel coding](#_Toc450829440)

[122-R20-6GR-Channel coding] Email discussion on Rel-20 6GR- Channel coding and Modulation – Mengzhu, Chunxuan (ZTE, Apple)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Working Assumption

* Study 6G data channel coding for higher throughput than 5G with acceptable performance-complexity tradeoff for both NW side and UE side,
  + Target peak data rate is assumed to be 2 times of the target peak data rate defined in TR38.913

Note: The other target throughput is up to company to report.

Note: Applicability of the potential channel code will be further discussed.

Agreement

* For 6G channel coding, LDPC is used for data (including SIBs) and Polar code is used for L1 control information (larger than 11 bits, including PBCH)
* For 6G LDPC
  + Working assumption: For data rate within NR range, reuse of NR LDPC design is supported
  + For data rate beyond NR range, study LDPC extension with acceptable performance-complexity tradeoff for both NW side and UE side
    - Note: Applicability of the potential LDPC extension to data rate within NR range will be further discussed
* For 6G Polar code
  + Working assumption: For control information within NR range (larger than 11 bits), reuse of NR Polar code design is supported
  + For control information beyond NR range, study Polar code extension with acceptable performance-complexity tradeoff for both NW side and UE side
    - Note: Necessity for control information beyond NR range is to be further discussed
    - Polar code maximum mother code length is kept as 1024.
  + FFS: further motivation(s) for potential extension/enhancement until RAN1#123

R1-2508012 FL summary#3 for 6G channel coding Moderator (ZTE, Apple)

R1-2508011 FL summary#2 for 6G channel coding Moderator (ZTE, Apple)

R1-2508010 FL summary#1 for 6G channel coding Moderator (ZTE, Apple)

R1-2506754 Channel Coding in 6G Radio Air Interface Nokia

R1-2506817 Discussion on channel coding for 6GR Spreadtrum, UNISOC

R1-2506829 Discussion on channel coding for 6GR ZTE Corporation, Sanechips

R1-2506901 Discussion on Channel Coding for 6GR air interface vivo

R1-2506992 Discussion on 6GR Channel Coding Xiaomi

R1-2507017 Discussion on channel coding for 6GR interface CMCC

R1-2507030 Channel Coding for 6GR Interface Lekha Wireless Solutions

R1-2507061 Channel coding for 6GR air interface Huawei, HiSilicon

R1-2507120 Channel coding for 6G network CATT

R1-2507179 Discussion on 6G channel coding OPPO

R1-2507256 Discussion on channel coding for 6GR Samsung

R1-2507286 Discussion on channel coding for 6GR Fujitsu

R1-2507362 Views on 6G channel coding study LG Electronics

R1-2507446 Channel coding aspects for 6GR air interface InterDigital, Inc.

R1-2507483 Channel Coding for 6G Lenovo

R1-2507509 Discussion on 6GR channel coding ETRI, ESA, Thales

R1-2507548 Discussion on Channel Coding for 6GR Rakuten Mobile, Inc

R1-2507610 Channel coding for 6GR interface MediaTek Inc.

R1-2507641 Channel coding for 6GR interface Ericsson

R1-2507680 Considerations of 6G Channel Coding Apple

R1-2507724 Channel coding for 6GR Qualcomm Incorporated

R1-2507749 Views on Channel Coding for 6GR AT&T

R1-2507818 Discussion on Channel coding for 6GR NTT DOCOMO, INC.

R1-2507849 Discussion on Channel Coding for Small Block Lengths EURECOM

R1-2507854 Channel Coding for 6GR Air Interface Tejas Network Limited

R1-2507858 Discussion on channel coding for 6GR air interface Google Korea LLC

R1-2507871 Study of channel coding aspects in 6G Radio Fraunhofer IIS, Fraunhofer HHI

R1-2507904 Channel coding for control and data channels in 6G CEWiT

R1-2507948 Discussion on channel coding for 6GR ZTE Corporation, Sanechips

(Revision of R1-2506829)

### [Modulation](#_Toc450829441), joint channel coding and modulation

[122-R20-6GR-Modulation, joint channel coding and modulation] Email discussion on Rel-20 6GR-Modulation,joint channel coding and modulation –Jing (Qualcomm)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Agreement

For 6GR constellation shaping evaluation for CP-OFDM, and improved MCS table, the proposed scheme will be compared with non-shaping with NR MCS table. The evaluation and comparison should consider at least the following:

* BLER performance under AWGN channel (at least for performance calibration)
  + 1st transmission (baseline) and with HARQ re-transmission
* BLER performance under fading channel with fixed MCS
  + 1st transmission (baseline) and with HARQ re-transmission
* Throughput performance with link adaptation (adaptive MCS and rank) under fading channel
  + Needs to provide assumptions on rate adaptation (e.g., target BLER for 1st transmission, maximum # of retransmissions)
* Transmitter and receiver complexity (e.g., shaping/deshaping, demapper), latency, parallelism implementation, and storage requirements,
* Other KPI not excluded, such as PAPR, EVM, MPR/A-MPR
* Expected spec impact
* FFS detailed assumption of constellation shaping and improved MCS table
* System level evaluation can be done after link level evaluation.

Agreement

For 6GR constellation shaping study, proponent is encouraged to provide details for the PS/GS schemes considered for evaluation and comparison, including at least the following

* Probabilistic shaping for CP-OFDM and DFT-s-OFDM
  + Use the list of spectrum efficiencies in NR MCS table as starting point, and provide constellation (including normalization), coding rate and target probabilistic distribution for each SE
    - If multiple coding rate and target probabilistic distribution pairs are provided for each SE, how to switch between them
  + Relationship between shaping and FEC, coded bits to modulation symbol mapping, and other modules (such as scrambling, interleaving), in transmit and receive chains. How to handle HARQ retransmission
  + PS algorithm details (for example, source coding based, channel coding based, etc) and parameters (such as block length, rate loss)
* Geometric shaping for CP-OFDM and DFT-s-OFDM
  + Use the list of spectrum efficiencies in NR MCS table as starting point, and provide target constellation shape (including normalization) (1D-NUC, 2D-NUC, QAM-CS, etc) for each SE
    - If multiple constellation shapes are provided for each SE, how to switch between them
  + GS mapping details, such as bit to constellation point mapping and shape
  + Relationship with other blocks (such as scrambling, interleaving). How to handle HARQ retransmission

Agreement

For link level simulation for modulation evaluation, companies are encouraged to evaluate with the following assumptions and should report the exact scheme evaluated.

* channel configuration, including Channel profiles,Tx/RX antenna settings
* For MIMO scenario: SU-MIMO or MU-MIMO, follow agenda item 11.2 for MIMO when available.
* Precoder assumption
  + Close loop MIMO (reciprocal beamforming (e.g., SVD, SLR/RZF, etc.), codebook based)
    - Realistic CSI/SRS/AP-SRS periodicity and delay, and SRS chanEst assumptions,
    - or genie beamforming
  + Open loop MIMO
* Receiver assumption (for MIMO): LMMSE (baseline) for UL, rML or LMMSE for DL
* LLR demapper: Max-log (baseline) or Log-MAP
* Channel estimation: Realistic (baseline) or ideal
* Other assumptions: Channel coding NR-LDPC (baseline), PxSCH bandwidth, SCS, FD interleaver used or not, 5GNR BICM interleaver usage
* Note: For MIMO, SIMO, MISO and SISO are included when possible

Agreement

For 6GR constellation shaping evaluation for DFT-s-OFDM, and improved MCS table, the proposed scheme will be compared with non-shaping with NR MCS table. In addition to what has been agreed for CP-OFDM in earlier agreement, the evaluation and comparison should further consider at least the following:

* PAPR/CM of the resulting waveform
* EVM, MPR/A-MPR

Agreement

For the study of uniform 4096QAM for DL and uniform 1024QAM for UL, need to study performance (assuming realistic channel estimation, time/freq synchronization assumption, phase noise assumption, etc), complexity/power consumption, requirements, benefit/necessity under applicable scenarios, associated restrictions, and challenges (such as EVM requirement, PAPR increase, MPR or A-MPR increase under realistic PA model).

* FFS: How to involve RAN4 early
* FFS: Shaping of higher order modulation
* System level evaluation can be done after link level evaluation.

