**3GPP TSG RAN WG1 #118bis R1-2408637**

**Hefei, China, October 14th – 18th, 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 | **Proposal 1.A**: For a UE configured with a total of PSRS=6 or 8 ports across ≥1 SRS resources for antenna switching intended for xT6R or xT8R, respectively, support the following fixed SRS port grouping where (with the PSRS ports indexed in an ascending order according to SRS resource ID and port number within each SRS resource):   * SRS port group 0, corresponding to CW0, comprises the even PSRS/2 out of PSRS ports; and * SRS port group 1, corresponding to CW1, comprises the odd PSRS/2 out of PSRS ports   The above feature is applicable only for reportQuantity = ‘cri-RI-CQI’  No other spec enhancement is introduced on new CW-to-layer mapping, DL resource allocation, CSI feedback, and DCI format  Note: The above grouping assumption is to align NW and UE on the association between SRS ports and reported CQIs for the two CWs when reportQuantity = ‘cri-RI-CQI’.  Note: different SRS ports are associated with different UE antenna ports.  Note: if one single CW is scheduled, both SRS port groups can correspond to the same CW, i.e. no enhancement is needed for the single-CW case  Note: This feature is a separate UE capability and, for UEs supporting this capability, configured via RRC (FFS details on the extend of RRC configuration)  Note: Whether to support 6Rx with more than 4 layers is to be decided in RAN4 Rel-19 RF enhancements WI  FFS (by RAN1#118bis): Whether there is impact on mapping between CWs to CSI-RS ports  For SRS antenna switching with multiple aperiodic SRS resource sets, PSRS ports indexed in an ascending order according to SRS resource set ID and SRS resource ID in a set and port number within each SRS resource  **FL assessment**: This was discussed OFFLINE [2] and since RAN1#117.  Please check if the text in brackets is agreeable.  Note on single CW:   * Keep brackets (discuss more): IDC * Remove brackets (agree): All other companies   AP CSI-RS:   * Keep brackets (discuss more): * Remove brackets (agree): Ericsson, Huawei/HiSi, Apple, Samsung, Qualcomm, OPPO, Nokia/NSB, Intel, TCL,   FFS whether there is impact on mapping between CWs to CSI-RS ports:   * Yes: Qualcomm, Tejas, MediaTek, Xiaomi, LG, * No: NTT DOCOMO, Intel, ZTE, * Need to study/further discuss (not ready to say ‘No’): Samsung, CATT, Huawei/HiSi, IDC, Fraunhofer IIS/HHI, CEWiT, Lenovo/MotM, Nokia/NSB, | **Support/fine**: Huawei/HiSi, Samsung, ZTE, Ericsson, Nokia/NSB, Fujitsu, Tejas, Xiaomi, vivo, NTT DOCOMO, NEC, OPPO, TCL, KDDI, Sharp, MediaTek, Google, Apple (ok), New H3C, CATT, HONOR, Spreadtrum, CMCC, Intel (ok), New H3C, Qualcomm, Fraunhofer IIS/HHI, Lenovo/MotM, TCL, CEWiT, IDC (ok, but single-CW FFS),  LG,  **Not support**: |
| 1.2 | **Proposal 1.B**: For the Rel-19 Type-I SP and Type-II codebook refinements (except based on Rel-18 Type-II Doppler) for 48, 64, and 128 CSI-RS ports, active resource counting is:   * For Capability 1 timeline: 1 * For Capability 2 timeline: 1   **FL assessment**: This was discussed OFFLINE [2] and since RAN1#117 – need to conclude  Since Capability 2 is quite (too) relaxed, there is no reason to further relax both OCPU and ARC for Capability 2.  For ARC, since the increase in the total # antenna ports (to up to 128) will be addressed in the ‘triplet’, there doesn’t seem any need to double-book this (mostly relevant to measurement buffering) in ARC (hence 1 should be more fitting, and K is excessive). Hence legacy in FG 2-33 can be interpreted as “Ks=1” (post aggregation) rather than “Ks=K”(pre-aggregation)  **K (UE indicates) only for Cap1:**  **Support/fine:** Apple, Fujitsu, Qualcomm,  **Concern:** Huawei/HiSi, Samsung, Ericsson, CMCC, vivo, | **Support/fine:** Ericsson, Nokia/NSB, ZTE, Fraunhofer IIS/HHI, Intel, TCL, Samsung, vivo, Google, CATT, Qualcomm, NTT DOCOMO, Xiaomi, HONOR, Spreadtrum, CMCC, Sharp, OPPO, MediaTek, NEC, New H3C, KDDI, Kyocera, Tejas, Huawei/HiSi (ok), Lenovo/MotM (ok majority), IDC, TCL, Apple (ok),  **Not support (only for Cap1):** Fujitsu |
| 1.3 | **[118] Agreement**  For the Rel-19 Type-I codebook refinement for 48, 64, and 128 CSI-RS ports, study, for RI= >1, applying the 3-bit scaling factor(s) as agreed in RAN1#117, where a per-layer scaling factor applied to the selected SD basis vector is given by e.g. , where unit scaling factor “1” is associated with the PDSCH-to-CSIRS EPRE offset “portion” contributed by the selected SD basis vector without the 3-bit scaling factor configured, e.g. is the scaling factor associated with the SD basis vector, and is the number of layers transmitted using the SD basis vector.   * Note: This feature is a separate UE capability * Study whether per-SD-basis-vector/layer power adjustment (including boosting) needs to be supported in addition   **Proposal 1.C.1**: 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  Note: This doesn’t preclude the use of power boosting at the NW side by implementation  **FL assessment**: This was discussed OFFLINE [2]. The above proposal is my best-effort middle ground as a compromise among widely diverging views below.  Per-layer soft scaling for RI=2-8:   * Support/fine for RI=2-8 Scheme-A+B with per-layer power boosting as a separate feature: Ericsson, Tejas, Xiaomi, Fujitsu, Lenovo/MotM, * Support/fine for RI=2-8 Scheme-A+B only if per-layer power boosting is supported: Google, Huawei/HiSi, NEC, vivo, Nokia/NSB, * Support/fine for RI=2-8 Scheme-A+B only if per-layer power boosting is NOT supported: NTT DOCOMO, Intel, IDC, Fraunhofer IIS/HHI (2nd), * Support/fine only for RI=2-8 Scheme-A, only if per-layer power boosting is NOT supported: Qualcomm * Support/fine for RI=2-8 Scheme-A+B and further study per-layer power boosting: Sharp, TCL, * Support/fine only for RI=2-4 Scheme-A with per-layer power boosting as a separate feature: ZTE * Not support for RI=2-8, not support for per-layer power boosting: OPPO, Samsung, Apple, MediaTek, Fraunhofer IIS/HHI (1st), | **Support/fine:** NTT DOCOMO, Ericsson (ok), Lenovo/MotM (ok), IDC, Google (ok sep cap), Samsung (ok, but no more), Qualcomm, ZTE (not against, but benefit small), vivo (ok), OPPO (same as SS), Xiaomi, Nokia/NSB (ok), Huawei/HiSi (same as ZTE), NEC (ok), Fujitsu, HONOR, Sharp, Intel, Apple, CATT, TCL, Spreadtrum, CMCC, MediaTek, Fraunhofer IIS/HHI, Tejas,  **Not support:** |
