**3GPP TSG RAN WG1 #119 R1-2409588**

**Orlando, US, November 18th – 22nd, 2024**

**Agenda item:** 9.2.2

**Source:** Moderator (Samsung)

**Title:** Moderator Summary on Rel-19 CSI enhancements

**Document for:** Discussion and Decision

## Introduction

The scope given in the Rel-19 NR MIMO Phase 5 WID pertaining to CSI enhancement is as follows (2d added in [1]):

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| 1. Specify CSI support for up to 128 CSI-RS ports, targeting FR1    1. Type-I codebook refinement supporting up to a total of 128 CSI-RS ports across all resources, assuming legacy CSI-RS resources (with up to 32 CSI-RS ports per resource), based on extension of legacy codebooks    2. Type-II codebook refinement supporting up to a total of 128 CSI-RS ports across all resources, assuming legacy CSI-RS resources (with up to 32 CSI-RS ports per resource), based on extension of legacy codebooks, **without modifying any codebook parameter other than** introducing additional values for the number of ports codebook parameter(s)    3. Extension of CRI(s)-based CSI reporting (CQI/PMI/RI calculated per CRI for ≥1 CRIs) for hybrid beamforming supporting up to a total of 128 CSI-RS ports across all resources, with up to 32 CSI-RS ports per resource, without new codebook design    4. SRS port grouping and its association to the two codewords for the 6/8Rx low complexity receiver supporting more than 4 layers, with legacy codebook       * No enhancement on codeword-to-layer mapping, DL resource allocation, CSI feedback, and DCI format       * Note: Whether to support 6Rx with more than 4 layers is to be decided in RAN4 Rel-19 RF enhancements WI 2. Specify UE reporting enhancement for CJT deployments under non-ideal synchronization and backhaul, targeting FR1, both FDD and TDD 3. Inter-TRP time misalignment and frequency/phase offset measurement and reporting, assuming legacy CSI-RS design, with stand-alone aperiodic reporting on PUSCH |

## Summary of companies’ proposals and views

***Ground rules in sharing your inputs:***

* **Please do NOT input anything in Tables 1A, 2A, and 3A**
  + **Including company names - appreciate your trying to save me some work, but …**
  + **For some reason, most likely due to poor MS Word inter-platform/version compatibility support (if any), the formatting of the FL proposals will change (for the worse) if you do so. This has happened several times in Athens and Changsha ☹**
* **Please input your comments ONLY in Tables 1C, 2C, and 3C, thanks! 😊**

