**3GPP TSG RAN WG1 #101 R1-2003880**

**e-Meeting, May 25th – June 5th, 2020**

**Agenda item:** 7.2.6.1

**Source:** Moderator (Samsung)

**Title:** Feature lead summary for MU-MIMO CSI

**Document for:** Discussion and Decision

# Introduction

The FL summary of the proposals in the submitted contributions ([1]-[12]) for Rel.16 NR\_eMIMO MU-CSI maintenance is given below and categorized under the following sections:

* *H*igh priority (essential)
* *E*ditorial
* *L*ow priority (non-essential)

Proposals on Rel.16 draft shadow CRs are not summarized here since they are to be discussed as a part of Rel.15 maintenance.

Summary

## High priority (essential)

The following issues pertain to some ambiguity in the current description of the specs and may have some significant impact on spec completeness and/or UE implementation.

In this meeting, no essential issue has been identified.

## Editorial

The following issues pertain to relative simple editorial corrections which are valid and not expected to be contentious. Some textual refinement may be fitting and can be discussed.

Table 2 Editorial

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| --- | --- | --- |
| **Issue #** | **Description/Proposal** | **Companies** |
| E.1: typographical correction (missing dash sign in RRC parameter name) | < Start TP for TS 38.214 V16.1.0>  5.2.2.2.5 Enhanced Type II Codebook  < Unchanged parts are omitted >  The parameter is configured with the higher-layer parameter *numberOfPMI-SubbandsPerCQI-Subband-r16*.  < End TP for TS 38.214 V16.1.0> | Support: Huawei/HiSi, Apple, Nokia/NSB, Samsung, LGE, ZTE |
| E.2: typographical correction (correction on clause #) | < Start TP for TS 38.212 V16.1.0> 6.3.2.1.2 CSI --------------- Unchanged parts omitted -------------  Table 6.3.2.1.2-2A: PMI of *codebookType=* *typeII-PortSelection-r16*  Note: the bitwidth for , and shown in Table 6.3.2.1.2-2A is the total bitwidth of , and up to Rank = , respectively, and the corresponding per layer bitwidths are , , and 4, (i.e., 1, 3, and 4 bits for each respective indicator elements , , and , respectively), where as defined in Clause 5.2.2.2.5 in [6, TS 38.214] is the number of nonzero coefficients for layer such that  < End TP for TS 38.214 V16.1.0> | Support: LGE, Apple, Nokia/NSB, Huawei/HiSi, Samsung, ZTE |
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## Non-essential

The following issues pertain to non-essential proposals with some potential specification impact which are not intended to address incomplete or faulty functions. Therefore, they will not be discussed during the eMeeting.

Table 3 Low-priority (non-essential)

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| **Issue #** | **Proposal(s)** | **Companies** |
| N.1: R=2 for BWP size < 24 PRBs | *Proposal 1: UE is not expected to be configured with R =2 for BWP size less than 24 PRBs.*  FL assessment: unclear if this proposal is relevant at all since there is no support for Rel.16 eTypeII when BWP size < 24 PRBs. | vivo |
| N.2: SCI payload for rank 1 | *Proposal 1: bits are used to indicate the strongest coefficients for RI=1, where*  FL assessment: optimization and requiring change in previous agreement | Support: CATT  Concern: Samsung |
| N.3: Parameter combination | *Proposal 1: For Rel-16 Type II CSI reporting, the minimum number of CSI subbands can be summarized as the following, where the number of CSI subbands is defined as the number of 1’s in csi-ReportingBand.*   * *For parameter setting 1*   + *To support up to rank 2 CSI reporting, the minimum number of CSI subbands is 5*   + *To support up to rank 3 CSI reporting, the minimum number of CSI subbands is 9*   + *To support up to rank 4 CSI reporting, the minimum number of CSI subbands is 13* * *For parameter setting 2*   + *To support up to rank 3 CSI reporting, the minimum number of CSI subbands is 5*   + *To support up to rank 4 CSI reporting, the minimum number of CSI subbands is 5* * *For parameter setting 3*   + *To support up to rank 3 CSI reporting, the minimum number of CSI subbands is 5*   + *To support up to rank 4 CSI reporting, the minimum number of CSI subbands is 5*   FL assessment: optimization | Apple |
| N.4: K0 | *Text Proposal 1. Modify the definition of , by introducing a minimum value, , from one of the following alternatives*  *1a. , to ensure that a UE can report one NZC per polarisation for rank*  *1b. , to ensure that a UE can report one NZC per polarisation for rank*  *2a. , to ensure that a UE can report one NZC for each selected beam for rank*  *2b. , to ensure that a UE can report one NZC for each selected beam for rank for*  FL assessment: optimization and requiring change in previous agreement | Support: Nokia/NSB, Huawei/HiSi (1a and 1b)  Concern: Samsung, ZTE |
| N.5: CBSR | ---------------------------- Start of proposed TP for TS38.214 ----  **5.2.2.2.5 Enhanced Type II Codebook**  --- Unchanged text omitted ---------  The bitmap parameter *n1-n2‑codebookSubsetRestriction-r16* forms the bit sequence and configures the vector group indices as in clause 5.2.2.2.3. Bits indicate the maximum allowed average amplitude, (), with , of the coefficients associated with the vector in group indexed by , where the maximum amplitudes are given in Table 5.2.2.2.5-6 and the average coefficient amplitude is restricted as follows    for , and . is the set of indices of the selected beams that are not associated with any of the sets of group indices g(k) for *k*=0,1,2,3 described in 5.2.2.3. A UE that does not report the parameter *amplitudeSubsetRestriction*='supported' in its capability signaling is not expected to be configured with or .  --- Unchanged text omitted ---------  ----------------------------End of proposed TP for TS38.214 ----  FL assessment: optimization | MotM/Lenovo |
| N.6: size of InS | *Proposal: When , the size of the intermediate set is give by for RI={1,2,3,4}, where is the number of FD bases selected for RI={1,2}.*  FL assessment: optimization | Qualcomm |
| N.7: additional restriction for | *Proposal: : For eType II and eType II port-selection, support if .*  FL assessment: optimization | Qualcomm |