| 1.4 | **[117] Agreement**  For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports with RI=5-8, support the following schemes:   * + … * Scheme-B (based on Scheme2 described in RAN1#116bis):   + …   + W2 structure:     - For the orphan layer, the inter-polarization co-phasing is selected from {1, j, -1, -j}     - For two layers sharing a same SD basis vector, the inter-polarization co-phasing between two layers is selected from the following pairs {(1, -1), (j, -j)} to achieve inter-layer orthogonality. * Only Scheme-A (RI=1-4+RI=5-8) and Scheme-B (RI=1-4+RI=5-8) are supported in Rel-19   **[118] Agreement**  For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, the UCI parameters are captured in the tables below for Scheme-B for RI=5-8:   * Note: The second column includes the location of the parameters when reported with two-part UCI   **Scheme-B**   |  |  |  | | --- | --- | --- | | Parameter | UCI | Details/description | | … | … | … | | Inter-pol co-phase selection indicator for each layer | Part 2  Wideband or Subband (\*\*) | *v*=5-8: QPSK: 2-bit indicator per layer group *l=*1*, …,* |   **Proposal 1.D**: For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, the inter-pol co-phase selection indicator row from the UCI parameter table for Scheme-B for RI=5-8 is amended as follows:  **Scheme-B**   |  |  |  | | --- | --- | --- | | Parameter | UCI | Details/description | | … | … | … | | Inter-pol co-phase selection indicator for each layer | Part 2  Wideband or Subband (\*\*) | *~~v~~*~~=5-8: QPSK: 2-bit indicator per layer group~~ *~~l=~~*~~1~~*~~, …,~~*  *v*=5, 7: QPSK:   * For a layer group with 2 layers: 1-bit indicator {(1, -1), (j, -j)} * For a layer group with 1 orphan layer: 2-bit indicator {1, -1, j, -j}   *v*=6, 8: QPSK:   * 1-bit indicator for each layer group {(1, -1), (j, -j)} |   **FL assessment**: The W2 co-phase row of the Scheme-B UCI table agreed in RAN1#118 doesn’t fully reflect the agreement in RAN1#117. Proposal 1.D attempts to fix this error. | **Support/fine:** NTT DOCOMO, ZTE, Qualcomm,Lenovo/MotM, IDC, Google, Samsung, Ericsson, Xiaomi, Nokia/NSB, Huawei/HiSi, NEC, Fujitsu, HONOR, Sharp, Intel, Apple, CATT, TCL, Spreadtrum, CMCC, MediaTek, Fraunhofer IIS/HHI,  **Not support:** |
| 1.5 | **Proposal 1.E**: 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 the legacy number of CSI-RS ports (i.e. 4, 8, 12, 16, 24, and 32 ports) for all applicable RI values (1, …, min(PCSI-RS,8)) 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).   * [The following of Rel-19 Type-I SP are four separate UE features: (1) Scheme-A >32port; (2) Scheme-B >32port; (3) Scheme-A ≤32port; (4) Scheme-B ≤32 port.]   **FL assessment**: This proposal is sound for the completeness of Rel-19 Type-I SP codebook. Note that this doesn’t impact the legacy Rel-15 Type-I SP design.  Re whether this is OOS or not, the WID says “… 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)**, …” which, strictly speaking, doesn’t preclude <=32 ports. So this extension proposal is not OOS. | **Support/fine:** ZTE, Lenovo/MotM, IDC, Samsung (ok), Xiaomi, Nokia/NSB, NEC, Fujitsu, Intel (FFS capability), NTT DOCOMO, CATT (only Scheme-B, no scheme-A), Spreadtrum, CMCC, MediaTek (ok with bullet),  **Not support:** Google (OOS),OPPO,Huawei/HiSi, vivo, HONOR, Apple, TCL, Fraunhofer IIS/HHI, Tejas, |
| 1.6.1 | **Proposal 1.F.1**: For the Rel-19 Type-I SP codebook refinement for P (the total number of aggregated ports)=48, 64, 128 CSI-RS ports, regarding timeline for the port subset indication for the SD NES Type-1,   * Capability 1 timeline: 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   **FL assessment**: This proposal is a natural extension for SD NES Type-1 considering the related agreement for Rel-19 Type-I SP and needed. | **Support/fine:** Samsung, Lenovo/MotM, IDC, Google, NTT DOCOMO, ZTE, Ericsson (Cap2 needs some discussion P vs P’), Xiaomi, Nokia/NSB (Cap2 P vs max(Pi)), Huawei/HiSi, Fujitsu, vivo, HONOR, Sharp, Intel, Apple, TCL (P’), Spreadtrum, CMCC, Qualcomm, Fraunhofer IIS/HHI,  **Not support:** |
| 1.6.2 | **Proposal 1.F.2**: For the Rel-19 Type-I SP codebook refinement for P (the total number of aggregated ports)=48, 64, 128 CSI-RS ports, regarding CPU occupation for the port subset indication for the SD NES Type-1,   * For Capability 1 timeline: OCPU = where is the number of CSI-RS ports in i-th sub-configuration derived from the corresponding antenna port subset indicator *portSubsetIndicator* * For Capability 2 timeline: OCPU =   **FL assessment**: This proposal is a natural extension for SD NES Type-1 considering the related agreement for Rel-19 Type-I SP and needed. | **Support/fine:** Samsung, Lenovo/MotM, IDC, Google, ZTE (open), Xiaomi, Nokia/NSB, Huawei/HiSi, Fujitsu, HONOR, Sharp, Intel, Apple, TCL, Spreadtrum, CMCC, Fraunhofer IIS/HHI,  **Not support:** NTT DOCOMO, Qualcomm |
| 1.6.3 | **Proposal 1.F.3**: For the Rel-19 Type-I SP codebook refinement for P (the total number of aggregated ports)=48, 64, 128 CSI-RS ports, regarding active resource/port counting for the port subset indication for the SD NES Type-1,   * active resource counting is , where M is the number of sub-configurations that refer to the any of the K aggregated CSI-RS resources * active port counting is , where is the number of CSI-RS ports in i-th sub-configuration derived from the corresponding antenna port subset indicator *portSubsetIndicator*   **FL assessment**: This proposal is a natural extension for SD NES Type-1 considering the related agreement for Rel-19 Type-I SP and needed. | **Support/fine:** Samsung, Lenovo/MotM, IDC, Google, NTT DOCOMO, ZTE (open), Xiaomi, Huawei/HiSi, Fujitsu, vivo, HONOR, Sharp, Intel, Apple, TCL, Spreadtrum, CMCC, Qualcomm, Fraunhofer IIS/HHI,  **Not support:** |