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

Table 1A Summary: issue 1

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| **#** | **Issue/proposal** | **Companies’ views** |
| 1.1 | **[117] Agreement**  For the Rel-19 Type-I codebook refinement for 48, 64, and 128 CSI-RS ports, for RI=v=1, support the following:   * for each group of SD basis vectors, a 3-bit scaling factor can be NW-configured via higher-layer (RRC) signalling, where the scaling factors are defined as scalings on the power control offset configured for the associated CSI-RS resources   + The values of and for this feature are separately configured from those for CBSR   + Separate configuration (RRC signalling) from CBSR   + The candidate values of and are the same as those agreed for CBSR * The codepoints of each of the group-specific 3-bit scaling factors are mapped to values of   …  **[118bis] Agreement**  For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, regarding the support for the 3-bit scaling factor(s) for RI=*v* >1, support only for RI=*v*=2 without per-SD-basis-vector/layer power adjustment/boosting   * FFS: Details on per-layer scaling factor applied to each of the selected SD basis vectors, extending the agreed scaling factor for RI= *v* =1 (in RAN1#117)   This feature is a separate UE capability from soft scaling for RI=*v*=1. Introduce new RRC parameter to enable the feature.  …  For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, regarding per-layer scaling factor applied to each of the selected SD basis vectors associated with RI=*v* {2} for the 3-bit scaling factor(s), decide, by RAN1#119, from the following alternatives:   * Alt1: * Alt2: * Alt3: * Alt4: * Alt5: * Alt6: * Alt7:   + if two different vectors for , for the vector with smaller scaling factor , and for the other vector configured with larger scaling factor ;   + otherwise ( or one same vector for ), for the vector   Where ri denotes the number of layers associated with the i-th SD basis vector.  The same scheme applies to both Mode-A and Mode-B.  Note: as agreed in RAN1#117.  Normalization of precoder should be taken into account in the final specification design.  **Proposal 1.A.1:** For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, regarding per-layer scaling factor applied to each of the selected SD basis vectors associated with RI=*v=*2 for the 3-bit scaling factor(s):   * Reuse the scaling formula for RI=*v*=1, i.e.   + Reuse legacy precoder normalization (per discretion of the spec editor)   + FFS: Whether additional operations such as min(.) and/or additional normalization are needed * Regarding the configuration of the value (3-bit indicator per SD basis vector group), decide, by RAN1#119, between the following:   + Alt1. RI=1 and RI=2 are separately configured (RI-specific)   + Alt2. A same configuration is used for RI=1 and RI=2 (RI-common)   **FL assessment**: This was discussed OFFLINE [1]. **Only one set of simulation results is presented by Ericsson, justifying proposal 1.A.1 against “AltB”.**  Si value configuration   * **Alt1. RI-specific**: vivo, New H3C, Samsung (ok), NEC, OPPO, Lenovo/MotM, Ericsson (ok), Google, CMCC, * **Alt2. RI-common**: ZTE, Huawei/HiSi, Samsung, Ericsson, Apple, Xiaomi, Qualcomm, NTT DOCOMO, NTT CORP, Intel, MediaTek, Tejas, Sharp, Nokia/NSB, Fraunhofer IIS/HHI, IDC, | **Support/fine:** Ericsson, vivo, NewH3C, Samsung,(ok), ZTE (ok), CATT,NTT DOCOMO, NTT CORP,Intel, TCL, Fujitsu, NEC, MediaTek, Tejas, OPPO (ok), Sharp, CMCC, Lenovo/MotM (with RI-specific), Qualcomm (only when b0=b1)  **Not support (AltB):** Huawei/HiSi (with v scaling and min), Xiaomi (with v scaling), Fraunhofer IIS/HHI, IDC, Goggle, Nokia/NSB, Apple |
| 1.2 | **Proposal 1.B**: For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, extend the agreed Scheme-A and Scheme-B to 16, 24, and 32 CSI-RS ports, for all applicable RI values with K=1 only, and without any further modification/enhancement of the sub-features pertinent to the Rel-19 Type-I SP design (including, e.g. the Rel-19 Type-I SP CBSR, soft scaling, 2nd SD basis vector for Scheme-A RI=3-4).   * For the Rel-19 Type-I SP codebook, the support for 16, 24, and 32ports are 3 separate UE capabilities from the support for the previously agreed number of ports (48, 64, 128 ports) * The Rel-18 SD NES schemes applicable to Rel-15 Type-I SP codebooks are also applicable to the extension of the Rel-19 Type-I SP codebook to 16, 24, and 32 ports   **FL assessment**: This was discussed OFFLINE [1]. | **Support/fine (A+B):** ZTE, IDC, Samsung, Xiaomi, Nokia/NSB, NEC, Fujitsu, NTT DOCOMO, NTT CORP, Spreadtrum, UNISOC, CMCC, MediaTek, Ericsson, Apple, Google, IDC, Tejas, Sharp, Orange, Lenovo/MotM (ok, low priority), Huawei/HiSi (ok with RI=3-4 only), CATT (ok with SchemeB, not ok with Scheme-A), Intel (ok with SchemeB, not ok with Scheme-A),  **Not support:** OPPO,HONOR, TCL, Fraunhofer IIS/HHI, vivo, Xiaomi, |
| 1.3 | **Proposal 1.C**: For the Rel-19 Type-I SP codebook refinement for P=48, 64, 128 CSI-RS ports, when sub-band SP-CSI for Scheme-B is configured to be reported on PUCCH format 4:   * a UE is not expected to be configured with the smaller sub-band size between the two configurable sub-band sizes for a given BWP; and * the UCI for the co-phase selection is restricted from 2-bit (QPSK) to 1-bit (BPSK)   **FL assessment**: This proposal ensures that the payload for Scheme-B doesn’t exceed 104 bits (max is 115 bits including CRC) when reported on PUCCH format 4. While there are other fancier schemes, this seems simple enough. | **Support/fine:** Samsung,  **Not support:** |
| 1.4. | **Proposal 1.D**: For the Rel-19 Type-I SP codebook refinement for P=48, 64, 128 CSI-RS ports, regarding Scheme-B, when the UE is configured to report wideband CSI on PUCCH:   * For PUCCH format 2, one-part CSI is used * For PUCCH formats 3 and 4, two-part CSI is used where SD basis selection is reported in CSI-part2   **FL assessment**: This proposal is scheme-B optimization for WB PUCCH reporting. Whether a two-part CSI is needed or not can be discussed, e.g. whether the difference in payload across RIs is enough to justify the use of two-part CSI on PUCCH F3/4 especially for WB. | **Support/fine:** Qualcomm,  **Not support:** |
| 1.5 | **Proposal 1.E**: For the Rel-19 Type-I SP codebook refinement for P=48, 64, 128 CSI-RS ports, regarding Scheme-B, when the UE is configured to report the CSI on PUCCH, the number of PRBs for PUCCH resource and/or the number of Part 2 CSI reports are determined based on the RI value that results in the largest UCI payload.  **FL assessment**: This proposal seems needed for PUCCH resource determination. | **Support/fine**: Huawei/HiSi, vivo, NTT DOCOMO, NTT CORP, [Qualcomm],  **Not support**: |
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Table 1B SLS results: issue 1