R1-2508089 FL summary #3 on modulation, joint channel coding and modulation Modulator (Qualcomm Incorporated)

R1-2508073 FL summary #2 on modulation, joint channel coding and modulation Modulator (Qualcomm Incorporated)

R1-2508040 FL summary #1 on modulation, joint channel coding and modulation Modulator (Qualcomm Incorporated)

R1-2506755 On Modulation for 6G Radio Air Interface Nokia

R1-2506818 Discussion on modulation, joint channel coding and modulation for 6GR Spreadtrum, UNISOC

R1-2506830 Discussion on modulation for 6GR ZTE Corporation, Sanechips

R1-2506902 Discussion on Modulation for 6GR air interface vivo

R1-2506993 Discussion on modulation for 6GR air interface Xiaomi

R1-2507018 Discussion on modulation schemes for 6GR interface CMCC

R1-2507031 Modulation, joint channel coding and modulation for 6GR Interface Lekha Wireless Solutions

R1-2507053 Discussion on modulation for 6GR Tejas Network Limited

R1-2507062 Modulation for 6GR air interface Huawei, HiSilicon

R1-2507121 Modulation for 6G network CATT

R1-2507180 Discussion on modulation, joint channel coding and modulation for 6GR OPPO

R1-2507257 Disscussion on modulation for 6GR Samsung

R1-2507363 Discussion on modulation for 6GR LG Electronics

R1-2507419 Discussion on modulation for 6GR air interface Panasonic

R1-2507430 Modulation for 6G air interface Ericsson

R1-2507447 Modulation and joint channel coding and modulation for 6GR air interface InterDigital, Inc.

R1-2507484 Discussion on 6GR modulation Lenovo

R1-2507510 Discussion on 6GR modulation ETRI

R1-2507537 Case for p/2-BPSK DFT-s-OFDM in 6G NR (Low PAPR, Cell-Edge Gains) Wisig, IITH

R1-2507549 Discussion on Modulation and JCCM for 6GR Air Interface Rakuten Mobile, Inc

R1-2507599 Discussions on joint channel coding and modulation for 6GR Sony

R1-2507611 Modulation for 6GR interface MediaTek Inc.

R1-2507681 Discussion on modulation for 6G air interface Apple

R1-2507725 Modulation, joint channel coding and modulation for 6GR Qualcomm Incorporated

R1-2507750 Views on Modulation for 6GR AT&T

R1-2507758 Modulation for 6GR interface Charter Communications, Inc

R1-2507819 Discussion on Modulation NTT DOCOMO, INC.

R1-2507840 Discussion on 6GR modulation schemes Hanbat National University

R1-2507859 Discussion on modulation for 6GR air interface Google Korea LLC

R1-2507905 Modulation, joint channel coding and modulation CEWiT

## Energy efficiency

*Including evaluation assumptions, proposals for Evaluations, NW power saving, UE power saving, and joint mechanisms taking both NW and UE into account for power saving, targeting to categorize proposals by RAN1#123. From RAN1#124, proposals will be distributed to respective related agenda.*

[122bis-R20-6GR-Energy efficiency] Email discussion on Rel-20 6GR- Energy efficiency – Magnus, Weide (Ericsson, MTK)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

[Post-122b-R20-6GR-evaluation] – Magnus, Weide (Ericsson, MediaTek)

Email discussion for collection of companies’ inputs on from xxth-xxth , October.

Agreement

At least the following NR metrics,

* Network energy saving gain relative to baseline for BS
* UE energy saving gain relative to baseline for UE
* Impact to UPT (User-Perceived Throughput), if applicable,

as well as the metrics

* Impact to latency, if applicable
* Impact to QoS/delay budget satisfaction rate, if applicable

are used for 6G energy efficiency evaluation.

Agreement

Apply the following evaluation methodology framework for Quantitative analysis,

* For NW unloaded/empty load case or UE idle/inactive mode:
* For energy saving: analytical calculation
* For performance impact: analytical calculation, LLS
* For loaded cases and connected-mode UEs
* For energy saving: SLS
* For performance impact: LLS, SLS

Agreement

For evaluation purposes, expand the existing BS power model reference configuration with a set for ~7 GHz operation with the following parameters:

|  |  |
| --- | --- |
| Property | Configuration for Set 4 around 7 GHz |
| Duplex | TDD |
| BW | [100, 200, 400] MHz |
| SCS | [30 kHz, 60 kHz] |
| Number of TRP | 1 |
| Total number of DL TX RUs | [128, 256] |
| Total DL power level | [56] dBm |
| Total number of UL Rx RUs | [128, 256] |

Note: Bracketed values to be confirmed. Other values are not precluded.

The above configuration has no implication on supported BW, SCS for 6GR.

Agreement

Study whether/how to further update the BS model considering the following aspects, e.g.,

* Whether to downselect between Cat.1 and Cat. 2,
* Updates of parameter values (including defining a new Cat),
* Updates of power scaling, power states (including additional PSs)
* Etc.

Note: The defined BS power models does not preclude use case-specific enhancements regarding, e.g., multi-TRP, SBFD, multi-carrier etc

Agreement

Study and evaluate NW energy savings and the impact on UE performance and user experience with respect to 20ms and longer periodicities of sync signal(s) at least for initial access with the following consideration, but not limited to:

BS assumptions:

* Cell-common signaling (e.g., sync signal(s), broadcast PDCCH, SIB-1, SIB, paging, PRACH), e.g.,
  + Clustered provisioning of different cell-common signaling,
  + On-demand provisioning of different cell-common signaling,
* UE-specific signaling (for low, light, medium loads), e.g.,
  + Clustered provisioning with cell-common signaling,
  + Unclustered provisioning with cell-common signaling,

UE impact:

* Cell search complexity and latency, including frequency search latency,
* UE Power consumption,
* Sync signal detection, coverage and tracking performance,
* RRM, mobility,
* Beam management,
* Other properties are not precluded,
* Improvements to address identified impact, e.g.,
  + Additional sync signal needs,
  + Adaptation of sync signal transmission periodicity,
  + Sparser synch raster.

Agreement

Study and evaluate on-demand and/or periodic SIB-1 transmission with respect to

* NW energy savings potential and UE power consumption impact,
* SIB-1 acquisition delay,
* NW and UE complexity,
* Coverage,
* Applicable deployment scenarios, e.g.,:
  + Standalone cell/carrier,
  + Multiple TRPs/cells/carriers.

Agreement

For 6GR energy efficiency evaluation purposes, reuse the existing UE power consumption model FR1 and FR2 reference configurations in TR 38.840 for operation up to around 7GHz and within 24.25 GHz – 52.6 GHz, respectively.

* Scaling rules can be updated, including additional rule(s) for scaling UE power consumption, and including around 7GHz specific update
  + FFS: details.
* Power value and transition time update, if necessary, including around 7GHz specific update
* No implication on supported BW, SCS, modulation and antenna setting for 6GR
* Revisit if SCS for around 7GHz is different with respect to the reference configuration

Agreement

Study and evaluate DL WUS of OFDM based sequence and corresponding mechanisms for 6GR EE improvement, regarding at least the following aspects:

* Coverage target for DL WUS (e.g., same as PDCCH, common sync signal, or other)
* Measurements and/or synchronization.
* System overhead and network energy consumption/UE energy saving for UE operation with the DL WUS.
* RRC states
* Other functionalities

Agreement

For evaluation purposes, study extending NR UE power consumption scaling w.r.t. at least BW and/or antenna setting, considering at least the different characteristics in RF/BB power consumption and static/dynamic power consumption.

Agreement

For evaluation purposes, study extending NR UE power consumption model for UE operation with DL WUS of OFDM-based sequence, regarding the following aspects:

* Power state(s), sleep and non-sleep, and corresponding characteristics and power value(s)
* Transition energy and time for each of sleep state(s)
* Companies to report the assumption(s) for achieving the proposed power value(s), e.g., time/frequency domain detection, noise figure assumption(s), synchronization assumption(s), BW/antenna assumption(s), etc.

Agreement

Study and evaluate on-demand sync signal(s) mechanisms for 6GR energy efficiency, considering, e.g.,:

* On-demand sync signal(s) for single cell/carrier, multi-carrier/cell, multi-TRP,
* Network-triggered and UE-triggered on-demand sync signal(s),
* Idle and/or connected modes,
* Other mechanisms/aspects/signals/channels are not precluded.