| 1.6.4 | **Question 1.F.4**: Please share your view, if any, whether the Rel-19 Type-I SP codebook refinement for P=48, 64, 128 CSI-RS ports should be applicable to the Rel-18 **SD NES Type-2**. If so, please be specific on how this is done.   * Yes: Fujitsu, Google, ZTE (open), Xiaomi (open), Huawei/HiSi, NTT DOCOMO (open), TCL (open), * No (concern): Lenovo/MotM, Samsung, OPPO, vivo, HONOR, Intel, CATT, Spreadtrum, CMCC, Qualcomm,   **FL assessment**: This was briefly mentioned in RAN1#118 and two Tdocs in RAN1#118bis. It was pointed out that the extension for Rel-18 SD NES Type-2 is too cumbersome [17] and not needed. | |
| 1.7.1 | **[117] Agreement**  On the NZP CSI-RS resource aggregation of *K*=2, 3 or 4 legacy NZP CSI-RS resources to attain a total of 48, 64, and 128 ports (for Rel-19 Type-I/II codebook refinement), support to configure a CSI-RS resource set with the *K* CSI-RS resources as the associated NZP CSI-RS for each of the SRS resource set(s) with higher layer parameter usage in *SRS-ResourceSet* set to ‘nonCodebook’,   * The previously agreed restrictions on the *K* resources for Rel-19 Type-I/II codebook refinement apply * Reuse the legacy approach for triggering of the NZP-CSI-RS resources and the legacy timeline for the NZP-CSI-RS resources and SRS   **[118] Agreement**  For the Rel-19 Type-I and Type-II codebook refinement for 48, 64, and 128 CSI-RS ports, regarding NZP CSI-RS resource aggregation to attain 32 < P (or PCSI-RS) ≤ 128, for AP-CSI-RS where the K NZP CSI-RS resources are located in two consecutive slots,   * Except for codebook refinement based on Rel-18 Type-II Doppler, introduce per-resource higher-layer (RRC) configuration to indicate (via 1-bit per resource) whether 1-slot offset relative to the legacy resource-set-level slot offset configuration should be assumed or not * …   **Proposal 1.G.1**: For the Rel-19 Type-I and Type-II codebook refinement for 48, 64, and 128 CSI-RS ports, when an aperiodic CSI-RS resource set for aggregating K NZP CSI-RS resources (to attain a total of 48, 64, and 128 ports) is configured as the associated NZP CSI-RS for each of the SRS resource set(s) with higher layer parameter usage in *SRS-ResourceSet* set to ‘nonCodebook’, *and* when the SRS resource set(s) are aperiodic, the UE shall assume that the slot offset value for the associated CSI-RS resource set is 0 (while per-resource slot offset within the resource set can still be 0 or 1)  **FL assessment**: This proposal argues that this is needed since slot offset > 0 “deviates from the legacy behaviour” [28], which seems to refer to the legacy restriction in 38.214 that the associated AP-CSI-RS must be in the same slot as the DCI triggering the AP-SRS.  While the proposal is technically sound (restricting the slot offset to be 0 implies the same for all K resources), this can be handled via NW implementation (by configuring the slot offset to 0 whenever the AP CSI-RS resource set is configured as an associated CSI-RS).  Note that the spec isn’t designed for invalid/bad NW or UE implementations. | **Support/fine:** Samsung, IDC, Qualcomm, NTT DOCOMO, ZTE, vivo, Apple, CATT, MediaTek, Fraunhofer IIS/HHI,  **Not support (NW implementation):** Lenovo/MotM (need discussion), Google, Ericsson, OPPO, Xiaomi, Nokia/NSB, Huawei/HiSi (conclusion ok, no spec impact), HONOR, Intel, TCL, Spreadtrum, CMCC, |
| 1.7.2 | **[117] Agreement**  On the NZP CSI-RS resource aggregation of *K*=2, 3 or 4 legacy NZP CSI-RS resources to attain a total of 48, 64, and 128 ports (for Rel-19 Type-I/II codebook refinement), support to configure a CSI-RS resource set with the *K* CSI-RS resources as the associated NZP CSI-RS for each of the SRS resource set(s) with higher layer parameter usage in *SRS-ResourceSet* set to ‘nonCodebook’,   * The previously agreed restrictions on the *K* resources for Rel-19 Type-I/II codebook refinement apply * Reuse the legacy approach for triggering of the NZP-CSI-RS resources and the legacy timeline for the NZP-CSI-RS resources and SRS   **Proposal 1.G.2**: For the Rel-19 Type-I and Type-II codebook refinement for 48, 64, and 128 CSI-RS ports, when a CSI-RS resource set for aggregating K NZP CSI-RS resources (to attain a total of 48, 64, and 128 ports) is configured as the associated NZP CSI-RS for each of the SRS resource set(s) with higher layer parameter usage in *SRS-ResourceSet* set to ‘nonCodebook’, support to change the starting position of the time gap between CSI-RS and SRS from the last symbol of the reception of the aperiodic NZP-CSI-RS *resource* to the last symbol of the reception of the aperiodic NZP-CSI-RS *resource set*.  **FL assessment**: This proposal is a natural implication of the previous agreement when K>1 resources are aggregated (the K resources must be in a same resource set). Hence “resource” 🡪 “resource set” when K>1 (48, 64, 128 ports) | **Support/fine:** vivo, Lenovo/MotM, Samsung, Qualcomm, NTT DOCOMO, ZTE, Ericsson, Xiaomi, Nokia/NSB, Huawei/HiSi, HONOR, Sharp, Intel, Apple, CATT, Spreadtrum, CMCC, MediaTek, Fraunhofer IIS/HHI,  **Not support:** Google, OPPO, TCL, |