## Preparatory email discussion (04/21-24):

In addition to the captured comments in the above subsections, some additional comments can be summarized below. Some of the comments below are also relevant for the second phase of the eMeeting discussion.

Table 4 Additional comments

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| **Company** | **Comment** |
| Samsung | N.2: non-essential since spec is not broken and the overhead saving is insignificant when compared with the total CSI payload  N.4: addressing a corner case (when small parameter values for N\_SB values, beta etc. are configured) which is a not target use case of R16 eType2. Also, a proper gNB implementation can handle this. |
| Qualcomm | Open to discuss N.2-N.6 if possible (N.1 seems not applicable because we don’t support eType II for BWP < 24).  N.4: the idea is to introduce a minimum value for K0 incase is small. This spirit seems align with our proposal 2 (please see proposal 2 in N.6), in which we introduce a minimum value for when number of subbands is small. So, we kindly suggest move our proposal 2 to N.4   * FL assessment: Proposal 2 (in the original N.6) from Qualcomm does not seem to fall within the category of N.4 although it is related. For now, proposal of N.6 is separated and categorized as N.7 so it stands by its own. |
| ZTE | OK not to discuss N1 - N3 and N5 - N6 since the specification still works without them.  N.4/N.7: we agree for some cases (e.g., small bandwidth) gNB cannot acquire good CSI for them as there is only one coefficient reported, and it's not possible to achieve high-rank transmission even the wireless channel allows.   * However, it's not clear to us whether these are typical cases requiring high data rate transmission. * Further, the proposals from proponents are divergent, so it seems hard to achieve consensus in email on this issue. * N.4 is easier than N.7 as N.7 would let UE to calculate more coefficients for these corner cases. |
| LGE | For any of the non-essential issues, prefer not to discuss them unless a majority is formed |
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FL proposal for phase-2 discussion

Based on the above summary and inputs from the participants, two -threads (discussion topics) will be started during the official discussion week of the RAN1#101-e eMeeting.

1. Thread #1: Agree and finalize on the TP proposed for E.1
2. Thread #2: Agree and finalize on the TP proposed for E.2

# References

1. R1-2003396 On remaining issues on MU CSI vivo
2. R1-2003468 Maintenance of CSI enhancement for MU-MIMO ZTE
3. R1-2003530 Remaining issues on MU-CSI in R16 Huawei, HiSilicon
4. R1-2003626 Remaining issues on CSI enhancement for MU-MIMO CATT
5. R1-2003879 On maintenance of Rel.16 MU CSI enhancements Samsung
6. R1-2003927 TP on enhanced Type II port selection codebook LG Electronics
7. R1-2004228 Remaining issues for Rel-16 Type II CSI enhancement Apple
8. R1-2004264 Maintenance on Rel-16 CSI enhancements Nokia, Nokia Shanghai Bell
9. R1-2004372 Maintenance on MU-CSI Enhancements Motorola Mobility, Lenovo
10. R1-2004462 Remaining issues on MU-CSI enhancement Qualcomm Incorporated
11. R1-2004527 Discussion on MU CSI Ericsson