Agreement

Study and evaluate multi-carrier/cells/TRPs mechanisms for 6GR NES, considering, e.g.,:

* Sync signal-less carriers/cells/TRPs for at least intra-band and collocated inter-band multi-carrier/cell/TRPs, including potential extensions to additional deployments and scenarios,
* RRC states,
* UE energy consumption and complexity,
* Other mechanisms/aspects/signals/channels are not precluded.

R1-2508186 Summary #7 of 6GR Energy Efficiency Study Moderators (Ericsson, MediaTek)

R1-2508161 Summary #8 of 6GR Energy Efficiency Study Moderators (Ericsson, MediaTek)

R1-2508160 Summary #7 of 6GR Energy Efficiency Study Moderators (Ericsson, MediaTek)

R1-2508057 Summary #6 of 6GR Energy Efficiency Study Moderators (Ericsson, MediaTek)

R1-2508056 Summary #4 of 6GR Energy Efficiency Study Moderators (Ericsson, MediaTek)

R1-2508055 Summary #3 of 6GR Energy Efficiency Study Moderators (Ericsson, MediaTek)

R1-2508053 Summary #2 of 6GR Energy Efficiency Study Moderators (Ericsson, MediaTek)

R1-2508052 Summary #1 of 6GR Energy Efficiency Study Moderators (Ericsson, MediaTek)

R1-2506741 Discussion on 6G energy efficiency techniques FUTUREWEI

R1-2506756 Energy Efficiency in 6G Radio Nokia

R1-2506758 Discussion on energy efficiency for 6GR TCL

R1-2506819 Discussion on energy efficiency for 6GR Spreadtrum, UNISOC

R1-2506831 Discussion on energy efficiency for 6GR ZTE Corporation, Sanechips

R1-2506903 Discussion on 6G energy efficiency vivo

R1-2506994 Discussion on energy efficiency for 6GR Xiaomi

R1-2507019 Discussion on Energy Efficiency of 6GR interface CMCC

R1-2507021 Energy efficiency in 6G Tejas Network Limited

R1-2507063 Views on energy saving for 6GR Huawei, HiSilicon

R1-2507106 Discussions on energy efficiency of 6GR CATT

R1-2507181 Energy Saving for 6GR air interface OPPO

R1-2507214 Discussion on energy efficiency HONOR

R1-2507258 Discussion on energy efficiency for 6GR Samsung

R1-2507287 Discussion on energy efficiency for 6GR Fujitsu

R1-2507336 Discussion on 6GR energy efficiency China Telecom

R1-2507364 Discussion on energy efficiency for 6GR LG Electronics

R1-2507370 Considerations for 6G energy efficiency KT Corp.

R1-2507408 Views on 6G energy efficiency SK Telecom

R1-2507413 Discussion on Physical Layer Design for Energy Savings in 6G NEC

R1-2507470 Views on 6GR Energy Efficiency Ofinno

R1-2507476 6GR energy efficiency Ericsson

R1-2507485 Discussion on 6GR Energy Efficient design Lenovo

R1-2507511 Discussion on energy efficiency in 6GR ETRI

R1-2507531 On 6GR design for energy efficiency Panasonic

R1-2507540 6G Study on Energy Efficiency Fraunhofer IIS, Fraunhofer HHI

R1-2507562 Discussion on Energy Efficiency for 6G Radio WILUS Inc.

R1-2507569 Study on energy efficiency for 6GR Sharp

R1-2507580 Discussion on 6G energy efficiency Google

R1-2507584 Energy efficiency in 6GR interface InterDigital, Inc.

R1-2507600 Considerations on 6GR Energy Efficiency Sony

R1-2507612 Energy efficiency for 6GR MediaTek Inc.

R1-2507682 Views on 6G energy efficiency Apple

R1-2507726 Energy Efficiency in 6GR Qualcomm Incorporated

R1-2507751 Views on Energy Efficiency for 6GR AT&T

R1-2507820 Discussion on Energy Efficiency for 6GR NTT DOCOMO, INC.

R1-2507831 Discussion on Energy efficiency ITRI

R1-2507834 Discussion on Energy Efficiency for 6GR Quectel

R1-2507835 Energy Efficiency in 6GR Nordic Semiconductor ASA

R1-2507841 Discussion on energy efficiency in 6GR Hanbat National University

R1-2507844 Energy Efficiency in 6G Radio ITL

R1-2507877 Energy efficiency for 6GR ASUSTeK

R1-2507882 On 6GR energy efficiency Vodafone, Deutsche Telekom, Bouygues Telecom

R1-2507906 Views on Energy Efficiency CEWiT

R1-2507911 Discussion on Energy Efficiency for 6GR IIT Kanpur

R1-2507947 Discussion on energy efficiency and energy saving CAICT

## [AI/ML](#_Toc450829439) in 6GR interface

*Collecting AI/ML use cases in all potential components in physical layer design, targeting to select some use cases by RAN1#123. From RAN1#124, selected use cases will be distributed to respective related agenda.*

[122bis-R20-6GR-AI/ML] Email discussion on Rel-20 6GR-AI/ML – Feifei(Samsung)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

Observation

For 6GR AI/ML use cases identification/categorization, [24 sources] provided preliminary simulation results and analysis on low overhead CSI-RS or CSI prediction with AI/ML.

* [23 sources] provided preliminary simulation results and analysis on frequency and/or spatial domain CSI prediction with sparse/low overhead CSI-RS with AI/ML. Detailed evaluation assumptions (model input/output/label/benchmark/KPI/ training type) and initial analysis can be found in Table A.
* [6 sources] provided preliminary simulation results (or by citing to NR study for CSI time domain prediction) and analysis on CSI time domain prediction with AI/ML wherein [3 sources] assumed Rel-19 CSI prediction while [3 sources] assumed differently. Detailed evaluation assumptions (model input/output/label/benchmark/KPI training type) and initial analysis can be found in Table B.
* [4 sources] provided preliminary simulation results and analysis on CSI prediction cross carrier/band/frequency block with AI/ML. Detailed evaluation assumptions (model input/output/label/benchmark/KPI/training type) and initial analysis can be found in Table B.
* [2 sources] provided preliminary simulation results and analysis on CSI prediction across analog beams with AI/ML. Detailed evaluation assumptions (model input/output/label/benchmark/KPI training type) and initial analysis can be found in Table B.
* [ 1source] provided preliminary simulation results and analysis on, CSI prediction with linear projection as pre-processing. Detailed evaluation assumptions (model input/output/label/benchmark/KPI training type) and initial analysis can be found in Table B.
* and time domain CSI prediction combining CSI-RS and DMRS measurements (MediaTek).

Note: whether/how to capture the observation in the TR is a separate discussion.

Table A

|  |  |
| --- | --- |
| Sub-use case | Sub-Case A: Frequency and/or spatial domain CSI prediction with sparse/low overhead CSI-RS with AI/ML |
| Reported  companies | (23) Ericsson1, ZTE2, vivo3, OPPO, Xiaomi, CMCC, Huawei4, Samsung, Fujitsu, Apple, Qualcomm5, Kyocera6, Nokia7, {Spreadtrum, UNISOC}8, Interdigital9, Lenovo, LGE10, DoCoMo11, CEWiT, IITM, IIT Kanpur, Tejas, {CATT, CICTCI}12 |
| Model input  (for decoder of 2-sided model, when applicable) | 1. Measurement of channel with sparse/low overhead CSI-RS (majority)  1a. Additional long-term multi-path power/angle/delay info information as assistance information4  2. Reported CSI for NW-sided model3,4,5 |
| Model output  (for decoder of 2-sided model, when applicable) | 1. Full channel matrix (majority)  2. Eigenvector 3 for NW-sided model  3. Channel matrix/eigenvector with different/targeted antenna on/off patterns3, 12 |
| Label | 1. Estimated/ideal channel matrix based on full CSI-RS density(majority) 2. Ideal precoding matrix with full dimension3  3. Estimated/ideal channel matrix/eigenvector with different/targeted antenna on/off patterns3, 12 |
| Training types | Offline training(majority)  Online finetuning for UE-sided model (for NW-sided model + UE sided model without training collaboration)4 |
| KPI | NMSE, SGCS, throughput, ratio of CSI-RS overhead |
| Benchmark | 1. non-AI based on full CSI-RS  2. non-AI based on sparse CSI-RS |
| Model location for inference | UE-sided model  NW-sided model2,3, 4,5,6  Two-sided model3  NW-sided model + UE-sided model without training collaboration4 |
| Collaboration/interaction between UE and NW | As UE-sided model in NR  As NW-sided model in NR  As two-sided model for CSI compression4 in NR |
| Potential spec impact | 1.Sparse CSI-RS design and corresponding feedback (especially for NW-sided model)  2. Signalling/ procedure related to LCM  3. Inter-vendor collaboration for two-sided model, when applicable |