| 1.8 | **Proposal 1.H**: For the Rel-19 Type-I SP and MP codebook refinement, for RI=*v*>1, for each PMI sub-band, UE shall select a recommended *P*-by-*v* precoder matrix (associated with the reported PMI) with *v* orthogonal columns.  **FL assessment**: This is to ensure orthogonality constraint for Type-I is maintained. It is argued that this is especially crucial for SU-MIMO where the gNB typically follows the recommended PMI. However, it can be argued that this is a UE implementation issue. | **Support/fine:** Qualcomm,ZTE (open), MediaTek (SP), Nokia/NSB, Tejas, NEC,  **Not support:** vivo, Samsung, Fujitsu, NTT DOCOMO (study), Huawei/HiSi, CMCC, OPPO, Xiaomi, TCL, Ericsson, Lenovo/MotM, New H3C, Google, HONOR, Intel, Apple, Spreadtrum, Fraunhofer IIS/HHI, |
| 1.9.1 | **Proposal 1.I.1**: For the Rel-19 Type-I and Type-II codebook refinement for 48, 64, and 128 CSI-RS ports, except for that based on the Rel-18 Type-II Doppler, the following rule is supported:   * After the CSI report (re)configuration, serving cell activation, BWP change, or activation of SP-CSI, the UE reports a CSI report only after receiving at least one CSI-RS transmission occasion for each of the CSI-RS resources in the corresponding CSI-RS resource set for channel measurement and at least one CSI-RS and/or CSI-IM resource transmission occasion for each of the CSI-RS and/or CSI-IM resources in the corresponding resource set for interference measurement no later than the CSI reference resource and within the same DRX active time, when DRX is configured, and drops the report otherwise.   **FL assessment**: This is a natural extension of the legacy dropping rule. | **Support/fine:** ZTE, Lenovo/MotM, NTT DOCOMO, Lenovo/MotM, IDC, Google, Samsung, Qualcomm, Ericsson, OPPO, Xiaomi, Nokia/NSB, Huawei/HiSi, NEC, Fujitsu, vivo, HONOR, Sharp, Intel, Apple, CATT, TCL, Spreadtrum, CMCC, MediaTek, Fraunhofer IIS/HHI, Tejas,  **Not support:** |
| 1.9.2 | **Proposal 1.I.2**: For the Rel-19 Type-II codebook refinement for 48, 64, and 128 CSI-RS ports based on *the Rel-18 Type-II Doppler*, the following rule is supported:   * After the CSI report (re)configuration, serving cell activation, BWP change, or activation of SP-CSI, the UE reports a CSI report only after receiving *at least one aperiodic or KP consecutive periodic/semi-persistent CSI-RS transmission occasion(s) for each of the CSI-RS resources in each CSI-RS resource group* in the corresponding CSI-RS resource set for channel measurement and at least one CSI-RS and/or CSI-IM resource transmission occasion for each of the CSI-RS and/or CSI-IM resources in the corresponding resource set for interference measurement no later than the CSI reference resource and within the same DRX active time, when DRX is configured, and drops the report otherwise.   **FL assessment**: This is a natural extension of the legacy dropping rule. | **Support/fine:** NTT DOCOMO, Lenovo/MotM, IDC, Google, Samsung, Qualcomm, ZTE, Ericsson, OPPO, Xiaomi, Nokia/NSB, Huawei/HiSi, NEC, Fujitsu, vivo, HONOR, Sharp, Intel, Apple, CATT, TCL, Spreadtrum, CMCC, MediaTek, Fraunhofer IIS/HHI, Tejas,  **Not support:** |
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Table 1B SLS results: issue 1

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| **Company** | **SLS results** | | |
| **Issue #** | **Metric** | **Observation** |
| ZTE | 1.5 | UPT gain | SLS results of UPT gain for R19 Type-I(Scheme-A) codebook for RI=3-4 compared with R15 legacy: indicating that R19 Type-I(Scheme-A) codebook for rank-3/4 still offers a UPT gain (i.e., ~21.2% for cell-edge UE, ~3.8% for near-field UE, ~8.1% in average) over legacy mechanisms for ≥16 ports when PCSI-RS = 32 |
| 1.3 | UPT gain | SLS results of UPT gain for R19 Scheme-A codebook for RI=3-4: demonstrating that the 3-bit scaling factor cannot provide significant system performance gain, with a gain of 6.90% for cell-edge Ues and an average gain of only 1.43%. |
| vivo | 1.3 | Average UE throughput gain | The average throughput comparison of power boosting and non-power boosting    The average throughput comparison of power boosting and non-power boosting  It is shown that for Ues that select the non-full power codeword, if inter-layer/beam power boosting is enabled, around 13% and 17% gains are obtained in 200m ISD and 500m ISD scenarios, respectively. |
| Samsung | 1.1 | Avg UPT gain | When PMI/MCS (for RI>4) are calculated without SRS port grouping assumption, the case of low-complexity 8 RX receiver incurs 65% UPT loss compared to the scenario of 4RX receiver, which basically implies that it is not possible to work for RI>4 without SRS port grouping assumption for the low-complexity 8RX receiver. On the other hand, low-complexity 8RX with SRS port grouping obtains 43% UPT gain compared to the scenario of 4RX receiver and perform sufficiently well as expected. |
| Nokia/NSB | 1.3 | Power back-off per UE | Comparison of PDSCH power back-off levels for Ues applying power scaling only and power scaling and boosting.  The result shows a comparison of power back-off levels achieved by Ues applying power scaling only and power scaling combined with power boosting. Ues reporting higher ranks, *i.e.*, selecting multiple SD bases including at least one basis with reduced power show significant increase in the assumed PDSCH power when power boosting is allowed. |
