**3GPP TSG RAN WG1 #121 R1-250xxxx**

**St Julian, Malta, May 19th – 23rd, 2025**

**Agenda item:** 9.2.2

**Source:** Moderator (Samsung)

**Title:** Moderator Summary on Offline Session for Rel-19 CSI enhancements

**Document for:** Discussion and Decision

## Introduction

The following proposals were discussed.

## Summary of proposals

### Issue 1 (WID objective 2a and 2b): Type-I and Type-II codebook refinement for up to 128 CSI-RS ports

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| 1.3 | **Proposal 1.C**: For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports mode-B, support following TP to accurately referring spatial domain basis vector selection.  5.2.2.2.1a Refined Type I Single-Panel Codebook  <Unchanged part omitted>  The index is given by  where for and for . The mapping of and to and for is obtained as in Clause 5.2.2.2.3 by replacing with and replacing with , where the values of are given in Table 5.2.2.2.5-4 and Table 5.2.2.2.1a-5, and and for one to one mapping to and for with ,.  The index , for and is given by  and is mapped to . The mapping of index , for and , to , with , is given in Table 5.2.2.2.1a-6. The quantities and for *typeI-codebookMode-r19* = 'modeB' are the same as defined above for 'modeA'.  <Unchanged part omitted>  **Support/fine:** NEC, Google, Samsung, OPPO, NTT DOCOMO, Spreadtrum, Fujitsu, vivo, ETRI, Ericsson, Lenovo, Apple, ZTE/Sanechips, CATT, Xiaomi, Qualcomm,  **Not support (obvious):** Nokia**,**  **FL assessment**: This TP seems to be correct and clearer than the current text. Whether this is needed or not can be discussed.  **The TP can be found in Section 3.3** | 5.2.2.2.1a Refined Type I Single-Panel Codebook  <Unchanged part omitted>  The index is given by  where for and for . The selection of and for is obtained as in Clause 5.2.2.2.3, where the values of are given in Table 5.2.2.2.5-4 and Table 5.2.2.2.1a-5.  The index , for and is given by  and is mapped to . The mapping of index , for and , to , with , is given in Table 5.2.2.2.1a-6. The quantities and for *typeI-codebookMode-r19* = 'modeB' are the same as defined above for 'modeA'.  <Unchanged part omitted> |

Proposal 1.G

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| **Reason for change**: In RAN1 #118bis meeting [1], SRS port grouping has been agreed for periodic, semi-persistent and aperiodic SRS resource sets. The SRS ports indexing for P/SP SRS resource set and AP SRS resource set are different following the agreement. For P/SP SRS, the 6/8R ports consists of ports within a set, while for AP SRS, the 6/8R ports can consist of ports across multiple sets.  While the current description in TS38.214 seems sufficient, the proposed TP can improve the clarity. |
| **Summary of the change**: Separated description in TS38.214 for aperiodic from periodic and semi-persistent SRS |
| **Consequences if not approved**: Potential lack of clarity in description in TS38.214 |
| < Start of the text proposal > 5.2.2.5.1 UE assumptions for CQI/PMI/RI calculation *--- unchanged text omitted ---*  - For a UE configured with one or more SRS resource sets with higher layer parameter *usage* set to 'antennaSwitching' and higher layer parameter *resourceType* set to 'periodic' or 'semi-persistent', with a total of or 8 ports across the resources in a set intended for xT6R or xT8R, respectively, if the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to 'cri-RI-CQI' and the UE is configured with the higher layer parameter *SRSPortGrouping-r19*, the UE can assume that SRS port group 0 corresponds to codeword 0 and comprises the even ports, and that SRS port group 1 corresponds to codeword 1 and comprises the odd ports out of the total ports. The SRS ports are indexed in an ascending order according to SRS resource ID and port number within each SRS resource.  - For a UE configured with one or more SRS resource sets with higher layer parameter *usage* set to 'antennaSwitching' and higher layer parameter *resourceType* set to 'aperiodic', with a total of or 8 ports across the resources across the resource set(s) intended for xT6R or xT8R, respectively, if the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to 'cri-RI-CQI' and the UE is configured with the higher layer parameter *SRSPortGrouping-r19*, the UE can assume that SRS port group 0 corresponds to codeword 0 and comprises the even ports, and that SRS port group 1 corresponds to codeword 1 and comprises the odd ports out of the total ports. The SRS ports are indexed in an ascending order according to SRS resource set ID, SRS resource ID and port number within each SRS resource.  *--- unchanged text omitted ---*  < End of the text proposal > |

