**3GPP TSG RAN WG1 #104-e R1-2101181**

**e-Meeting, January 25th – February 5th, 2021**

**Agenda item:** 7.2.6

**Source:** Moderator (Samsung)

**Title:** Summary for Rel.16 NR eMIMO maintenance

**Document for:** Discussion and Decision

1. Introduction

The moderator summary of the maintenance-related issues raised in the submitted contributions for Rel.16 NR\_eMIMO maintenance is given below. The listed maintenance issues are under the usual designations:

* LP: low-PAPR RS
* MB: Multi-beam operation
* MT: Multi-TRP
* MU: Type-II enhancement for MU-CSI
* UL: UL full power transmission

An initial assessment on each of the issues is given (but can be revised based on the outcome of the discussion during the preparation week). The assessment will be used as a basis to select four issues (per chairman instruction) for further discussion in the upcoming weeks.

* *High priority (H):* this includes high-priority item (essential, pending issues, broken spec components) and proposed editorial changes that either enhance the clarity of the specs or correct mistakes
	+ *H2:* The proposal can be endorsed without discussion in the upcoming weeks (i.e. unless pointed out otherwise, the moderator will propose to the chair that the proposal be endorsed by Oct 23rd thereby not counted toward the four-thread quota). It can be merged with any of the assigned threads without any further discussion. This includes TPs associated with previous agreements.
* *Non-essential (N)*: this includes all other purposes such as spec optimization and low priority issues
* *Editorial (E)*: this includes editorial issues that will be handled as editorial CRs (to be communicated to the editors/chairs)
1. Maintenance issues

The issues are summarized in the following table:

**Table 1 Summary**

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| **#** | **Issue (summary)** | **Companies** | **Initial assessment** | **Company inputs (if any)** |
| MB.1  | Clarifying that multi-CC simultaneous TCI update can be applied to CORESET#0 FL: discussed in the pre- phase in the last meeting but not agreed | Vivo | N | vivo: should be H and can be combined with MB.2.There is obvious conflict between RAN1 spec and RAN2 spec. The spec impact should be clarified. We are also fine with conclusion.QC: Agree with initial assessment. |
| MB.2 | For multi-CC simultaneous TCI update, clarify which BWP’s tci-States-ToAddModList is applied to CORESET#0 if CORESET #0 belongs to both the active BWP and the initial BWP.FL: may not need spec change | Vivo | N  | vivo: should be H and can be combined with MB.1.We think this issue should be discussed. There is ambiguity on current specification. QC: Agree with initial assessment. |
| MB.3 | Alignment of RRC parameter name: enableDefaultBeamForCCS 🡪 enableDefaultBeamForCCS-r16 | CATT | E | LG: ok, prefer to be handled by EditorZTE: If our understanding is correct, the suffix ‘-r16’ has been removed for most of Rel-16 RRC parameters in the latest TS 38.214 for simplifying the presentation, unless that there is some ambiguities between Rel-15 current one and Rel-16 introduced one. If so, this update seems to be unnecessary.vivo: In TS38.331 “*CrossCarrierSchdulingConfig*” field descriptions, the name is also “*enableDefaultBeamForCCS*”.QC: Agree with initial assessment. |
| MB.4 | QCL assumption for CSI-RS/CSI-IM for L1-SINR measurement when it is not provided (R1-2100115, proposal 1)FL: This was discussed in pre-phase in last meeting | OPPO | N  | LG: agree with FL’s initial assessmentQC: Agree with initial assessment. |
| MB.5 | Clarify whether SSB can be configured for BFD (R1-2100115, proposal 2)FL: This was discussed in pre-phase in last meeting | OPPO | N  | LG: agree with FL’s initial assessmentZTE: If our understanding is correct, this TP also has impacts on PCell BFR. Therefore, if discussed, Rel-15 maintenance is preferred.QC: Agree with initial assessment. |
| MB.6 | BFD RS related RRC parameter name correction for *failureDetectionResourcesToAddModList* (R1-2100279, proposal 1) | ZTE | E | LG: ok, prefer to be handled by EditorQC: Agree with initial assessment. |
| MB.7 | Clarify the candidate cells to determine the minimal SCS for 28 symbols for BFR (R1-2100279, proposal 2) | ZTE | H | LG: we think that this issue is not of high priority.because current text may have no issue because ‘**the** at least one SCell’ would mean the SCell(s) in beam failure. QC: This may not be needed. Our understanding is that current spec means interpretation 1 in proposal 2 of R1-2100279. |
| MB.8 | Reset CORESEPoolIndex=0 for all CORESETs for mDCI mode after BFR (R1-2100279, proposal 3) | ZTE | H | LG: not essential. BFR with two CORESET pools is not of typical assumption for Rel-16 and is now being studied for Rel-17. Even if two CORESET pools are configured with Rel-16 BFR, it is unclear what cannot be handled by gNB implementation, e.g. use one CORESET pool/TRP for a while to communicate with the UE after beam failure.QC: Not essential. Agree with LG. |
| MB.9 | Remove bracket [and/] to be aligned with agreements in last RAN1 meeting that NZP+ZP IMR based L1-SINR is not supported (R1-2100339, proposal 1) | CATT | E | LG: ok, prefer to be handled by Editorvivo: supportQC: Agree with initial assessment. |
| MB.10 | Clarify that one of the conditions to apply q\_new to PUCCH after BFR should be that UE identified a q\_new (R1-2101272) | Huawei/HiSilicon | E | LG: supportvivo: supportQC: Agree with initial assessment. |
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| MT.1  | The issue of closed loop index vs out-of-order operation in mTRP:* OPPO (R1-2100113) proposed to specify a default closed loop index for CORESETPoolIndex = 1 for out-of-order operation.
* ZTE (R1-2100281) also made proposal on closed loop index for UE supporting out-of-order operation
* Huawei/HiSi (R1-2101256) proposed to capture the note on out-of-order operation vs closed loop index made during UE capability discussion.
 | OPPO, ZTE, Huawei/HiSi | H | LG: It was supposed to be discussed in RAN 1 maintenance due to limited time in UE feature session. We agree with FL’s assessment.ZTE: This issue is very important to be solved. Otherwise, MDCI based MTRP cannot work in FR1 because close loop index is always 0 in some typical cases as discussed in our tdoc.Vivo: fine to discuss.QC: Given the note was added in UE feature, we think it is better for this issue to be handled there.  |
| MT.2 | The issue of UL signal overlapping with two HARQ-ACK PUCCHs associated with different TRPs:* OPPO (R1-2100114) proposed TP to specify that the UE does not expect that two PUCCH/PUSCH triggered by two different TRP will overlap with one same uplink signal at the same time
* vivo(R1-2100417) proposed TP to specify that PUCCH of CSI/SR/LRR does not overlap with two HARQ-ACK PUCCHs.

FL: was discussed in pre-phase in previous meeting | OPPO, vivo | N  | LG: Agree with FL’s assessmentVivo: Current spec doesn’t have any restriction on this overlapping case. However, it may happen in M-DCI-based MTRP with separate HARQ-ACK feedback. According to current spec, the UE would apply the dropping or multiplexing rule defined for Rel-15/16 single TRP and may transmit the HARQ-ACK to the wrong TRPApple: We are fine to discuss this issue which has been raised multiple times if scope permitsQC: Agree with FL’s assessment |
| MT.3 | The issue of active BWP operation in M-DCI based mTRP:* Lenovo/MOT (R1-2100298) proposed that If a UE detects two DCIs indicating a same active DL BWP change in a same slot, the UE is not required to receive or transmit in the cell during a time duration from the end of the third symbol of a slot where the UE receives the DCI until the beginning of a slot indicated by the smaller slot offset value of the time domain resource assignment fields in the two DCI