| Ericsson | 1.3 |  | |  |  |  |  |  | | --- | --- | --- | --- | --- | | Scheme | 50% RU | | 70% RU | | |  | Mean user TP gain (%) | 5th percentile TP gain (%) | Mean user TP gain (%) | 5th percentile TP gain (%) | | Common backoff at the network (via network implementation) – ranks 1-4 | -27 | -38 | -32 | -44 | | Beam specific backoff at the network (Baseline – via network implementation) – ranks 1-4 | Baseline | Baseline | Baseline | Baseline | | Hard CBSR (6 of the 16 oversampled DFT elevation beam groups are allowed) – ranks 1-4 | 4 | 18 | -3 | -2 | | Beam-group specific scaling factor aware PMI/CQI selection at the UE for rank 1 only, (agreed in RAN1#117), no power scaling for ranks 2-4 | -3 | -6 | -10 | -10 | | Beam-group specific scaling factor aware PMI/CQI selection at the UE for ranks 1-4, (spec enhancement needed) | **21** | **80** | **21** | **69** | | Beam-group specific scaling factor aware PMI/CQI selection at the UE, rank restricted to ranks 1-2 only, (spec enhancement needed) | **13** | **61** | **14** | **60** |     For the Rel-19 Type-I codebook refinement, applying beam-group specific scaling factor for PMI/CQI selection for ranks 1-4 provides around 20% mean throughput gain, and 69-80% cell edge throughput gain over a network implementation-based baseline scheme.  For the Rel-19 Type-I codebook refinement, applying beam-group specific scaling factor for PMI/CQI selection for ranks 1-4 significantly outperforms the following schemes:   * beam-group scaling factor for PMI/CQI selection is only applied for rank 1, and beam-group scaling factor for PMI/CQI selection is not applied for ranks 2-4 * hard CBSR applied to ranks 1-4   For the Rel-19 Type-I codebook refinement, a simplified scheme of applying beam-group specific scaling factor for PMI/CQI selection for ranks 1-2 provides around 14% mean throughput gain, and 60% cell edge throughput gain over a network implementation-based baseline scheme. |
|  |  |  |  |

Table 1C Additional inputs: issue 1

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 1A** |
| Lenovo/ MotM | **Proposal 1.A:**  We are fine with the main text. Regarding impact on CSI-RS mapping to CW, we also prefer further study to verify/discuss during the meeting  **Proposal 1.C.1:**  The original motivation of beam power scaling was inter-cell interference reduction. The addition of power boosting was a way to improve power allocation efficiency if some beams are scaled down, so power boosting is an add-on feature. Our first preference is to separately trigger power boosting but if there is divergence on whether/how to apply/indicate it, leading to ambiguity in CQI calculation, then better to omit power boosting as a whole.  **Proposal 1.D:**  Support  **Proposal 1.F.1/2/3:**  Support  **Proposal 1.F.1/2/3:**  Support  **Question 1.F.4:**  Do not support. Separate CSI-RS resources are needed for Type-2 NES, leading to further complexity in the presence of multiple CSI-RS resources per spatial-domain adaptation pattern. Also, unlike Type-1 NES, each pattern in NES Type-2 would be associated with different virtualization of the P>32 ports, which seems to be very complex as well. We do not believe it is a practical setup or a priority in any way.  **Proposal 1.G.1:**  Needs further discussion in the meeting  **Proposal 1.G.2:**  Fine  **Proposal 1.H:**  Handling inter-layer orthogonality can be ensure via UE implementation to handle quantization errors. No need for this proposal in our opinion  **Proposal 1.I.1/2:**  Support |
| InterDigital | **Proposal 1.A.1:** We are generally ok with the proposal, however we would like to study whether there is an impact on mapping between CWs to CSI-RS ports. Also, we should study the case of single CW transmission. In our view, it should be clarified whether UE should use the antenna set associated to the first or second port-group or both. Further, since RAN4 has specified two different sets of performance requirement for 4Rx and 8Rx Ues, we think 8Rx processing should be based on UE capability. Hence, we suggest to have the related note in a bracket.  [Note: if one single CW is scheduled, both SRS port groups can correspond to the same CW, i.e. no enhancement is needed for the single-CW case]  **Proposal 1.C.1, Proposal 1.D, Proposal 1.E, Proposal 1.F.1, Proposal 1.F.2, Proposal 1.F.3, Proposal 1.G.1, Proposal 1.I.1, Proposal 1.I.2:** Support/Fine |
| New H3C | **Proposal 1.A: OK**  **Proposal 1.B: OK**  **Proposal 1.H: Not support** |
| Google | **Proposal 1.C.1:** We can compromise to accept RI=2 without inter-layer power borrowing, but we think RI=2 should also be a separate UE capability, since the benefit is still unclear.  **Proposal 1.D:** OK  **Proposal 1.E:** Enhancement of codebook for <32 ports look to be out of scope.  **Proposal 1.F.1/2/3:** Support.  **Proposal 1.F.4:** Support Type-2 SD NES for up to 128 ports. The configuration can be similar to 128-port on R18 PMI prediction codebook as follows:   * Support the NW to configure K CSI-RS resources as CMR and configure one group of CSI-RS resources from different ports by *nzp-CSI-RS-resourceList* in a CSI report sub-configuration   **Proposal 1.G.1/2:** We failed to see the necessity for both proposals. Previous statement of “reuse the legacy approach” is already sufficient, which means the AP-CSI-RS resources are in the same slot as DCI.  **Proposal 1.H:** We would like to understand the benefit. What would be the problem if a non-orthogonal precoder is used?  **Proposal 1.I.1/2:** OK. |
| Samsung | **Proposal 1.C.1**  As we mentioned before, our biggest concern was unnecessarily-high UE computational complexity when RI>1 especially when considering power-boosting (which create inter-dependency for SD basis selection across layers). But limiting RI=2 only and no power-boosting seem relaxing UE computational burden and can be manageable albeit more complex than the case without soft-scaling constraint. It is expected the UE computational complexity with up to RI=2 with soft-scaling constraint would be similar to that of up to RI=4 without the soft-scaling constraint, so we can live with the proposal as long as it is for *only RI=2 without power-boosting*, as stated in the proposal.  **Proposal 1.D.**  Support. This should be amended according to the previous agreement.  **Proposal 1.E.**  Ok with proposal due to following reasons:   * It is obvious that a unified design is preferable regardless of # of ports (>32 and <=32 ports). * There will be no additional impact for the pre-Rel-19 UE supporting Rel-15 Type-I SP CSI. * Performance gain is shown in companies’ SLS results.   **Question 1.F.4**  Similar view with Lenovo.  **Proposal 1.F.1/2/3**  Support.  **Proposal 1.G.1**  Support.  In the legacy, it is specified that the associated AP-CSI-RS and the DCI triggering the AP-SRS should be located in the same slot. This constraint was introduced to reduce a latency to be scheduled for non-codebook-based PUSCH. Similarly, it would be natural to also apply a same principal to the case that an AP-CSI-RS resource set with aggregating K NZP-CSI-RS resources is configured as the associated CSI-RS, when AP-SRS is configured, in order to maintain the low latency for the case with >32 ports as well. This can be simply done by the behaviour that the UE assumes that the slot offset value for the associated CSI-RS resource set is 0. Also, since it is agreed in the last meeting to support per-resource RRC configuration to indicate whether 1-slot offset relative to the resource-set-level slot offset configuration is assumed or not, it can still offer NW to assign resource-specific 1-slot offset.  **Proposal 1.G.2**  Ok with the proposal.  **Proposal 1.H.**  Rel-16/18 Type-II CB already allows UE to report non-orthogonal column vectors for a given subband. It is up to UE implementation whether to determine/report orthogonal column vectors or not, and it has no issue as long as ||y||^2=||Wx||^2=P regardless of orthogonal W or not, where P is a PDSCH transmit power.  **Proposal 1.I.1/1.I.2**  Ok with the proposals |
| Qualcomm | **Proposal 1.A**: OK with the last sentence in bracket [ ]  **Proposal 1.C.1**: OK  **Proposal 1.E.1**: OK with the proposal in principle.  Since Rel-15 Type-I is a very basic/mandatory UE feature anyway supported, we’d like Rel-19 Type-I as additional UE features for <=32port, over >32port  Thus we suggest to add a note:   |  | | --- | | * The following of Rel-19 Type-I SP are four separate UE features: (1) Scheme-A >32port; (2) Scheme-B >32port; (3) Scheme-A <=32port; (4) Scheme-B <=32 port. |   **Proposal 1.G.1**: OK  **Proposal 1.G.2**: OK  **Proposal 1.I.1/.2**: OK |
| NTT DOCOMP | **Proposal 1.A**:  For the last FFS for multiple aperiodic SRS resource sets, we support it.  For the FFS on mapping between CWs to CSI-RS ports, the issue is discussed for the case only when when ‘cri-RI-CQI’ is configured but ‘non-PMI-PortIndication’ is not provided. Two options can be considered. Option 1 is preferred.   * Option 1: ‘*non-PMI-PortIndication*’ is always provided. * Option 2: predefine another mapping between CSI-RS ports and layers.   **Proposal 1.F.1/3:**  Support.  **Proposal 1.G.1/2:**  Support.  **Proposal 1.I.1**:  Support. |
| ZTE | 1. **A/1.B:**   Support**.**  **1.C.1:**  We are NOT strongly against this proposal. However, based on our simulation, if power boosting is NOT supported, we can hardly see the benefit of the soft scaling factor. In fact, power boosting can be anyway enabled at NW side. If UE does NOT consider power bosting in CSI calculation, the reported CSI, especially the CQI, cannot be the optimal one.   1. **D:**   Support.   1. **E:**   Support.  **1.F.1:**  It needs to be clarified that whether P is the total number of configured CSI-RS ports, or P is the total number of indicated CSI-RS ports for NES.  **1.F.2/1.F.3/1.F.4:**  We are open to discuss. But it seems more discussion is needed.  **1.G.1/1.G.2:**  Fine.   1. **H:**   Open to discuss.  **1.I.1/1.I.2:**  Support. |
| Vivo | **Proposal 1.C.1**  We are okay to limit the maximum number of layers to 2 for 3-bit power scaling although our first preference is to have inter-layer power boosting. |
| Mod V11 | **Revisions to address inputs**  **@Yushu (Google): Re 1.E from ZTE, please check my FL assessment re whether this is OOS or not (WID says “..up to 128 ports ..” so it’s not OOS 😊). Also, the Note added by JD (Qualcomm) should clarify the intention.** |
| Ericsson | **Proposal 1.A**  Support proposal. We are supportive of the yellow text in brackets also.  **Proposal 1.D**  Support.  **Proposal 1.F.1**  Fine with at least capability 1. For capability 2, it may need to be defined in terms of the number of subset of ports indicated. For example, if P=128, but the UE is indicated with a subset of 16 ports. In this case, the UE only computes a CSI for 16 ports for which case the legacy timelines may be fine. Should the scaling factor in capability 2 be defined as max(1, ceil(P’/32)), where P’ is the number of subset of ports indicated? This way if the indicated number of ports is smaller or equal to 32, the timelines will be same as legacy timelines.  **Proposal 1.G.1**  Tend to agree with feature lead’s assessment that this can be handled via NW implementation. Hence, we prefer to handle this via network implementation.  **Proposal 1.G.2**  Ok  **Proposal 1.I.1**  Support  **Proposal 1.I.2**  Support |
| OPPO | **Proposal 1.A**  Fine with the proposal.  Regarding single CW, we think no enhancement is needed and UE can use both antenna port groups (8RX) for receiving.  Regarding AP SRS resource set, we are fine with the yellow part.  **Proposal 1.C.1**  We could accept if it is only restricted to RI=2.  **Proposal 1.E**  Need further study.  Firstly, there is only one company providing simulation result (only for P=32 ports), without consideration on the increase on CSI overhead. The trade-off between UPT and increased UCI overhead for Rel-19 Scheme A/B needs to be considered for evaluation, e.g. comparison with similar overhead. Further, we don’t think there would be performance gain for finer SD basis and inter-pol co-phase at least for small number of ports, e.g. 4,8,12, considering UPT/OH.  Secondly, though the WID doesn’t explicitly preclude enhancement for <=32 ports, it was common understanding in RAN discussion that “up to 128 ports” means “up to 128 ports and more than legacy 32 ports”. Without additional guidance from RANP, we have similar concern as google on the OOS issue, with the risk of opening the door to other enhancements for <=32 ports.  **Question 1.F.4**  We don’t think the application to SD NES Type-2 is needed. For NES Type-2, the virtualization of antenna ports to 48,64,128 ports seem a corner case.  **Proposal 1.G.1/2**  We are not objecting the proposals, but the spec. impact in addition to previous agreement is unclear to us.  **Proposal 1.I.1/2**  Fine. |