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| **Company** | **SLS results** | | |
| **Issue #** | **Metric** | **Observation** |
| ZTE | 1.2 | 5%/95%/avg UPT gain | Performance comparison between Rel-19 Type-I codebook (Scheme-A) and Rel-15 Type-I codebook for RI=3-4  *It is shown in the figure of SLS results above that Rel-19 Type-I codebook (Scheme-A) for rank-3/4 offers a significant UPT gain (i.e., ~21.2% for cell-edge UE, ~3.8% for near-field UE, ~8.1% in average) over Rel-15 SP Type-I codebook for PCSI-RS = 32.* |
| Samsung | 1.2 | Avg UPT gain vs overhead | *It is shown in the figures of SLS results above that Both schemes A and B yield avg UPT gain over the Rel-15 T1 for at least configurations of 32 and 16 ports. Especially, scheme B yields significant UPT gains 8% and 4.5% over both Scheme A and Rel-15 T1 in the legacy number of CSI-RS ports 32 and 16 ports, respectively.* |
| vivo | 1.2 | Cell mean SE | Cell mean SE comparison for different CB schemes  *It is shown in the figure of SLS results above that when rank adaptation up to rank 2 is enabled, Rel-19 Type-I Scheme B yields 1~2% Cell-mean SE gain over Rel-15 Type-I for 8T4R, 16T4R, and 32T4R.* |
| Nokia | 1.2 | Mean UPT gain vs overhead | Mean throughput gain vs mean overhead comparison between Rel-15 Type-I, Scheme-A and Scheme-B for maximum rank 8, with 16 (4x2) and 32 (8x2) ports.  *It is observed from the SLS results above that:* *for 16 ports, Scheme-A shows about 5.6% mean throughput gain over Rel-15 Type-I with about 5 bits increase in mean overhead. Scheme-B shows about 11.5% mean throughput gain over Rel-15 Type-I with about 58 bits increase in mean overhead.* *For 32 ports, Scheme-A shows about 6% mean throughput gain over Rel-15 Type-I with about 10 bits increase in mean overhead. Scheme-B shows about 13% mean throughput gain over Rel-15 Type-I with about 59 bits increase in mean overhead.* |
| Ericsson | 1.1 | Mean UPT gain, 5% UPT gain | Comparison of alternatives A and B for 3-bit scaling factor applied to RI=v=2  *It is observed from the SLS results above that Alt A outperforms Alt B (i.e., Alt B incurs 9% and 26% loss for 50% and 70% RU, respectively).* |
| 1.2 | Mean UPT gain, 5% UPT gain | Comparison between Rel-15 and Rel-19 Type I codebooks for 32 ports for ranks 1-4  *It is observed from the SLS results above that Rel-19 Type I Scheme A (no array splitting) shows around 3% (4%) gain at 50% RU and around 7% (8%) gain at 70% RU when compared to the Rel-15 baseline for mean user throughput (cell edge throughput). Rel-19 Type I Scheme B shows around 7% (12%) gain at 50% RU and around 16% (24%) gain at 70% RU when compared to the Rel-15 baseline for mean user throughput (cell edge throughput).* ***​*** |
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Table 1C Additional inputs: issue 1

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| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 1A** |
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### Issue 2 (WID objective 2c): CRI-based CSI for hybrid beamforming (HBF)