Table B

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sub-use case | Sub-Case B:  CSI time domain prediction (as Rel-19 CSI prediction or extension) | Sub-case C:  CSI prediction cross carrier/band/frequency band | Sub-Case D:  CSI prediction across analog beams | Sub-Case E:  prediction with linear projection as pre-processing |
| Reported  Companies | (6) Ericsson2, BJTU, Samsung, MediaTek3, LGE, vivo1 | (4) Samsung, Apple, LGE, DoCoMo1 | (2) Samsung, vivo1 | (1) Huawei |
| Model input | 1. Channel matrix over K CSI-RS occasions  2. Measurements of interference over K CSI-RS occasions1  3. Channel matrix over K CSI-RS occasions with >20ms periodicity3  4 Channel matrix with one P CSI-RS with 20ms periodicity and K-1 AP CSI-RS2 | Channel matrix of carrier/band/frequency block A | Channel matrix of Set B of beams | K past CSI information after linear projecting |
| Model output | 1. Channel matrix of future instances  2. Interference in future instances1 | Channel matrix of carrier/band/frequency block B | Channel matrix of Set A of beams | Predicted CSI information after linear projecting at a future time instance |
| Label | Measurement in future time occasions. | Channel matrix of carrier/band/frequency block B | Channel matrix of Set A of beams | Ground-truth CSI information after linear projecting, based on the measurement at the future time instance |
| Training types assumption | offline training | offline training | offline training | Online finetuning |
| KPI | NMSE, SGCS, throughput, [ratio of CSI-RS overhead] | SGCS, NMSE, throughput, ratio of CSI-RS overhead | SGCS, NMSE, throughput, ratio of CSI-RS overhead | SGCS |
| Benchmark |  | 1.Ground truth of target frequency block  2. Sample and hold | Ground truth of Set A of beams | 1.Non-AI based CSI prediction  2.AI-based CSI prediction based on CSI information without linear projection |
| Model location for inference | UE-sided model  NW-sided model1 | UE-sided model  NW-sided model1 | UE-sided model  NW-sided model1  Two-sided model1 | UE-sided model |
| Collaboration/interaction between UE and NW | As UE-sided model in NR  As NW-sided model in NR1 | As UE-sided model in NR | As UE-sided model in NR | Similar to UE-sided model in NR |
| Potential spec impact | 1. As AI based CSI prediction in NR  2. Reporting content, signalling and procedure for LCM for extension cases1 | 1. Cross carrier/frequency switching procedure enhancement based on predicted CSI  2. signalling/ procedure related to LCM | 1.CSI-RS configuration for predicted beams  2. signalling/ procedure related to LCM | Signaling/ procedure related to LCM considering online finetuning |

Observation

For 6GR AI/ML use cases identification/categorization, [23 sources] provided preliminary simulation results and analysis on low overhead DMRS with AI/ML receiver.

* [22 sources] provided preliminary simulation results and analysis on sparse orthogonal DMRS in frequency and/or time domain with AI/ML receiver.
* [11 sources] provided preliminary simulation results and analysis on superimposed pilot with AI/ML receiver.
* [5 sources] provided preliminary simulation results and analysis on DMRS free with AI/ML receiver.
* Detailed evaluation assumptions (model input/output/label/benchmark/KPI/ training type) and initial analysis can be found in Table C.

Note: whether/how to capture the observation in the TR is a separate discussion.

Table for detailed assumptions of each category will be added.

Table C, For low overhead DMRS with AI/ML receiver

|  |  |  |  |
| --- | --- | --- | --- |
| Sub-use case | Sub-case A:  Sparse orthogonal DMRS in frequency and/or time domain | Sub-case B:  Superimposed pilot | Sub-case C:  DMRS free |
| Reported companies | (23) Nokia1, Futurewei2, Ericsson3, ZTE4, {Spreadtrum, UNISOC}5, Interdigial6, vivo7, xiaomi8, CMCC9, {CATT, CICTCI}10, Fujitsu11, Apple12, Samsung13, Kyocera14, Lenovo15, Huawei16, Qualcomm 17, Ofinno18, NVIDIA19, MediaTek20, Lekha21, LGE22, DocoMo23 | (12) vivo 1, CMCC2, ZTE3, Lenovo4, Huawei5, OPPO6, NVIDIA7, LGE8，Xiaomi9 , InterDigital10 , DocoMo11 Kyocera12 | (5) InterDigital1, Huawei2, NVIDIA3, MediaTek4, Lenovo5 |
| Model input | 1. Received signal/estimated channel at DMRS and received signal on data 1,13, 22,15,3,17,10,4, 20,6,18,23  1a. additionally noise variance 1,13  2. Received signal/estimated channel at DMRS2,7, 8,11,12,13,16,5,23 | 1. Received signal and DMRS sequence (superimposed signal) (Majority)  2. Estimated channel (in delay doppler domain) from the received signal ~~of target REs~~ (superimposed signal) 1  For Tx side of two-sided model: modulated symbols and DMRS symbol5 | Received signal  For Tx side of two-sided model: coded bit2,5 |
| Model output | 1. Estimated channel at target data and/or DMRS REs2,4,5,7,8,9,11, 12, 13,16,17,18,19,21,22,23  1a. Estimated noise variance 12  2. LLRs1,2,3, 4, 6,10, 13,15,19,20, 22  3. Filtering coefficients for channel estimation 7 | 1. Estimated channel at target data REs1,3,4,5,6,8  2.LLR2,3, 5,6,7,8,11,12  3.Estimated modulation symbols9  For Tx side of two-sided model: superimposed signal5 | 1.LLR (majority)  2.Estimated channel2  For Tx side of two-sided model: modulated data symbols 5,2 |
| Label | 1. Ideal channel information 2,5,7,8,9,11,12,13,15,16,17,18,22,23  2. Known sequence/data1,2,3, 4,10, 13,15,16,20,22  3. Label free (unsupervised)6, 21  4. Estimated channel using legacy DMRS pattern with legacy receiver8  5. Estimated channel of adjacent RE (self-supervised)13 | 1. Known sequence/data 2,3,11,12  2. Ideal channel information1,8  3.Transmitted modulation symbols9 | 1. Known sequence/data  2 ideal channel information2  3. Label free1 |
| Training types assumption | offline training | offline training | offline training |
| KPI | MSE, BLER, throughput | MSE, BLER, throughput | MSE, BLER, throughput |
| Benchmark | With ideal channel information  With conventional receiver with sparse or legacy DMRS | With ideal channel informal  With conventional receiver with legacy DMRS overhead | With ideal channel information  With conventional receiver with legacy DMRS overhead |
| Model location for inference | UE-sided model for DL or NW-sided model for UL | UE-sided model for DL  NW-sided model for UL  Two-sided model5 | UE-sided model for DL1  NW-sided model for UL3,4  Two-sided model2,5 |
| Collaboration/interaction between UE and NW | Similar to UE-sided or NW-sided model as NR | Similar to UE-sided or NW-sided model as NR  Similar to two-sided model as NR | Similar to UE-sided model as NR  Similar to NW-sided model as NR  Similar to two-sided model as NR |
| Potential spec impact | 1. DMRS design  2. RAN 4: Demod requirement  3. Signalling/ procedure related to LCM for UE and/or NW sided model  Etc. | 1. DMRS design  2. RAN 4: Demod requirement  3. Signalling/ procedure related to LCM for UE and/or NW sided model or two-sided model (including inter-vendor calibration), when applicable  Etc. | 1. RAN 4: Demod requirement  2. Signalling/ procedure related to LCM for UE and/or NW sided model or two-sided model (including inter-vendor calibration), when applicable  3. Constellation design and related signalling/procedure  Etc. |

Observation

For 6GR AI/ML use cases identification/categorization, [13 sources] provided preliminary simulation results and analysis on CSI compression and feedback.

* [10 sources] provided preliminary simulation results and analysis on CSI compression with joint source and channel coding (JSCC)
* [11 sources] provided preliminary simulation results and analysis on CSI compression with joint source, channel coding and modulation (JSCM)
* [2 sources] provided preliminary simulation results and analysis on CSI feedback with downloadable basis/codebook.
* [3 sources] provided preliminary simulation results (or cite to NR AI/ML for CSI compression simulation results) and analysis on CSI reconstruction with CSI feedback with SRS (assuming separate source and channel coding).
* Detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis can be found in in Table D.