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| 1.4 | **Proposal 1.D**: For Rel-19 Type-II codebook refinement for 48, 64, and 128 CSI-RS ports based on the Rel-18 Type-II Doppler codebook, a UE shall assume that CSI-RS ports mapped to the same port index across the K aperiodic CSI-RS resources, , as described in Clause 7.4.1.5.3 of [4, TS 38.211], share the same antenna port.  **FL assessment**: This proposal has been discussed since RAN1#121. The proposal is reformulated based on vivo’s latest Tdoc [5]  The proposal is technically sound. It was argued by vivo that for “KDOPP = {4, 8, 12} CSI-RS resource groups are introduced for Type-II Doppler CSI. This means that within a CMR group, there may be multiple CSI-RS ports with the same CSI-RS port index mapped to different antenna ports.” | **Support/fine:** vivo, Apple, CATT, Xiaomi, NEC,  **Not support** (NW implementation)**:** Google, Samsung, OPPO, NTT DOCOMO, Spreadtrum, Fujitsu, ETRI, Ericsson, Lenovo, ZTE/Sanechips, |

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| 1.6 | **[117] Agreement**  For the Rel-19 Type-II codebook refinement for 48, 64, and 128 CSI-RS ports, on CBSR,   * -bit group-based CBSR * the following (X1, X2) values are supported:  |  |  |  | | --- | --- | --- | | **P** | **(N1, N2)** | **(X1, X2)** | | 48 | (8,3) | (1,1), (2,1), (4,1) | | (6,4) | (1,1), (2,1), (2,2), | | 64 | (16,2) | (1,1), (2,1), (2,2), (4,1), (4,2) | | (8,4) | (1,1), (2,1), (2,2), (4,1), (4,2) | | 128 | (16,4) | (1,1), (2,1), (2,2), (4,1), (4,2) | | (8,8) | (1,1), (2,1), (2,2), (4,1), (4,2) |   **Proposal 1.F**: For the Rel-19 Type-II codebook refinement for 48, 64, and 128 CSI-RS ports, on CBSR, clarify that the -bit group-based bitmap is identical for all the groups  **FL assessment**: This proposal is technically sound. Although the proposal is aligned with the understanding of the FL (and should be to other 😊), it doesn’t hurt to clarify to avoid ambiguity, | **Support/fine:** Fraunhofer IIS/HHI, Samsung, Spreadtrum, Fujitsu, vivo, Ericsson, Lenovo, Apple, CATT, Xiaomi, NEC,  **Not support:** NTT DOCOMO, Google, ETRI, ZTE/Sanechips, Huawei/HiSi, |

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| 1.2 | **[120bis] Conclusion**  For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, when the Rel-18 SD NES Type-I is configured for the Rel-19 Type-I SP codebook, the *powerOffset* parameter **can be configured** in all the respective subConfiguration IEs   * The supported values for *powerOffset* follow the legacy specification   **Proposal 1.B**: For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, when the Rel-18 SD NES Type-I is configured for the Rel-19 Type-I SP codebook with the *powerOffset* parameter configured in all the respective subConfiguration IEs, the soft scaling (if configured) is calculated based on *powerControlOffset* (in linear scale) of the respective CSI-RS resource and *powerOffset* (in linear scale) in the respective sub-configuration  **FL assessment**: For this proposal to be valid, a UE must be configured with Rel-19 Type-I SP, SD+PD NES, and soft scaling.   * But the use of soft scaling together with SD+PD NES has not yet been agreed, at least explicitly. * Even if it were not precluded, this would seem to fall into optimization rather than an essential change.   More discussion on the combination is needed. | **Support/fine:** Google, Fujitsu (open), Lenovo, ZTE/Sanechips,  **Not support:** Samsung, OPPO, NTT DOCOMO (discuss combo first), Spreadtrum, vivo, ETRI, Ericsson, Apple, CATT, Xiaomi (discuss combo first), Qualcomm, Nokia, |