Table 2A Summary: issue 2

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| **#** | **Issue** | **Companies’ views** |
| 2.1 | **[116bis] Agreement**  For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, on the configured KS>1 NZP CSI-RS resources, reuse the legacy CMR and IMR rules for the Rel-15 CRI-based reporting. This includes:   * All the KS NZP CSI-RS resources are associated with a same CSI-RS resource set * …   **Proposal 2.A**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding aperiodic CSI-RS resource configuration, an RRC-configured resource-level slot offset (relative to the resource-set-level slot offset) is supported for aperiodic CSI-RS resource set   * FFS: The number of bits for indicating the resource-level slot offset (relative to the resource-set-level slot offset) for KS resources, including the value(s) of the slot offset * FFS: Whether, in addition, configuring an *available* slot offset for each CSI-RS resource within the aperiodic CSI-RS resource set   + Note: “*Available* slot offset” is analogous to the Rel-17 SRS triggering offset enhancement   **FL assessment**: The proposal is unclear. It was agreed that all the KS resources are associated with a same resource set. In this case, all the restrictions apply including the permitted resource-level slot offset | **Support/fine**: Huawei/HiSi  **Not support**: ZTE, |
| 2.2 | **Proposal 2.B**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding UCI reported in CSI part-1, if resource-specific RI restriction is configured, zero padding bits are introduced in CSI part 1 for each of the (MMR) reported CRIs:   * For a k-th CRI from the (MMR) reported CRIs (where k=1, 2, …, (MMR)), zero padding bits are inserted after RI field for the k-th CRI, where:   + - , where is the size of RI field corresponding to CRI *i*, and is the set of CRIs corresponding to the (KsMR) resources     - is the size of RI field corresponding to the k-th CRI   **FL assessment**: The proposal is needed to ensure that the payload for CSI part 1 stays the same for a given RRC configuration. Resource-specific RI restriction (not supported in legacy) implies that the variation of RI bit-width can vary depending on which CRI(s) are selected. So padding bits are needed (following the legacy method of ensuring constant payload). | **Support/fine**: Samsung,  **Not support**: |
| 2.3 | **Proposal 2.C**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding one-part CSI wideband reporting, if resource-specific RI restriction is configured, the zero padding bits for each of the M reported CRI are determined as follows:   * For a k-th CRI from the M reported CRIs, , where:   + , where *Q* is the set of CRIs corresponding to Ks resources and is the maximum payload size of associated CSI fields for a j-th CRI, and , where is the set of rank values that are allowed to be reported for the j-th CRI;   + ,where is the reported rank for k-th CRI;   + Note: is the size of RI field corresponding to k-th CRI.   + Note: The definition of the operator B(∙) is as legacy (as defined in 38.212).   + Note: the is in the same place as legacy padding bits.   **FL assessment**: The proposal is needed analogous to CSI part 1. | **Support/fine**: Samsung,  **Not support**: |
| 2.4 | **Proposal 2.D**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, if the UCI associated with each of the M CRIs comprises two parts and is multiplexed on PUCCH, the UE determines the PUCCH resource, the number of PRBs for the PUCCH resource, assuming that the CSI associated with each of the M reported CRIs corresponds to [rank 1][rank with highest payload].  **FL assessment**: The proposal (addressing the use of two-part UCI on PUCCH) can benefit from more discussion. It is unclear whether rank-1 is the best assumption for resource determination since it represents the lowest overhead. | **Support/fine**: Samsung,  **Not support**: |
| 2.5 | **Proposal 2.E**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding packing order and priority levels of *NRep* CSI reports with *M* CRIs, the UCI packing order and the consecutive priority levels (higher to lower) are as follows:   * The UCI for the *M* CRIs of the first CSI report * The UCI for the *M* CRIs of the second CSI report * *…* * The UCI for the *M* CRIs of the *NRep*-th CSI report   Note: The UCI packing order and the associated priority level for the UCI for the M CRIs in each report follows the previous agreements.  **FL assessment**: The proposal addresses the priority and packing order when NRep>1 reports. This proposal seems needed for completion. | **Support/fine**: Tejas,  **Not support**: |
| 2.6 | Proposal 2.F: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding UCI omission for the UCI reported in CSI part-2, support the following method for assigning priority levels to multiple CRIs in a single CSI instance.   * For the non-reported *MR* CRIs, priority order (from higher to lower) is assigned based on the RRC configured order of *MR*. * For the reported *M*-*MR* CRIs (or *M* CRIs if *MR* is not configured), priority order (from higher to lower) is assigned based on a beam quality measure like, CRIs’ SINR or CRIs’ RSRP or a combination of resource specific RI and resource specific CQI.   + FFS which beam quality measure.   **FL assessment**: The proposal introduces additional priority rules for the (M-MR) CRIs. Given the previous agreement on priority rules and packing order (along with M CRIs), it is unclear why this additional set of rules is needed. | **Support/fine**: Tejas,  **Not support**: |
| 2.7 | **Proposal 2.G**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports,select between the following priority functions:   * Alt1: * Alt2:   where   * *m =* 0 for non-*M* CRI based CSI reports (legacy CSI reports up to Rel-18), * *m =* 1 for *M* CRI based CSI reports. is the maximum number of CRIs configured for multi-CRI CSI reports not carrying L1-RSRP or L1-SINR   **FL assessment**: The proposal introduces additional priority rule for the (M-MR) CRIs. Whether this is needed or not can be discussed (currently unclear to the moderator). | **Support/fine**: Tejas, [Qualcomm],  **Not support**: |
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Table 2B SLS results: issue 2

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Table 2C Additional inputs: issue 2

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| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 1A** |
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### Issue 3 (WID objective 3): CJT calibration reporting for non-ideal synchronization and backhaul