Note: whether/how to capture the observation in the TR is a separate discussion.

Table D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sub-use case | Sub-case A:  CSI compression with JSCC | Sub-case B:  CSI compression with JSCM | Sub-case C:  DLable basis/codebook | Sub-case D:  CSI reconstruction with CSI feedback with SRS  (assuming SSCC) |
| Reported companies | (10) ZTE1, Samsung2, vivo3, {Pengcheng, ZGC}, Lenovo, OPPO, MediaTek4, Fujitsu, BJTU5, {BUPT, ZGC}6 | (11) BJTU1, Samsung2, OPPO3,{Pengcheng, ZGC}4,vivo, CMCC, ZTE, {BUPT, ZGC}7, Fujitsu8, Apple, Lenovo | (2) ZTE1, Samsung | (3) Qualcomm, vivo, Samsung |
| Model input  of decoder or model output of encoder, when applicable | 1. Compressed CSI bits  1a. additionally estimated channel based on SRS2,3  1b. (for training), assuming the model input via error bits caused by in UL transmission after legacy channel decoding4 | 1. Compressed CSI complex values via UE-sided model  2. Compressed CSI complex values via a projection matrix1,2,3  3. Received signal at sparse CSI-RS and CSI-RS sequence 1,4 | 1.Amplitudes and phases obtained by a look up table based on feedback CSI bits  2. Selected basis1 | 1. Compressed CSI bits  2. Estimated channel based on SRS |
| Model output of decoder or model input of encoder, when applicable | 1. (Reconstructed) Eigenvectors  2. (Reconstructed) Explicit H1,2,3,4 | 1. (Reconstructed) Eigenvectors  2. (Reconstructed) Explicit H2 | Reconstructed Eigenvectors | (Reconstructed) Eigenvectors |
| Label | 1.Eigenvectors  2.Explicit H1,2,3,4 | 1.Eigenvectors  2.Explicit H2 | Eigenvectors | Eigenvectors |
| Training types | Offline training | Offline training | Offline training | Offline training |
| KPI | SGCS, NMSE, SE,  UE complexity | SGCS, NMSE, SE,  UE complexity | UPT vs overhead | SGCS, UPT |
| Benchmark | eType II  NR separate source and channel coding | eType II  NR separate source and channel coding  JSCM with two-sided model1,2,3 | eType II | eType II  NR AI/ML CSI compression without SRS  SRS without CSI feedback |
| Model location for inference | Two-sided model | Two-sided model  NW-sided model1,2,3 | NW-sided model | Two-sided model |
| Collaboration/interaction between UE and NW | Similar to two-sided model in NR | Similar to two-sided model in NR  For NW-sided model:  no collaboration or Similar to NW-sided model in NR | No collaboration  or Similar to NW-sided model in NR | Similar to two-sided model in NR |
| Potential specification impact | 1. Necessary signalling/ procedure to support JSCC  2. Signalling/ procedure related to LCM for two-sided model including inter-vendor collaboration | 1. Necessary signalling/ procedure to support JSCM  2. Projection matrix design for NW-sided model, when applicable  3. Signalling/ procedure related to LCM with NW-sided model or two-sided model including inter-vendor collaboration, when applicable  4. RAN4 requirements, e.g., EVM | 1. Downloadable basis/codebook related signalling/ procedure  2. Signalling/ procedure related to LCM with NW-sided model | 1. Necessary signaling/procedure to support lower overhead and/or simpler CSI feedback  2. Signalling/ procedure related to LCM for two-sided model including inter-vendor collaboration |

Observation

For 6GR AI/ML use cases identification/categorization, [5 sources] provided preliminary simulation results and analysis on (de)modulation.

* [5 sources] provided preliminary simulation results and analysis on modulation constellation design with the help of AI, and with non-AI or AI receiver.
* [3 sources] provided preliminary simulation results and analysis on AI-based modulation and precoding with two-sided model.
* Detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis can be found in Table F.

Note: whether/how to capture the observation in the TR is a separate discussion.

Table F For (de)modulation

|  |  |  |
| --- | --- | --- |
| Sub-use case | Sub-use case A:  AI-based (de)modulation | Sub-use case B:  AI-based modulation and precoding |
| Reported companies | (5)ZTE1, OPPO2, vivo3, Lenovo4, Xiaomi5 | (3) ZTE, OPPO, Lenovo |
| Model input | For constellation design  1. Coded bits 1,2,3,4,5  2. Channel characterization and modulation order4  For AI receiver  1.Received signal2,3,4 | Encoder: Coded bits  Decoder: Estimated symbols |
| Model output | For constellation design  1. Learned constellation 1,2,3,45  2. Probability of constellation points 4  For receiver  1. LLR2,3,4 | Encoder: modulated symbols after layer mapping  Decoder: Soft LLR |
| Label | Known coded bits | Known coded bits |
| Training types | Offline training | Offline training |
| KPI | BLER | BLER |
| Benchmark | Uniform QAM with legacy receiver | Uniform QAM with legacy receiver and NR layer mapping |
| Model location for inference | 1.NA (AI for constellation design with legacy receiver) 1,2,3,4,5  2.Receiver-sided model2,3,4 | Two-sided model |
| Collaboration/interaction between UE and NW | NA  or  Similar to NW-sided model or UE-sided model in NR | Similar to two-sided model in NR |
| Potential specification impact | 1. Constellation design and related signaling/procedure  2. Signaling/ procedure related to LCM for NW-sided model or UE-sided model  3. RAN4 requirements, e.g., EVM | 1. Modulation design and layer mapping design  2. Signaling/ procedure related to LCM for two-sided model including inter-vendor collaboration  3. RAN4 requirements, e.g., EVM |

Observation

For 6GR AI/ML use cases identification/categorization, [5 sources] provided preliminary simulation results and analysis on AI-based none-linearity handling at transmitter or receiver.

* [5 sources] provided preliminary simulation results and analysis on AI-based DPoD/None-linearity compensation at receiver.
* [2 sources] provided preliminary simulation results and analysis on AI-based DPD at transmitter.
* Detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis can be found in Table G.

Note: whether/how to capture the observation in the TR is a separate discussion.

|  |  |  |
| --- | --- | --- |
| Sub-use case | Sub-use case A:  AI-based DPoD/None-linearity compensation | Sub-use case B:  AI-based DPD |
| Reported companies | (5) Samsung1, Ericsson2, OPPO3, vivo4, Huawei5 | (2) vivo2, Huawei1 |
| Model input | 1. Received signal1,3,4,5 | Time domain samples before pre-distortion |
| Model output | 1. Compensated signal in time domain1,2,4,5  2. Soft bits2,3 | Time domain samples after pre-distortion |
| Label | 1. DMRS1  2. Known bit sequence2,3,4  3. time domain samples from known sequence5 | Time domain samples |
| Training types | Online training/finetune1  Offline training | Offline training  Online training/finetune2 |
| KPI | BLER, MPR, EVM, throughput | BLER, EVM, MPR |
| Benchmark | Without compensation | No DPD |
| Model location for inference | NW-sided model | UE-sided model |
| Collaboration/interaction between UE and NW | Similar to NW-sided model as NR | Similar to UE-sided model as NR |
| Potential specification impact | 1. RAN 4 requirements, e.g. EVM  2. DMRS/Sequence design/selection, Tx power determination  3. Signaling/ procedure related to LCM for NW-sided model | 1. RAN4 requirements, e.g. EVM  2. Tx power determination  3. Signaling/ procedure related to LCM for UE-sided model |

Observation

For 6GR AI/ML use cases identification/categorization, [4 sources] provided preliminary simulation results and analysis on low overhead SRS with AI/ML

[1 source] provided preliminary simulation results and initial analysis on low PAPR SRS sequence design with help of AI/ML

Detailed evaluation assumptions (model input/output/label/KPI/benchmark) and analysis in Table I.

Note: whether/how to capture the observation in the TR is a separate discussion.