### Issue 2 (WID objective 2c): CRI-based CSI for hybrid beamforming (HBF)

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| 2.1 | Proposal 2.A: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports,   * If higher layer parameter *mrSelectedResources* is not configured for the CSI report, support to associate the NZP CSI-RS resource for interference measurement with the NZP CSI-RS resource for channel measurement with smallest CRI; * Else, support to associate the NZP CSI-RS resource for interference measurement with the first configured NZP CSI-RS resource for channel measurement among the non-reported MR CRIs.   FL assessment: For the KS NZP CSI-RS resources for CM, only 1 NZP CSI-RS resource for IM can be configured (regardless whether MR is configured or not). The proposal introduces an association rule where the single NZP CSI-RS resource for IM corresponds to the “first” NZP CSI-RS resource for CM.  It is unclear if this association is needed since NZP CSI-RS resource for IM is typically used for interference emulation.    **It seems proposal 2.A is not agreeable. To conclude this issue, either one of the three alternatives can be agreed:**   * **Alt1. Conclude that when one NZP CSI-RS for IM is configured, it is associated with all the KS CMRs** * **Alt2. Conclude that when one NZP CSI-RS for IM is configured, the association between the one NZP CSI-RS for IM to KS CMRs is left to NW implementation** * **Alt3. No conclusion needed** | **Support/fine:** Huawei/HiSi, Google (ok), NTT DOCOMO,  Not support: Samsung, OPPO, Spreadtrum, Fujitsu, vivo, ETRI, Ericsson, Lenovo, Apple, ZTE/Sanechips, CATT (may need clarification), Xiaomi (already agreed to reuse legacy), Qualcomm, |

### Issue 3 (WID objective 3): CJT calibration reporting for non-ideal synchronization and backhaul

Proposal 3.A

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| **Reason for change**: It was agreed that CJTC Dd report can be linked with Rel-18 Type-II CJT, which implies that the CQI/PMI calculation for Rel-18 Type-II CJT can be configured to assume a previously reported CJTC Dd report. Analogous to Rel-19 Type-II CJT mode-1, this can be reflected in the CQI/PMI calculation equation.  However, the current description in TS38.214 already captures the necessary behaviour albeit without equation. |
| **Summary of the change**: Added the equation for CQI/PMI calculation when CJTC Dd report is linked with Rel-18 Type-II CJT |
| **Consequences if not approved**: Possible lack of clarity in UE behaviour when CJTC Dd report is linked with Rel-18 Type-II CJT |
| 5.2.2.5.1b UE assumptions for CQI/PMI/RI calculation for CJT  If the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to 'cri-RI-PMI-CQI', the higher layer parameter *codebookType* is set to 'typeII-CJT-r18' or ' typeII-CJT-PortSelection-r18', and the corresponding CSI-RS Resource Set for channel measurement is configured with CSI-RS resources, for CQI calculation  - a UE should assume PDSCH signals on antenna ports in the set for layers would result in signals equivalent to corresponding symbols transmitted on antenna ports of each of the *N*0 selected CSI-RS resources, as given by    where is the precoding matrix corresponding to the procedure described in Clause 5.2.2.2.8 and 5.2.2.2.9 for *codebookType* set to 'typeII-CJT-r18' and ' typeII-CJT-PortSelection-r18', respectively, and are the indices of the *N*0 selected CSI-RS resources in increasing order, such that . A UE should assume that the signals , , fully overlap in time and frequency.  - if the CSI reports with *reportQuantity* set to 'cri-RI-PMI-CQI' and *codebookType* set to 'typeII-CJT-r18' is linked to a CSI report with *reportQuantity* set to 'cjtc-Dd' by the higher layer parameter *linkedCJTCReport*, and the two CSI reports are jointly triggered, or separately triggered and the compensation is enabled by the higher layer parameter *delayOffsetCompensation,* a UE should assume PDSCH signals on antenna ports in the set for layers would result in signals equivalent to corresponding symbols transmitted on antenna ports of each of the *N*0 selected CSI-RS resources, as given by    where is the precoding matrix corresponding to the procedure described in Clause 5.2.2.2.8 and 5.2.2.2.9 for *codebookType* set to 'typeII-CJT-r18', and are the indices of the *N*0 selected CSI-RS resources in increasing order, such that , is the subcarrier index and is the reference subcarrier index, is the subcarrier spacing and is within the interval in which the delay offset, is reported by the UE. A UE should assume that the signals , , fully overlap in time and frequency. |

# References