Table 3A Summary: issue 3

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| **#** | **Issue** | **Companies’ views** |
| 3.1.1 | **[118bis] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with two separate triggers, to indicate *whether or not* the UE should perform delay offset (DO) compensation based on the latest linked CJTC Dd report when calculating the Rel-18 Type-II CJT CSI, introduce a 1-bit indicator per CSI trigger state:   * … * FFS (RAN1#119): Whether the 1-bit indicator applies to all the NTRP CSI-RS resources, or 1-bit indicator per CSI-RS resource * …   **Proposal 3.A.1**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with two separate triggers, to indicate *whether or not* the UE should perform delay offset (DO) compensation based on the latest linked CJTC Dd report when calculating the Rel-18 Type-II CJT CSI, the 1-bit indicator per CSI trigger state applies to all the NTRP configured CSI-RS resources.  **FL assessment**: This was discussed OFFLINE [1]. | **Support/fine**: Ericsson, New H3C, Huawei/HiSi, Samsung, vivo, ZTE, Apple, Lenovo/MotM, NTT DOCOMO, NTT CORP, OPPO, Qualcomm, CATT, Intel, TCL, Xiaomi, Spreadtrum, UNISOC, Fujitsu, NEC, KDDI, MediaTek, Sony, Google, IDC, Sharp, Nokia/NSB, CMCC, HONOR, NICT,  **Not support**: |
| 3.1.2 | **[118bis] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with two separate triggers, to indicate *whether or not* the UE should perform delay offset (DO) compensation based on the latest linked CJTC Dd report when calculating the Rel-18 Type-II CJT CSI, introduce a 1-bit indicator per CSI trigger state:   * … * FFS (RAN1#119): How this applies to a single CSI trigger state associated with >1 CSI reports   **Proposal 3.A.2**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with two separate triggers, to indicate *whether or not* the UE should perform delay offset (DO) compensation based on the latest linked CJTC Dd report when calculating the Rel-18 Type-II CJT CSI, when a single CSI trigger state associated with NR >1 Rel-18 Type-II CJT CSI reports, the 1-bit indicator per CSI trigger state applies to all the NR reports.  **FL assessment**: This was discussed OFFLINE [1]. | **Support:** Ericsson, New H3C, Huawei/HiSi, Samsung, vivo (ok), ZTE,Apple, Lenovo/MotM, NTT DOCOMO, Qualcomm, CATT, Intel, TCL, Xiaomi, Spreadtrum, UNISOC, Fujitsu, NEC, KDDI, MediaTek, Sony, OPPO, IDC, Sharp, IDC, CMCC, Nokia/NSB, NICT,  **Not support (left to NW implementation):** Google, |
| 3.2.1 | **[118bis] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with a joint trigger:   * Reuse the CPU occupation and active resource counting for the Rel-18 eType-II CJT * FFS (RAN1#119): Re timeline, decide whether to reuse or further relax the timeline for the Rel-18 eType-II CJT   **Proposal 3.B.1**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with a joint trigger, the timeline (Z/Z’) is determined as Z/Z’ associated with the Rel-18 eType-II CJT, plus Drelax   * The value of Drelax is a UE capability, taken from {0, drelax}   + FFS: The value of drelax (>0), including whether it depends on SCS * For linking CJTC Dd and Rel-18 eType-II CJT CSI, joint triggering is a separate UE feature group from separate triggering   **FL assessment**: This was discussed OFFLINE [1]. | **Support/fine**: Samsung, vivo, New H3C, Ericsson, Huawei/HiSi, Apple, NTT DOCOMO, NTT CORP, OPPO (ok), Qualcomm, Intel, TCL, Xiaomi, Spreadtrum, UNISOC, Fujitsu, NEC, KDDI, MediaTek, Sony, Sharp, CMCC, ZTE, CATT, Nokia/NSB, NICT, [Google]  **Not support**: |
| 3.2.2 | **Proposal 3.B.2**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with a joint trigger, the CJT CSI report with delay offset (DO) compensation considers only the reference TRS set index and those TRS set indices whose 1-bit inside/outside indicator dn is reported as ‘inside’  **FL assessment**: Since linkage assumes UE-specific PDSCH digital DO pre-compensation akin to Rel-18 Type-II CJT, a proper use case would assume that the selection of NTRP TRPs already removes TRPs that result in dn=’outside’. So the need for this proposal is unclear. | **Support/fine**: MediaTek,  **Not support**: |
| 3.3 | **[118bis] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured, support linking the CMRs in the two CSI Report Settings so that UE knows which CMRs in the two report settings correspond to the same TRP.   * Based on a fixed correspondence between the set of TRS resource set IDs in sequential order and the set of CSI-RS resource IDs in sequential order of configuration in their respective Resource Setting   FFS: linking, when the number of resources configured for CJT CSI is < number of resource sets configured for CJT Dd, in case of separate triggers  **Question 3.C:** For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured, regarding linking the CMRs in the two CSI Report Settings, please share your views, if any, on   * Whether or not, for separate trigger, the UE can assume that the number of CSI-RS resources associated with the Rel-18 eType-II CJT CSI is always the *same* as the number of TRS resource sets associated with the Rel-19 CJTC Dd report   + If not, whether an additional mapping between the CMRs is needed or not   **Yes** **(always same, baseline)**: Apple, CATT, Lenovo/MotM, Samsung, OPPO, Google,  **Not always (need justification)**: Fujitsu,  **FL assessment**: This FFS can be discussed. If there is no resolution, the baseline is that there is no additional mapping needed and hence the number of CSI-RS resources associated with the Rel-18 eType-II CJT CSI is always the same as the number of TRS resource sets associated with the Rel-19 CJTC Dd report. | |
| 3.4 | **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific frequency offset pre-compensation on PDSCH by the NW, *decide*, by RAN1#118, whether to support configuring a UE (via RRC signaling) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported frequency offset (when ReportQuantity is ‘cjtc-F’). And if supported, whether any of the following is additionally supported or not:   * NW indicates the frequency offset value to be compensated for the Rel-18 eType-II CJT CSI report, and/or * The two separately configured reports (i.e. Rel-18 eType-II CJT CSI report and the CJTC frequency offset report) are always jointly triggered and carried on a same PUSCH (hence on a same slot) * The frequency offset value to be compensated is the latest reported fO before the DCI triggering the CJT CSI reporting   FFS: AP-CSI-RS can be configured for the Rel-18 eType-II CJT report  The above only applies when the CMRs do not share common QCL source for Doppler shift indication  **Proposal 3.D.1**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific frequency offset pre-compensation on PDSCH by the NW, support configuring a UE (via RRC signaling) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported frequency offset (when ReportQuantity is ‘cjtc-F’), using the same mechanisms as that for UE-reported delay offset (when ReportQuantity is ‘cjtc-Dd’).   * This implies that all the supported sub-features associated with ReportQuantity = ‘cjtc-Dd’ linked to Rel-18 eType-II CJT CSI are extended to ReportQuantity = ‘cjtc-F’ linked to Rel-18 eType-II CJT CSI   **FL assessment**: The above issue needs some discussion. | **Support/fine**: vivo, Xiaomi, Fujitsu, Sharp, Sony, Samsung, ZTE,  **Not support (NW implementation)**: Huawei/HiSi, MediaTek, CMCC, CATT, Nokia/NSB, Qualcomm, Lenovo/MotM, NTT DOCOMO, NTT CORP, OPPO, |