Table I SRS with AI/ML

|  |  |  |
| --- | --- | --- |
| Use case | Low overhead SRS with AI/ML | Low PAPR SRS sequence design |
| Reported companies | (4) {Spreadtrum, UNISOC}, vivo, Huawei, Kyocera | (1) vivo |
| Model input | Measurement of channel with low overhead SRS of frequency/temporal domain | Sequence index |
| Model output | Estimated channel | Learn sequences |
| Label | Ideal channel information | Label free |
| Training types | Offline training | Offline training |
| KPI | SCGS, throughput | PAPR, SGCS, Cross-correlation between SRS sequences |
| Benchmark | With legacy SRS  With ideal channel information | Legacy SRS sequence |
| Model location for inference | NW-sided model | NW-sided model  or  Without model for inference |
| Collaboration/interaction between UE and NW | Similar to NW-sided model in NR | No collaboration for no model  Similar to NW-sided model in NR |
| Potential specification impact | 1.Sparse SRS design  2. Signalling/ procedure related to LCM for NW-sided model | 1. SRS design  2. Signaling/procedure related to DLable/ULable SRS sequence, when applicable  3. Signalling/ procedure related to LCM for NW-sided model, when applicable |

Observation

For 6GR AI/ML use cases identification/categorization, [3 sources] provided preliminary simulation results and analysis on AI-enabled UL precoder indication with detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis can be found in Table H.

Note: whether/how to capture the observation in the TR is a separate discussion.

Table H AI-enabled UL precoder indication

|  |  |
| --- | --- |
| Use case | AI-enabled UL precoder indication |
| Reported companies | (3) vivo1, Fujitsu2, Samsung3 |
| Model input  of decoder or model output of encoder | UL precoder indicator/compressed UL precoder |
| Model output of decoder or model input of encoder | (Reconstructed) eigenvectors of UL channel |
| Label | Estimated eigenvectors of UL channel based on SRS measurement |
| Training types | offline training  online finetune1 |
| KPI | SCGS, BLER |
| Benchmark | NR TPMI codebook |
| Model location for inference | No model for inference 1,3  Two-sided model1,2 |
| Collaboration/interaction between UE and NW | Similar to one-sided model in NR 1,3  Similar as two-sided model in NR1,2 |
| Potential specification impact | 1.The signaling/procedure related to the download/upload of UL codebooks/compressed UL precoder  2. LCM procedure to facilitate the training of the downloadable/uploadable UL codebooks when no model for inference, 1,3  3. Signalling/ procedure related to LCM for for two-sided model including inter-vendor collaboration, when applicable1,2 |

Observation

For 6GR AI/ML use cases identification/categorization, [3 sources] provided preliminary simulation results and analysis on AI/ML based waveform for PAPR reduction with detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis in Table J.

Note: whether/how to capture the observation in the TR is a separate discussion.

Table J AI/ML based waveform for PAPR reduction

|  |  |
| --- | --- |
| Use case | AI/ML based waveform for PAPR reduction |
| Reported companies | (3) vivo1, Samsung2, Huawei3 |
| Model input | Symbols in frequency domain |
| Model output | For model output of encoder for UE-sided/NW-part of two-sided model: transformed/precoded symbols in frequency domain  For output of decoder for NW-part of two-sided model:  1. LLR1,3  2. Symbols in frequency domain2 |
| Label | Label free2,3  Known bit sequences or its LLR1,3 |
| Training types | offline training |
| KPI | BLER, CCDF of PAPR(UL), throughput (DL) |
| Benchmark | DFT-s-OFDM |
| Model location for inference | Two-sided model  UE-sided model (for frequency domain shaping)1 |
| Collaboration/interaction between UE and NW | Similar to two-sided model in NR  No collaboration for UE-sided model1 |
| Potential specification impact | 1. Signaling/ procedure related to LCM for two-sided model including inter-vendor collaboration, when applicable  2. Signaling/ procedure related to LCM for UE-sided model 1  3. Related RAN4 requirements |

Observation

For 6GR AI/ML use cases identification/categorization, [2 sources] provided preliminary simulation results and analysis on AI/ML based HARQ-ACK feedback with detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis in Table K.

Note: whether/how to capture the observation in the TR is a separate discussion.

Table K. AI/ML based HARQ-ACK feedback

|  |  |
| --- | --- |
| Use case | AI/ML based HARQ-ACK feedback |
| Reported companies | (3) Qualcomm, vivo |
| Model input | HARQ ACK/NACK bit sequence |
| Model output | Learned sequences/modulated symbols |
| Label | HARQ-ACK/NACK bit sequence |
| Training types | Offline training |
| KPI | BLER |
| Benchmark | NR RM code for up to 11bits with Maximum Likelihood (ML) receiver |
| Model location for inference | No model for inference |
| Collaboration/interaction between UE and NW | No collaboration |
| Potential specification impact | 1.Learned sequence/modulated symbols design  2.Downloadable sequence/modulated symbols related signalling/ procedure for HARQ-ACK  3. Related RAN4 requirements |

Observation

For 6GR AI/ML related service, for 6GR AI/ML use cases identification/categorization, [2 sources] provided preliminary simulation results and analysis on improved scheduling/HARQ for token traffic

Detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis in Table L.

Note: whether/how to capture the observation in the TR is a separate discussion.

Table L for improved scheduling/HARQ for token traffic

|  |  |
| --- | --- |
| Use case | Improved scheduling/HARQ for token traffic |
| Reported companies | (2) Huawei1, OPPO2 |
| Model input | Tokenizer model:  • Input: Raw data (e.g., image/video/audio, etc.)  De-tokenizer model:  • Input: Tokens |
| Model output | Tokenizer model:  • Output: Tokens (e.g., tokenized image/video/audio)  De-tokenizer model:  • Output: Inference results for downstream tasks/Raw data (e.g., image/video/audio, etc.) |
| Label | Training at OTT, transparent to RAN1,2 |
| Training types | Offline training at OTT, transparent to RAN |
| KPI | Supported number of UEs, achievable throughput |
| Benchmark | NR scheduling/HARQ mechanism without knowledge of Token traffic |
| Model location for inference | The tokenizer model is at UE or NW/OTT server (e.g., an encoder).  The de-tokenizer model is at NW/OTT server or UE (e.g., a decoder). |
| Collaboration/interaction between UE and NW | NA |
| Potential specification impact | • Service awareness in RAN  • Token error identification, new scheduling and HARQ |

Observation

For 6GR AI/ML use cases identification/categorization, [13 sources] provided preliminary simulation results and analysis on AI/ML for beam management and extension.

* [7 sources] provided preliminary simulation for DL Tx beam management and analysis on inter-cell/inter-TRP/M-TRP DL Tx beam prediction and management.
  + Besides, [5 sources] citing to NR study for DL Tx beam management and analysis on inter-cell/inter-TRP/M-TRP DL Tx beam prediction and management.
* [3 sources] provided preliminary simulation results and analysis on cross frequency DL Tx beam prediction.
* [2 sources] provided preliminary simulation results and analysis on Tx-Rx beam pair prediction.
* [2 sources] provided preliminary simulation results for beam management and analysis on beam prediction for initial access.
  + Besideds,[5 sources] citing to NR study for beam management and analysis on beam prediction for initial access.
* [1 source] provided preliminary simulation results and analysis on DL Tx beam prediction for spatial and/or temporal domain with additional local UE information.
* [1 source] provided preliminary simulation results and analysis on reinforcement learning-based approach beam selection
* Detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis can be found in in Table E.