| Xiaomi | **Proposal 1.A**:  Support  **Proposal 1.C.1**:  We also think power boosting is helpful to improve system performance. We are fine with the proposal if companies can live with it for progress. But, for the last bullet, if power boosting is implemented at NW side and is transparent to UE. UE will calculate CQI without power boosting. This may result that the CQI calculated at UE does not match the PDSCH channel when power boosting is implemented at NW side. I.e., the calculated CQI may be underestimated.  **Proposal 1.D**:  Fine  **Proposal 1.E**/**Proposal 1.F.1/ Proposal 1.F.2/ Proposal 1.F.3/ Proposal 1.F.4**:  Open to discuss  **Proposal 1.G.1**:  Agree with FL’s assessment.  **Proposal 1.G.2**:  Fine  **Proposal 1.I.1**/ **Proposal 1.I.2**:  Fine |
| Nokia | **Proposal 1.A**  Support.  We are fine also with the text in brackets.  Regarding the FFS whether there is impact on mapping between CWs to CSI-RS ports, we are ok to further study  **Proposal 1.C.1**  We are ok, although our preference was to support the scaling with power boosting for all ranks  **Proposal 1.D**  Support  **Proposal 1.E**  Support.  **Proposal 1.F.1 – 1.F.2**  Ok  For Capability 2 timeline, a more accurate scaling factor is probably: ceil(max(Pi)/32), but we are fine also with ceil(P/32)  **Proposal 1.G.1**  Agree with FL assessment that this can be handled by NW implementation to ensure that AP-CSI-RS resources and DCI trigger are in the same slot  **Proposal 1.G.2**  ok  **Proposal 1.I.1 – 1.I.2**  Support |
| Huawei, HiSilicon | **Proposal 1.A:** support the proposal.  **Proposal 1.C.1**: Without considering the power boosting will make the soft scaling less useful. The main benefit of soft scaling is UE can compare the actual PMIs to select the best precoder. However, because gNB will always do the power boosting to use all its transmission power, if power boosting is not considered at UE side, the selected PMI by UE will not be the optimal one thus the benefits of scaling cannot be achieved. With that said, we can be open to the proposal if majority view accepts it.  **Proposal 1.D**: fine with it.  **Proposal 1.E**: We don’t think we should introduce too many kinds of codebooks without clear benefits, and there’s already the Rel-15 Type-I codebook.  **Proposal 1.F.1/1.F.2/1.F.3**: fine with them.  **Question 1.F.4**: The Rel-19 type-I SP codebook can be applicable to SD NES type-2.  **Proposal 1.G.1:** Fine with it, as long as there’s restriction already in the spec, there’s no need to have an agreement. A conclusion should be fine.  **Proposal 1.G.2:** Fine with it.  **Proposal 1.I.1/1.I.2:** Fine with them. |
| Mod V17 | **P1.A: On the two bracketed texts (Note and Apple’s AP-CSI-RS proposal), it seems almost all companies are fine so far. If the situation remains so I will remove the brackets**  **P1.F.1: Capability 2 in brackets to discuss P vs P’ vs max (Pi) in next round(s)** |
| NEC | **Proposal 1.A**: Support  **Proposal 1.C.1**: We can live with this proposal, even we prefer per layer power boosting.  **Proposals 1.D/1.E**: OK.  **Proposal 1.H**: Support. We can just add a description to ensure orthogonality in TS, there is no much impact.  **Proposals 1.I.1**/**1.I.2**: OK |
| OPPO | **Proposal 1.A (further input)**  For the issue on mapping between CWs to CSI-RS ports, we also think the issue exists when ‘*non-PMI-PortIndication*’ is not configured. We think a simple way can be: network should always configure ‘*non-PMI-PortIndication*’ for this feature. |
| Fujitsu | **Proposal 1.C.1**: Support  **Proposal 1.D:** Support  **Proposal 1.E**: Support this proposal. Definition of Rel-19 Type I for <=32ports can be clearer, especially for the case of NES SD Type 1. If UE is configured enabling ports P<=32 by *portSubsetIndicator* andmultiple CMRs for Rel-19 Type I (2 CMRs, P=8+8=16ports), the codebook and port indexing should be based on Rel-19 Type I other than Rel-15 Type I.  **Proposal 1.F.1/2**: Support  **Proposal 1.F.3:** In Rel-18, NES SD type 2 has been supported for shutdown partial physical antennas other than digital antenna ports. Compared with SD type 1, SD type 2 can provide better performance gain because of precoder by more digital antenna ports. Thus, in order to adapt to different performance requirements, both SD type 1and Type 2 should be supported in Rel-19.  **Proposals 1.I.1**/**2**: OK |
| vivo | **Proposal 1.A**  For the FFS point, we think it is not needed to have specification enhancement. gNB can simply configure a proper *non-PMI-PortIndication* to address this issue*.*  Specifically, gNB can simply divide all the 8 CSI-RS ports to two non-overlap groups, and configures the CSI-RS ports for each CW from each of the two non-overlap groups. For example, for the layers associated with the first CW, gNB can configure CSI-RS ports from the first non-overlap group (e.g., 0, 1, 2, 3), and for the layers with the second CW, gNB can configure CSI-RS ports from the second non-overlap group (e.g., 4, 5, 6, 7).  **Proposal 1.E**  We don’t support this. The legacy numbers of ports are out of the scope for this WI. There is no need nor justification to introduce a new codebook for legacy numbers of ports.  **Proposal 1.F.1**  OK  **Proposal 1.F.3**  Something needs to be clarified to avoid ambiguity of “M is the number of sub-configurations that refer the K aggregated CSI-RS resources”.  