FL: was discussed in pre-phase in previous meeting and some companies commented there is no issue in current spec | Lenovo/MOT | N  | LG: Agree with FL’s assessmentvivo: this can be coordinated between TRPs by implementation.QC: Agree with FL’s assessment |
| MT.4 | The issues of QCL collision of different channels/signals:Issue 1: PDCCH and PSDSCH of different TRP:* vivo (R1-2100417) proposed to conclude that PDSCH and PDCCH for different TRP shall not overlap

Issue 2: QCL of PDSCH and SSB on the same symbol:* Apple (R1-2101349) proposed to clarify that in mTRP system, the gNB should ensure at least one DMRS port and SSB are QCLed, Instead of all the DMRS ports. Because one PDSCH could be indicated with two TCI state in mTRP.

Issue 3: PDCCH monitoring priority rule in M-DCI mTRP:* Ericsson (R1-2101690) proposed that for the PDCCH monitoring priority rule based QCL-TypeD in multi-DCI based M-TRP, apply the priority rule within CORESETs with same CORESETPoolIndex for a UE capable of two simultaneous QCL-TypeD
* Intel (R1-2100633) proposed to extend PDCCH prioritization based on QCL Type D properties to multi-DCI multi-TRP operation
 | vivo, Apple, Ericsson, Intel | H | LG: Issue 1 and 2 can be discussed. Issue 3 has already been discussed in the last RAN 1 meeting and corresponding TP was not agreed. vivo: agreeQC: Issue 1 is not clear since rate matching and OoO are separate issues (the connection between the two in R1-2100417 is not clear). Issue 2 and 3 can be discussed. |
| MT.5 | The issue of default TCI state for PDSCH in mTRP system:* vivo(R1-2100418) proposed to specify the default TCI state of PDSCH in mTRP for the following scenarios:
	+ When the DCI does not have TCI field in S-DCI based mTRP system
	+ When the DCI indicates only one TCI state in S-DCI based mTRP system
	+ The mapping of default TCI states for PDSCH of scheme 2a/2b
	+ Cross-carrier scheduling
* Samsung (R1-2101182) propose to specify the default TCI state of PDSCH of cross-carrier in S-DCI based mTRP.
* ASUSTeK (R1-2101565) proposed to discuss and clarify the default TCI state of cross carrier scheduling in mTRP systems

FL: was discussed a lot in previous meetings | vivo, Samsung, ASUSTek | N | LG: Agree with FL’s assessmentVivo: propose H. The default QCL of our listed cases need to be specified otherwise the spec is not complete since default QCL of scheme 3/4 and AP-CSI-RS have been captured. |
| MT.6 | The issue of SPS PDSCH transmission in mTRP:* Samsung (R1-2101182) proposed to include the SPS of scheme 4 in the description of Type-1 HARQ-ACK codebook determination and also proposed to specify the method of receiving two overlapped SPS PDSCHs associated with different TRPs in M-DCI mTRP
* Qualcomm (R1-2101441) proposed to clarify that the RV sequence used across multiple repetitions in schemes 2b, 3, and 4 is based on setting rvid=0. Qualcomm (R1-2101441) also proposed TP to specify that Each SPS PDSCH is associated with a CORESETPoolIndex value, and resolving overlap procedures are done within the same CORESETPoolIndex value
* Ericsson (R1-2101688) proposed CR to specify the RV values for DL DPSCH SPS in S-DCI mTRP

FL: was discussed in pre-phase in previous meeting and some companies thought that is it is not essential to rel16 and maybe for later release | Samsung, Qualcomm, Ericsson | N  | LG: SPS transmission in M-DCI based M-TRP should be high priority as SPS PDSCHs overlapped in time cannot be supported even though a UE has capability receiving different PDSCHs at a given time.QC: This issue is essential and should be discussed with high priority. If companies think discussing SPS for both single-DCI and multi-DCI does not fit in one Email thread, we are open to discuss one of them only (the issues for single-DCI seem to be more straightforward).  |
| MT.7 | The issue of radio link monitoring in mTRP:* Apple (R1-2101349) proposed to enhance the method of UE determining RLM RS in M-DCI mTRP system by adding Lmax = 8.