Note: whether/how to capture the observation in the TR is a separate discussion.

able E-1 AI/ML for beam management and extension

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sub-use case | Sub-case A:  Inter-Cell/M-TRP DL Tx beam prediction and management | Sub-Case B:  Cross frequency DL Tx beam prediction | Sub-Case C:  Tx-Rx beam pair prediction | Sub-Case D:  Beam prediction for initial access | Sub-Case E:  DL Tx beam prediction for spatial and/or temporal domain with additional local UE information | Sub-Case F:  reinforcement learning-based approach beam selection |
| Reported companies | (7) Nokia, ZTE, xiaomi, CEWiT, DoCoMo, , Lenovo, BJTU  (5) Qualcomm, Samsung, LGE, NVIDA, CEWiT (citing to NR study) | (3) Futurewei1, xiaomi2, Apple3 | (2) Ericsson, Nokia | (2) Huawei, vivo  (5) Qualcomm, Samsung, LGE, ZTE, Apple (citing to NR study) | (1) Huawei | (1) Nokia |
| Model input | Measurements from Set B of one or more TRPs/Cells | Measurements in frequency A | Measurements from Set B DL Tx-Rx beam pairs. | Measurements from Set B of SSB | Measurements from Set B  And additional local UE information (moving direction and speed) as UE side model input | Measurements from a set of DL Tx beam scheduling stats (at the NW), Cross corelation among DL Tx beams |
| Model output | Predicted best beam information and/or predicted measurements from Set A of target cell/TRP(s) [of current or future time instance] | Predicted cell/beam related information of frequency B  [of current or future time instance] | Predicted best DL Tx-Rx beam pairs information from Set A DL Tx-Rx pairs. | Predicted best DL Tx beam information (and/or predicted measurements from Set A [of current or future time instance] | Predicted Best beam indexes (probability of each Tx beam in Set A to be the Top-1 Tx beam) and/or Predicted measurements from Set A [of current or future time instance] | Selected beam index for scheduling UE(s) |
| Label | Measurements [or Top beams] of Set A of target cell/TRP(s) | Measurements on cell(s)/beam(s) of frequency B | Measurements [or Top beams pairs] of Set A Tx-Rx pair | Measurements [or Top beams] of Set A | Measurements [or Top beams] of Set A | label-free (online learning) |
| Training types assumption | offline training | offline training | offline training | offline training | offline training;  online finetuning  (for UE side model) | Online learning |
| KPI | Prediction cell/beam/measurement accuracy,  Throughput,  RS overhead reduction | Prediction beam/measurement accuracy,  RS overhead reduction | Prediction beam/measurement accuracy,  RS overhead reduction | Prediction beam accuracy | Prediction beam/measurement accuracy | Throughput, End to end packet latency |
| Benchmark | Based on Set A  Based on Set B | Measurements on cell(s)/beam(s) of frequency B | Based on Set A  Based on Set B | Based on Set A  Based on Set B | NR beam prediction with AI/ML | Beam with largest RSRP (from the set) consider as the scheduling beam |
| Model location for inference | UE-sided model or NW-sided model | UE-sided model or NW-sided model | UE-sided model | UE-sided model or NW-sided model | NW-sided model + UE-sided model without training collaboration | NW-sided model |
| Collaboration/interaction between UE and NW | As UE-sided or NW-sided model in NR | As UE-sided or NW-sided model in NR | As UE-sided model in NR | Similar to UE-sided or NW-sided model in NR | As UE-sided or NW-sided model in NR | No collaboration |
| Potential spec impact | 1. Inter-Cell/M-TRP beam prediction related singling/procedure  2. Signalling/ procedure related to LCM for NW-sided model or UE-sided model | 1. Cross frequency DL Tx beam prediction related signalling /procedure  2. Signalling/ procedure related to LCM for NW-sided model or UE-sided model | 1.Signalling/ procedure related to LCM for UE-sided model | 1. Initial access related to beam prediction  2. Signalling/ procedure related to LCM for NW-sided model or UE-sided model | 1. As NR AI for BM;  2. Signalling/ procedure related to NW-sided model + UE-sided model.  3. Signalling/ procedure related to online finetuning, if any | 1. Signalling/ procedure related to exploration phase (to mitigate the impact of exploration). |

Observation

For 6GR AI/ML use cases identification/categorization,

[one source] provided preliminary simulation results and analysis on pathloss prediction in the spatial, temporal, and/or frequency domain, to use the predicted pathloss in UL (PUSCH/PUCCH/PRACH/SRS) power control.

[one source] provided preliminary simulation results and analysis on UL closed-loop power control with an NW-sided AI/ML model, where the model predicts the optimal power adjustment (or TPC command index) for the UE,

[one source] provided preliminary simulation results and analysis on prior-information-aided DCI decoding,

[one source] provided preliminary simulation results and analysis on lossless DCI compression,

[one source] provided preliminary simulation results and analysis on early contention resolution in RACH,

[one source] provided preliminary simulation results and analysis on sensing based RAN digital twin construction with NW-side AI/ML model,

[one source] provided preliminary simulation results and analysis on AI/ML-enabled RAN digital twin with distributed model,

[one source] provided preliminary simulation results and analysis on AI/ML based SRS power imbalance compensation,

[one source] provided preliminary simulation results and analysis on Site Specific Learning for AI/ML and RAN Digital Twin,

Detailed evaluation assumptions (model input/output/label/KPI/benchmark) and initial analysis can be found in in Table M

Note: whether/how to capture the observation in the TR is a separate discussion.

Table M -1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Use Case** | Prior-Information-Aided DCI Decoding | Lossless DCI Compression | UL closed-loop power control with an NW-sided AI/ML model, where the model predicts the optimal power adjustment (or TPC command index) for the UE. | Pathloss prediction in the spatial, temporal, and/or frequency domain, to use the predicted pathloss in UL(PUSCH/PUCCH/PRACH/SRS) power control. |
| **Reported companies** | (1)CMCC | (1)CMCC | (1) Nokia | (1) Nokia |
| **Model input** | LLR after demodulation at current transmission, and historical AI/ML based predicted LLR | Historical DCI payload | UL SINR measurement, UE Tx power estimate (derived from Pcmax, P0, PL alpha, pathloss measurement), and PUSCH allocation size | L1-RSRP measurements from a sub-set/set of RSs/beams (Set B).  input can consider history of measurements |
| **Model output** | Decoded DCI payloads, and predicted LLR for next transmission | Predicted DCI payload | Predicted TPC command index | Predicted pathloss value(s) (or predicted L1-RSRP(s)) for a set of RSs/beams (Set A).  output can consider future instances |
| **Label** | DCI payload sequences | DCI payload sequences | Optimal TPC command index (offline learning)  label-free (online learning) | Pathloss value(s) (or L1-RSRP(s)) for a set of RSs/beams (Set A) |
| **Training types** | Offline training at the UE side | Offline training at the NW side, and model delivery to UE side | Offline and Online learning | Offline training |
| **KPI** | BLER performance | BER and sample-level prediction accuracy;  DCI overhead reduction | UL throughput. | Pathloss prediction accuracy, throughput, RS overhead reduction, Complexity. |
| **Benchmark** | Traditional DCI decoder | Traditional DCI design | 1. UL Power control with optimized OLPC parameters  2. UL Power control with optimized OLPC parameters and possibly legacy CLPC algorithms (with 5G TPC tables). | Pathloss estimation based on Set A  Pathloss estimation based on Set B |
| **Model location for inference** | UE-sided model | UE-sided model + NW-sided model | NW-sided model | UE-sided model  NW-sided model |
| **Collaboration/interaction between UE and NW** | Similar to UE-sided model in NR | Model transfer from NW to UE | None | As UE-sided or NW-sided mode in nRl |
| **Potential specification impact** | 1. Signalling/configuration design for prior-information-aided DCI decoder.  2. Signalling/ procedure related to LCM for UE-sided model | 1. Signalling/configuration design for Lossless DCI Compression.  2. Signalling/ procedure related to LCM including model transfer | Configurability of the values in TPC command tables or an extended TPC command table (compared to NR). | 1. Pathloss prediction related signalling/procedure  2. Signalling/ procedure related to LCM for UE-sided or NW-sided model  3. RAN4 performance requirements and test cases, including defining new requirements related to pathloss reference signal (PL-RS) measurement and activation delays of TCI state(s). |