| 3.5.1 | **Proposal 3.E.1**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with two separate triggers, introduce a UE capability for the following:   * The UE capability is used to inform the NW on the maximum duration of 2 sec the UE can store the latest CJTC Dd report, measured from the transmission of the linked CJTC Dd report * When the UE does not report this UE capability, it is assumed that the UE can store a CJTC Dd report [indefinitely]   **FL assessment**: Wording is based on the outcome of Monday and Wednesday **OFFLINE** sessions in RAN1#118bis.  This is intended to avoid stale Dd report from being utilized. However, it can be argued that this can be handled via NW implementation. | **Support/fine**: Lenovo/MotM, ZTE, Qualcomm, vivo, OPPO, Xiaomi, Huawei/HiSi, NEC, HONOR, Sharp, KDDI, MediaTek, NTT DOCOMO, NTT CORP, Apple, Google, Spreadtrum, CATT,  **Not support**: Intel, Ericsson, Nokia/NSB, |
| 3.5.2 | **Proposal 3.E.2**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with two separate triggers, when at least one of the NTRP reported delay offset (DO) values in a linked CJTC Dd report is ‘out of range’, the UE does not perform DO compensation on the triggered Rel-18 eType-II CJT CSI associated with TRP(s) that are ‘out of range’  **FL assessment**: Tuesday **OFFLINE** outcome in RAN1#118bis. | **Support/fine**: Huawei/HiSi, Qualcomm, Samsung, Ericsson, Sony, Lenovo/MotM, Xiaomi, NEC, HONOR, OPPO,  **Not support**: Nokia/NSB, vivo, ZTE, Apple, IDC, NTT DOCOMO, NTT CORP, CATT, |
| 3.6 | **[117] Agreement**  For the Rel-19 aperiodic standalone CJT calibration reporting, regarding the applicable type(s) of the configured NTRP NZP CSI-RS resources/resource sets when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset),   * all the ‘CSI-RS for CSI’ resources within each resource set follow the legacy pre-Rel-19 rules of CSI-RS resources associated with a same resource set * all the resources across the NTRP CSI-RS resources/resource sets are configured with the same bandwidth   **Proposal 3.F**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when *ReportQuantity* is *‘cjtc-P’* (DL/UL phase offset), the NTRP P/SP CSI-RS resources are configured within X={1,[2]} slots, without DL/UL switching in between the NTRP resources, where X=1 implies that the NTRP resources are configured within a same slot, and X=2 implies that the NTRP resources are configured within two adjacent slots.  **FL assessment**: This is analogous to legacy CMR behaviours for Rel-17 NCJT and Rel-18 Type-II CJT | **Support/fine**: Qualcomm, OPPO, NTT DOCOMO, NTT CORP, Nokia/NSB, Apple, Huawei/HiSi, [vivo]  **Not support**: Samsung, Ericsson, ZTE, CATT, |
| 3.7.1 | **Proposal 3.G.1:** For the Rel-19 aperiodic standalone CJT calibration reporting, support joint Dd + phase offset (PO) reporting as follows:   * Only wideband (=1) PO is supported * No further optimization of CSI reporting format, e.g. configurability of not reporting {dn} * The UCI parameters are captured in the table below   *When ReportQuantity is ‘cjtc-Dd-P’ (joint Doffset+d and PO)*   |  |  | | --- | --- | | Parameter | Details/description | | nref1 | Reference TRS resource set index for Doffset+d, based on the ordering from RRC configuration:  bits | | nref2 | Reference TRS resource set index for PO, based on the ordering from RRC configuration: bits | | {Dn,offset,  n=0, 1, …, NTRP – 1 n≠nref1} | Delay offset for CSI-RS resource set n:  bits | | {dn,  n=0, 1, …, NTRP – 1, n≠nref1 } | 1-bit inside/outside indicator for CSI-RS resource set n: bits | | {POn ,  n=0, 1, …, NTRP –1, n≠nref2} | Wideband phase offset for CSI-RS resource n:  bits |  * The UCI mapping order is as follows:   + nref1,   + nref2,   + {Dn,offset, n=0, 1, …, NTRP – 1, n≠nref} ordered from the lowest to highest CSI-RS resource set ID,   + {dn, n=0, 1, …, N TRP – 1, n≠nref} ordered from the lowest to highest CSI-RS resource set ID   + {POn, n=0, 1, …, NTRP – 1, n≠nref} ordered from the lowest to highest CSI-RS resource ID,   **FL assessment**: This proposal (from RAN1#118) is an optimization since each can be reported separately. | **Support/fine:** Qualcomm, Sony, Samsung (ok), Google, ZTE, Fujitsu, Sony, Lenovo/MotM, Ericsson (open),  **Not support**: Huawei/HiSi, MediaTek, NTT DOCOMO, NTT CORP, NEC, Intel, Apple, TCL, Huawei/HiSi, Xiaomi, IDC, Sharp, KDDI, CMCC, ETRI, OPPO, Apple, vivo, New H3C, Nokia/NSB, Spreadtrum, TCL, |
| 3.7.2 | **Proposal 3.G.2:** For the Rel-19 aperiodic standalone CJT calibration reporting, support reporting, as a new ReportQuantity in one CSI reporting instance and one CSI Reporting Setting, L1-RSRPs associated with the configured NTRP CSI-RS resources and the following CJT calibration report type:   * ReportQuantity is ‘cjtc-Dd’ (delay offset), ~~or~~ * ~~ReportQuantity is ‘cjtc-F’ (frequency offset), or~~ * ~~ReportQuantity is ‘cjtc-Dd-F’ (delay+frequency offset), or~~ * ~~ReportQuantity is ‘cjtc-P’ (DL/UL phase offset)~~   Regarding the L1-RSRP:   * The legacy L1-RSRP is fully reused, where the L1-RSRP associated with nref is the reference for the other (NTRP-1) differential L1-RSRP(s)   + The NTRP CRI(s) are not reported * ~~FFS: Whether this is supported via a new ReportQuantity or a joint CSI request/triggering~~   **FL assessment**: This proposal (from RAN1#118) is an optimization primarily for TRP selection (which utilizes both RSRP and CJTC report).  As a possible compromise, the proposal is limited to Dd only to add NW to select TRP with only one CSI Report Setting.  @Those not supporting or against: please check if this helps 😊 | **Support/fine:** NEC, NTT DOCOMO, NTT CORP, Lenovo/MotM, Samsung (ok), Sony (open),  **Not support**: ZTE, Xiaomi, Fujitsu, Ericsson, Apple, Huawei/HiSi, OPPO, TCL, ETRI, New H3C, Google, Nokia/NSB, vivo, Sharp, Intel, KDDI, Spreadtrum, TCL, |
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Table 3B LLS/SLS results: issue 3