FL: was discussed in pre-phase in previous meeting and some companies thought that is optimization for mTRP | Apple | N  | LG: Agree with FL’s assessmentApple: We would like to clarify that this is different from last proposal. If gNB does not know which RSs are selected for BM, gNB cannot know how to count RLM RS in FG 16-1g/16-1g-1. This is an essential issue. We think this can be moved to MT.12, since it just reuses the same approach as 3 CORESET case.QC: Agree with FL’s assessment |
| MT.8 | HARQ transmission/retransmission in mTRP system:* Apple (R1-2101349) proposed to clarify that in M-DCI system, the UE is not mandated to support receiving PDSCH HARQ re-transmission scheduled by different TRPs.
* Apple (R1-2101349) proposed to reach a conclusion on whether support sub-slot based HARQ-ACK when the UE is configured with M-DCI mTRP.
* Huawei/HiSi (R1-2101256) proposed to clarify that the DCI for initial and re-transmission of PDSCH of the same TB shall be transmitted in PDCCHs with same CORESETPoolIndex.

FL: it seems that has impact on the UEs using CA architecture to implement mTRP | Apple, Huawei/HiSi, ZTE | H  | LG: Agree with FL’s assessmentZTE: We support discussing this issue as the high priority.Vivo: Agree with FL assessment.Apple: Since this has product impact from us, we hope this can be discussed. We are very flexible account the actual solutionQC: We think UE feature may be more suitable to discuss the issue. We are ok to discuss the issue in maintenance as well. In that case, for the first and third bullets (retransmission), the existing behavior (allowing for retransmission across TRPs for reliability use cases) should not be excluded and the solution should be backward compatible. We kindly request to include this point in the scope of discussions if it is decided to discuss this as part of maintenance. |
| MT.9 | The issue of BFR in S-DCI mTRP system:* Qualcomm (R1-2101441) proposed to reset the mapping of all TCI codepoints of PDSCH to qnew after BFR in S-DCI based mTRP system.

FL: fallback QCL of PDSCH in BFR was discussed extensively in MB session in both rel15/16 | Qualcomm | N | LG: Agree with FL’s assessmentQC: This item is essential in our view. This is related to the new behavior that is introduced in sDCI based mTRP wrt default beams. Hence, Rel. 15/16 discussions in multi-beam are unrelated / irrelevant to this. The note from FL seems to be not based on the proposal in R1-2101441. |
| MT.10 | M-DCI mTRP in NR-DC:* Qualcomm (R1-2101441) proposed to clarify BD/CC limit in the presence of NR-DC in M-DCI based mTRP system

FL: was discussed in pre-phase in previous meeting and comments said that it is not essential issue | Qualcomm | N  | LG: Agree with FL’s assessmentQC: The behavior for multi-DCI and NR-DC is not defined in the current spec. |
| MT.11 | Support out-of-order operation within a slot:* CATT (R1-2100340) proposed to update 38.214 to support out-of-order of PDSCH from different TRPs within a slot: description in current 38.214 only supports out-of-order PDSCH across slot, the TP is given:

FL: was discussed in pre-phase in previous meeting and it looks like an optimization | CATT | N  | LG: Agree with FL’s assessment |
| MT.12 | Editorial change on mTRP (some needs discussion on the necessarity of the change):* ZTE (R1-2100281) proposed to delete “[subject to UE capability]” in 7.3.1.2.2 of 38.211.
* ZTE (R1-2100281) proposed TP to capture missed part of “the 1st PDSCH transmission occasion” of one agreement on scheme 3 and 4 in Section 5.1.5 of 38.214.
* ZTE (R1-2100281) proposed to remove the “when sequenceOffsetforRV is present” from the Caption of Table 5.1.2.1-3 in 38.214 because it is not necessary.
* Vivo(R1-2100417) proposed to add “*If a UE is not provided ackNackFeedbackMode = separate*,..” in Section 9.2.3 of 38.213 to avoid confusion to the readers.
* LGE (R1-2100617) proposed TP for Section 5.1.5 of 38.214 to clarify that if a UE does not support rel16 per-TRP default TCI state, the UE shall apply the default TCI state of rel15 on mTRP PDSCH transmission.
* CATT (R1-2100340) proposed that in Section 5.1.2.1 of 38.214, we shall use a separate table to describe the RVs for PDSCH of scheme 4.
* CATT (R1-2100340) proposed TP to correct a terminology (“transmission occasion”) in Section 5.1.2.1 of 38.214.
* CATT (R1-2100340) proposed to add “,” before “only when” in Section 5.1 in 38.214 to avoid misunderstanding.
* CATT (R1-2100340) proposed to add “*if a UE is not provided ackNackFeedbackMode = separate*,..” in Section 9.2.3 of 38.213 to avoid confusion to the readers.
* Ericsson (R1-2101691) proposed TP for Section 5.1.5 of 38.214 to clarify that it is “and at least one TCI codepoint *activated by the activation command in 6.1.3.24 of [10, TS38.321]*”
* Intel (R1-2100634) proposed CR for Section 5.1.2.3 of 38.214 to clarify that when counting even or odd PRGs in FDMSchemeA or FDMSchemeB, the PRGs are numbered continuously in increasing order with the first PRG index equal to 0.
 | ZTE, vivo, LGE, CATT, Ericsson, Intel | H  | LG: Ok to discussQC: Ok to discuss. |
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| MU.1 | The term $\left⌈\frac{K^{NZ}}{2}\right⌉-υ$ in UCI group 1 can be negativeFL: The issue is present for some configurations that lead to small K^NZ value. The proposal is an optimization and can be avoided by proper codebook configuration | Huawei/HiSi | N | LG: Agree with FL’s assessmentZTE: Agree with FL. Further, K\_NZ should be equal to or larger than rank, which makes the cases with negative $\left⌈\frac{K^{NZ}}{2}\right⌉-υ$ values very few.QC: Agree with FL assessment. It can be avoided by proper codebook configuration. |
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| UL.1 | Clarification relative phase(s) among Tx ports for non-coherent and partial-coherent UEs.FL: It has been discussed in past several meetings | ZTE | N | LG: Agree with FL’s assessment. This issue has been discussed for past several meetings, and failed to reach consensus. ZTE: We believe this issue should be High priority (H), or at least be H2. Although this issue has been raised many times in previous meetings, it has NOT yet been formally discussed. As per our view, it is essential to enhance the clarity of the current specs based on the following considerations.* In current specs, the full-coherent TPMIs are allowed to be indicated to non/partial-coherent UE to implement Mode 1 based UL full Tx power.
	+ From the perspective of gNB, it will assume that the relative phase of the full-coherent TPMIs can be ensured by the non/partial-coherent UE and its maximum Tx power can be 23dBm. Correspondingly, gNB may configure such power control parameters of  (RB number) and  (MCS level) based on the maximum Tx power with 23dBm.
	+ From the perspective of the non/partial-coherent UE, it can NOT ensure the relative phase for the Mode 1 full-coherent TPMIs in practice, which means the actual maximum Tx power is NOT 23dBm.

Therefore, from the perspective of specs, it is essential to keep the alignment between gNB and the non/partial-coherent UE that the relative phase among non-coherent Tx ports is random/uncontrolled. Vivo: Agree with FL’s assessment.Apple: We are fine to discuss this issue which has been raised multiple times if scope permits. This can also clarify the UE behavior.QC: Agree with FL’s assessment. |
| UL.2 | Clarification on TPMI group signaling for mode 2FL: It may require some discussion on 4tx UE reporting 2-port {2-bit bitmap} only | Samsung | H  | LG: Agree with FL’s assessment.ZTE: Ok to discuss for clarification.Vivo: Agree with FL’s assessment.QC: Not essential. This should be demoted.  |
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1. Discussion and proposal

From the inputs shared by participating companies during the preparation phase, the following **observation** can be made:

* The following X issues can be handled as E (a part of editorial CR): ...
* The following Y issues can be designated as H2 (editorial TPs that can be agreed without further email discussion, including capturing previous agreements): ...
* The following Z issues can be designated as H (requiring discussion and additional agreements/conclusions): ...