Table M-2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sub-use case** | Early contention resolution in RACH | Sensing based RAN digital twin construction with NW-side AI/ML model | AI/ML-enabled RAN digital twin with distributed model | AI/ML based SRS power imbalance compensation | Site Specific Learning for AI/ML and RAN Digital Twin |
| **Reported**  **Companies** | (1) Ofinno | (1) Huawei | (1) Huawei | (1) Huawei | (1) DeepSig |
| **Model input** | Received PRACH signal  (e.g., preamble waveform) | Point cloud sensed by the BS with mono-static sensing and sensed/reported by UEs with bi-static sensing | UE-part models: local sparse point cloud  NW-part model: latent space information from multiple UEs | UL measured channel matrix from SRS with IL imbalance | Received signal/estimated channel at DMRS and received signal on data, and the channel information generated by digital twin |
| **Model output** | Predicted number of UEs that transmitted the same preamble for given PRACH resources | 3D point cloud representing the static environment | UE-part models: compressed latent space information  NW-part model: global point cloud | DL channel matrix with IL compensated | Decoded bit |
| **Label** | Ground-truth number of UEs that transmitted the same preamble | Ground truth point cloud | Ground truth point cloud | UL SRS measurement without IL (assuming it is compensated by UE at certain conditions) or DL CSI-RS measurement | Ground truth of target bit |
| **Training types assumption** | Offline training | Offline training | Offline training (adopted in simulation)  Online finetuning (can be optionally considered) | offline training | Offline training |
| **KPI** | Prediction accuracy of UE multiplicity, RACH access delay, first-attempt success probability | Sensing accuracy metric: root mean square error (RMSE) of point cloud. RMSE= is the square root of the average of the squared errors between each sensed point ( in forms of coordinates) and ground truth point (in forms of coordinates) in the point cloud including n points with {x, y, z} dimensions. | 1. Overhead metric: Feedback bits per point  2. Sensing accuracy metric: intersection-over-union (IoU), edge detection probability | SGCS | BLER, throughput |
| **Benchmark** | First-attempt success rate based on legacy PRACH receiver | BS side mono-static sensing only to construction RAN digital twin | 1. Single UE sensing (to justify sensing accuracy metric of using distributed model).  2. Raw data transmission (to justify overhead metric of using distributed model). | 1. SRS without IL imbalance;  2. non-AI based SRS IL imbalance compensation | Legacy receiver without the help of digital twin |
| **Model location for inference** | NW-side model | NW-side model | Distributed model: a NW-side model paired with multiple UE-side models. | NW-sided model | NW-sided model |
| **Collaboration/interaction between UE and NW** | Similar to NW-sided model in NR | Similar to NW-sided model in NR | Similar to two-sided model: UE reporting of compressed sensing results for inference.  Inter-vendor training collaboration between NW side and UE side. | Similar to NW-sided model in NR | Similar to NW-sided model in NR |
| **Potential spec impact** | 1. Signaling/procedure related to Mgs.3 grant for more than one UEs selected the same PRACH sequence  2. Signalling/procedure related to LCM for NW-sided model | 1. Signaling/procedure related to bi-static sensing results reported from UE  2. Signalling/procedure related to LCM for NW-sided model | 1. Sensing results reported from UE in forms of compressed latent message  2. Signalling/procedure related to LCM for two-sided model including inter-vendor collaboration | 1. Inference: UE reporting on the IL range for ensuring generalization  2. Signalling/procedure related to LCM for NW-sided model | 1. Signalling/procedure related to LCM for NW-sided model |

R1-2508117 Moderator summary #4 on AI/ML for 6GR Samsung (Moderator)

R1-2508004 Moderator summary #3 on AI/ML for 6GR Samsung (Moderator)

R1-2508003 Moderator summary #2 on AI/ML for 6GR Samsung (Moderator)

R1-2508002 Moderator summary #1 on AI/ML for 6GR Samsung (Moderator)

R1-2508001 Moderator summary #0 on AI/ML for 6GR Samsung (Moderator)

R1-2506742 Discussion on AI/ML in 6GR interface FUTUREWEI

R1-2506757 Views on AI/ML Operation and Use Cases for 6G Radio Air Interface Nokia

R1-2506762 AI/ML Use Cases for 6GR Air Interface Ericsson

R1-2506778 Discussion on AI-based Smart Radio for 6G Air Interface ZTE Corporation, Sanechips

R1-2506780 Discussion on AI/ML-driven use cases for 6GR BJTU

R1-2506784 Discussion on AI/ML in 6GR air interface TCL

R1-2506820 Discussion on AIML in 6GR interface Spreadtrum, UNISOC

R1-2506821 AI/ML for 6G Air Interface InterDigital, Inc.

R1-2506904 Discussion on AI/ML in 6GR interface vivo

R1-2506951 AI/ML in 6GR interface Kyocera

R1-2506995 Discussion on AI/ML in 6GR interface Xiaomi

R1-2507020 Discussion on AI/ML in 6GR interface CMCC

R1-2507029 Discussion on AI/ML in 6GR interface Lekha Wireless Solutions

R1-2507064 Views on AI/ML in 6GR air interface Huawei, HiSilicon

R1-2507080 On Data Collection, Monitoring, and Model Pairing for AI/ML-based CSI Compression Southeast University

R1-2507107 Views on AI/ML in 6GR interface CATT, CICTCI

R1-2507182 AIML use cases for 6GR air interface OPPO

R1-2507203 AI/ML in 6GR interface Tejas Network Limited

R1-2507259 AI/ML Use cases and framework for 6GR Samsung

R1-2507288 Discussion on AI/ML in 6GR Fujitsu

R1-2507305 Discussion on AIML in 6GR interface NEC

R1-2507377 Discussion on AI/ML in 6GR interface Panasonic

R1-2507378 AI/ML Use Cases for 6G NTU

R1-2507400 Discussion on AI/ML in 6GR interface LG Electronics

R1-2507409 Views on AI/ML in 6GR air interface SK Telecom

R1-2507433 AI and ML in 6GR air interface NVIDIA

R1-2507471 Views on AI/ML in 6GR interface Ofinno

R1-2507488 Discussion on AI/ML Use-cases in 6GR Lenovo

R1-2507492 Use cases for AI/ML in 6GR interface KT Corp.

R1-2507512 Discussion on AI/ML in 6GR interface ETRI

R1-2507522 AI/ML in 6GR Air Interface Google

R1-2507525 New use cases for AI/ML in 6GR interface Pengcheng Laboratory, ZGC Institute of Ubiquitous-X Innovation and Application

R1-2507547 Discussion on AI/ML in 6GR interface Continental Automotive

R1-2507601 Discussion on the potential AI/ML use cases for 6GR interface Sony

R1-2507604 Discussion on AI/ML for 6GR interface Ruijie Networks Co. Ltd

R1-2507605 Discussion on AI/ML Use Cases for 6GR DeepSig Inc

R1-2507613 AI/ML Framework and Use Cases for 6GR Air Interface MediaTek Inc.

R1-2507633 Discussion on AI/ML in 6GR interface Transsion Holdings

R1-2507683 Discussion on 6G AI/ML use cases Apple

R1-2507727 AI/ML in 6GR air interface Qualcomm Incorporated

R1-2507752 AI/ML use cases and framework for 6GR Air Interface AT&T

R1-2507776 Discussions on AI/ML in 6GR interface Sharp

R1-2507779 Discussion on AI/ML in 6GR Shanghai Jiao Tong University, Toyota

R1-2507821 Discussion on AI/ML for 6GR air interface NTT DOCOMO, INC.

R1-2507826 AI/ML in 6GR air interface KAIST

R1-2507827 Discussion on AI/ML-enabled use cases for 6GR BUPT, ZGC Institute of Ubiquitous-X Innovation and Application

R1-2507842 Discussion on AI/ML in 6GR air interface Hanbat National University

R1-2507872 Discussion on AI/ML in 6GR Interface Indian Institute of Tech (M)

R1-2507883 On new use cases for AI/ML in 6GR interface Vodafone, Deutsche Telekom

R1-2507907 AI/ML in 6GR Interface CEWiT

R1-2507910 Discussion on AI/ML in 6GR -Physical Layer Rakuten Mobile, Inc

R1-2507940 Discussion on AI/ML in 6GR air interface IIT Kanpur

## Initial access

*Placeholder only and to be broken down. No contributions before RAN1#124. Including synchronization signal and raster, broadcast signals/channel and physical random access channel, etc.*

## MIMO operation

*Placeholder only and to be broken down. No contributions before RAN1#124.*

## Physical layer control, data scheduling and HARQ operation

*Placeholder only and to be broken down. No contributions before RAN1#124.*

## Duplexing

*Placeholder only and to be broken down or adapted based on the discussion in AI 11.1. No contributions before RAN1#124.*

## 6GR spectrum utilization and aggregation

*Placeholder only and to be broken down. No contributions before RAN1#124.*

## NTN

*Placeholder only and to be broken down or adapted based on the discussion in AI 11.1. No contributions before RAN1#124.*

## Other physical layer signals, channels and procedures

*Placeholder only and to be broken down and adapted. No contributions before RAN1#124.*

## Sensing

*Including PHY functions and procedures for sensing technology (e.g., waveform. reference signals, measurement feedback, etc…), aspects of integration with communication services.*

*Placeholder only and to be broken down. No contributions before RAN1#124b.*

# Elections

*Elections for the positions of a second Vice Chair of TSG RAN WG1 will be held during RAN WG1#122bis on 14th, October 2025 in Prague.*

# Closing of the meeting (Day 5, 5:00 pm at the latest)