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| **Company** | **SLS results** | | |
| **Issue #** | **Metric** | **Observation** |
| ZTE | 3.4 | Cell-edge and average UPT gains | SLS throughput results for non-compensated CJT and UE-specific DO/FO pre-compensated CJT  *It is observed in the figure of SLS results that, UE-specific FO pre-compensation CJT (130.26% performance for cell-edge UE, 107.77% performance in average) outperforms non-pre-compensated CJT (100% performance for cell-edge UE, 100% performance in average) and DO pre-compensated CJT (127.18% performance for cell-edge UE, 106.61% performance in average), and both DO and FO pre-compensated CJT provides the best performance (156.41% performance for cell-edge UE, 117.81% performance in average).* |
| Qualcomm | 3.7.1 | Relative UPT gain vs DL SNR | A graph of different types of data  Description automatically generated with medium confidence  Performance comparison between PO+delay/TAE and subband phase with MRT-precoded CSI-RSs (left figure) and non-MRT-precoded CSI-RSs (right figure)  *From the SLS results, the following observations can be made:*   * *For MRT-precoded CSI-RSs, Opt1 (wideband/initial PO + delay/TAE) outperforms Opt2 (subband PO) for the case of all 16 subbands (which is with massive UCI overhead).*   *For non-MRT-precoded CSI-RS), the benefit of Opt1 (wideband/initial PO + delay/TAE) over Opt2 (subband PO) is reduced.* |
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Table 3C Additional inputs: issue 3