In light of the above observations, the moderator makes the following **proposals**:

* On E-rated issues (...), prepare draft CRs in Appendix A ...
* On H2-rated issues (...), prepare draft CRs in Appendix B ...
* On H-rated issues (...), continue discussion on 4 threads:
	+ Thread 1 (moderator Jiwon) Maintenance and TPs for Multi-beam 1: ...
	+ Thread 2 (moderator Yushu) Maintenance and TPs for Multi-beam 2: ...
	+ Thread 3 (moderator Li) Maintenance and TPs for Multi-TRP: ...
	+ Thread 4 (moderator Rakesh) Maintenance and TPs for UL Full-Power: ...

# Appendix A: Draft CRs for E-rated issues

Draft CR ....

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# Appendix B: Draft CRs for H2-rated issues

Draft CR

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# References

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| 1 | R1-2100113 | Text proposals for default close loop index for different TRPs | OPPO |
| 2 | R1-2100114 | Text proposals for overlapping between uplink signals | OPPO |
| 3 | R1-2100115 | Text Proposals for Multi-beam Operation Enhancement | OPPO |
| 4 | R1-2100279 | Maintenance of multi-beam operation | ZTE |
| 5 | R1-2100280 | Draft CR on UL full power transmission Mode 1 | ZTE |
| 6 | R1-2100281 | Maintenance of Multi-TRP enhancements | ZTE |
| 7 | R1-2100298 | Maintenance on multi-TRP transmission | Lenovo, Motorola Mobility |
| 8 | R1-2100339 | Corrections to multi-beam operation | CATT |
| 9 | R1-2100340 | On remaining issues of multi-TRP/panel transmission | CATT |
| 10 | R1-2100416 | Maintenance on multi beam related issues | vivo |
| 11 | R1-2100417 | Maintenance on multi TRP | vivo |
| 12 | R1-2100418 | Maintenance on default QCL issues and multi TRP | vivo |
| 13 | R1-2100617 | Draft CR on multi-TRP/panel transmission | LG Electronics |
| 14 | R1-2100633 | Correction for multi TRP PDCCH prioritization | Intel Corporation |
| 15 | R1-2100634 | Draft CR for clarification of scheme 2a/2b | Intel Corporation |
| 16 | R1-2101180 | On maintenance of Rel.16 multi-beam operation | Samsung |
| 17 | R1-2101182 | On Rel.16 multi-TRP/panel transmission | Samsung |
| 18 | R1-2101183 | On UL full power transmission | Samsung |
| 19 | R1-2101256 | Remaining issues for multi-TRP in Rel-16 | Huawei, HiSilicon |
| 20 | R1-2101271 | Corrections on Type II CSI reporting in Rel-16 | Huawei, HiSilicon |
| 21 | R1-2101272 | Corrections on Scell BFR in Rel-16 | Huawei, HiSilicon |
| 22 | R1-2101349 | Remaining issues on Rel-16 Multi-TRP enhancement | Apple |
| 23 | R1-2101441 | Remaining Issues on Multi-TRP Enhancements | Qualcomm Incorporated |
| 24 | R1-2101565 | Interoperation between cross-carrier scheduling and multiple TRPs | ASUSTeK |
| 25 | R1-2101688 | Draft CR on DL SPS based PDSCH repetitions | Ericsson |
| 26 | R1-2101690 | Maintenance for multi-DCI based multi-TRP in Rel-16 | Ericsson |
| 27 | R1-2101691 | Maintenance for single-DCI based multi-TRP in Rel-16 | Ericsson |
| 28 |  |  |  |