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| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 3A** |
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# References

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| --- | --- | --- | --- |
| 1 | RP-242394 | Revised WID: NR MIMO Phase 5 | Samsung (Moderator) |
| 2 | R1-2409587 | Moderator Summary for OFFLINE discussion on Rel-19 CSI enhancements | Moderator (Samsung) |
| 3 | R1-2409371 | CSI enhancements | MediaTek Inc. |
| 4 | R1-2409378 | Discussion on CSI enhancements | ZTE Corporation, Sanechips |
| 5 | R1-2409428 | On 128 CSI-RS ports and UE reporting enhancement | Huawei, HiSilicon |
| 6 | R1-2409432 | CSI enhancements for Rel. 19 MIMO | Fraunhofer IIS, Fraunhofer HHI |
| 7 | R1-2409460 | Further Details on Rel-19 Enhancements of CSI | InterDigital, Inc. |
| 8 | R1-2409505 | Discussion on CSI enhancements | CMCC |
| 9 | [R1-2409589](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_119/Docs/R1-2409589.zip) | Views on Rel-19 CSI enhancements | Samsung |
| 10 | R1-2409630 | Discussion on CSI enhancements | Spreadtrum, UNISOC |
| 11 | R1-2409674 | Remaining issues on Rel-19 CSI enhancements | vivo |
| 12 | R1-2409747 | CSI enhancements for MIMO | Intel Corporation |
| 13 | R1-2409761 | CSI enhancements | Tejas Networks Limited |
| 14 | R1-2409793 | Views on R19 MIMO CSI enhancement | Apple |
| 15 | R1-2409851 | Discussion on CSI enhancements | NEC |
| 16 | R1-2409889 | Further discussion on Rel-19 MIMO CSI enhancements | Xiaomi |
| 17 | R1-2409934 | Views on NR MIMO CSI enhancements Phase 5 | CATT |
| 18 | R1-2409970 | Discussion on CSI enhancements | Lenovo |
| 19 | R1-2410040 | CSI enhancements | TCL |
| 20 | R1-2410054 | Discussion on Rel-19 CSI enhancements | Fujitsu |
| 21 | R1-2410109 | CSI enhancements for Rel-19 MIMO | OPPO |
| 22 | R1-2410154 | CSI Enhancement for NR MIMO | Google |
| 23 | R1-2410176 | Discussion on CSI enhancements | HONOR |
| 24 | R1-2410220 | Further views on CSI enhancements | Sony |
| 25 | R1-2410303 | Discussion on Open Issues of CSI Enhancement | Rakuten Mobile, Inc |
| 26 | R1-2410316 | CSI enhancement for NR MIMO Phase 5 | Nokia |
| 27 | R1-2410353 | Remaining issues on CSI enhancements for large antenna arrays and CJT | Ericsson |
| 28 | R1-2410382 | Discussion on CSI enhancements | NTT DOCOMO, INC., NTT CORPORATION |
| 29 | R1-2410436 | CSI enhancements | Sharp |
| 30 | R1-2410472 | CSI enhancements for >32 ports and UE-assisted CJT | Qualcomm Incorporated |
| 31 | R1-2410549 | Discussion on CSI enhancements for NR MIMO Phase 5 | KDDI Corporation |
| 32 | R1-2410586 | Discussion on CSI enhancements | NICT |
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