Does it simply mean M is the number of configured sub-configurations, i.e., M is the number of sub-configurations that refer any of the K aggregated CSI-RS resources? Another possible interpretation is M is the number of sub-configurations which use all of the K resources. For example, if one of the configured sub-configurations only uses ports from K-1 resources from the K resources, is this sub-configuration included in the counting of M?  Our preference is the first interpretation, i.e., M is the number of sub-configurations that refer any of the K aggregated CSI-RS resources, which seems simpler. Then it is better to clarify it as “M is the number of sub-configurations that refer any of the K aggregated CSI-RS resources”.  [Mod: Thanks for spotting this]  **Question 1.F.4**  We don’t support to apply this to Type 2 NES. It seems too complex to apply aggregation of resources to Type 2 NES.  **Proposal 1.G.1**  OK. This is simply to reuse legacy approach. But one thing to clarify, it means the resource set level slot offset is 0, but the resource level slot offset (0 or 1) still applies. Is it correct?  [Mod: Correct]  **Proposal 1.G.2**  Support. This is simply to reuse legacy approach, i.e., a simple CR-like clarification to apply the legacy approach.  **Proposal 1.I.1**  OK  **Proposal 1.I.2**  OK |
| HONOR | **Proposal 1.A:** Support this proposal. Regarding the mapping between CWs to CSI-RS ports, we prefer a simple solution that ‘*non-PMI-PortIndication*’ should be configured.  **Proposal 1.C.1:** We can accept current proposal without power boosting. The power boosting will significantly increase the UE capability for searching PMI/CQI.  **Proposal 1.D**: Support.  **Proposal 1.E**: Not necessary as we already have basic Rel-15 Type I codebook. Especially for Scheme B, it’s designed for finer SD beams, which is not the case for codebook <=32 ports.  **Proposal 1.F.1/1.F.2/1.F.3**: Support.  **Question 1.F.4:** Agree with Lenovo.  **Proposal 1.G.1**: Up to network implementation.  **Proposal 1.G.1**: Fine.  **Proposal 1.H**: Not necessary. Up to UE implementation.  **Proposal 1.I.2**: Support. |
| Sharp | **Proposal 1.A:** Support. In our view, although the legacy non-PMI-portIndication can indicate CSI-RS ports for each rank, it cannot indicate CSI-RS ports for each CW associated with a SRS port group. For this reason, we think SRS port grouping has impact on mapping between CWs to CSI-RS ports.  **Proposal 1.B:** Support.  **Proposal 1.C.1:** Support.  **Proposal 1.D:** Support.  **Proposal 1.F.1/1.F.2/1.F.3:** We are fine with these proposals.  **Proposal 1.G.2:** Support.  **Proposal 1.I.1/1.I.2:** Support. |
| Intel | **Proposal 1.A**: Ok with text in brackets.  **Proposal 1.C.1**: Ok with the proposal.  **Proposal 1.D**: Support the proposal.  **Proposal 1.E**: In principle, we are fine with the proposal. On the UE capability, we prefer to discuss it later considering that separate capability for >32 and <=32 ports might complicate the UE capability reporting due to more codebook combinations.  **Proposal 1.F.1/2/3**: Ok with the proposal.  **Question 1.F.4**: Large CSI-RS overhead makes Type 2 NES CSI enhancements less appealing. We are ok to deprioritize it in this WI.  **Proposal 1.G.1**: Do not support – can be solved by NW implementation.  **Proposal 1.G.2**: Fine with the proposal.  **Proposal 1.H**: Reasonable UE implementation will not have any issues. Spec change is not needed.  **Proposal 1.I.1/2**: Fine with the proposal. |
| NTT DOCOMO2 | **Proposal 1.E**: Support  **Question 1.F.4**: Open to further discuss.  **Proposal 1.F.2**:  After checking the legacy spec. (shown below), we prefer to follow legacy text style for O\_CPU.  - if a *CSI-ReportConfig* contains a list of *L* sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*],  - for periodic CSI reporting, where is the total number of CSI-RS resources corresponding to the *i*-th sub-configuration.  - for aperiodic and semi-persistent CSI reporting, where is the total number of CSI-RS resources corresponding to the *i*-th sub-configuration, and where the *i*-th sub-configuration is from *N* indicated sub-configurations out of *L* sub-configurations contained in a *CSI-ReportConfig*, where and .  For example,   * For Capability 2 timeline, Rel-18 OCPU rule for NES is reused. * For Capability 1 timeline,   + for periodic CSI reporting, where is the total number of CSI-RS resources corresponding to the *i*-th sub-configuration, where is the number of CSI-RS ports in *i*-th sub-configuration derived from the corresponding antenna port subset indicator [*port-subsetIndicator*] according to clause 5.2.1.4.2 if configured, otherwise , the number of ports configured by *nrofPorts.*   + for aperiodic and semi-persistent CSI reporting, where is the total number of CSI-RS resources corresponding to the *i*-th sub-configuration, where is the number of CSI-RS ports in *i*-th sub-configuration derived from the corresponding antenna port subset indicator [*port-subsetIndicator*] according to clause 5.2.1.4.2 if configured, otherwise , the number of ports configured by *nrofPorts,* and where the *i*-th sub-configuration is from *N* indicated sub-configurations out of *L* sub-configurations contained in a *CSI-ReportConfig*, where and .   [Mod: This is also possible but the current proposal is simpler. The legacy NES OCPU rule is unenecessarily complex.]. |
| Apple | **Proposal 1.A**: We are okay with the proposal. At least the second paragraph of text in yellow regarding SRS resource set ID is needed since aperiodic antenna switching SRS can use more than 1 SRS resource set.  **Proposal 1.B**: We are okay  [Mod: Thanks very much for your flexibility and big compromise]  **Proposal 1.C.1**: We are okay  **Proposal 1.D:** We are okay  **Proposal 1.E**: We prefer not to extend  **Proposal 1.F.1**: We are okay  **Proposal 1.F.2**: We are okay  **Proposal 1.F.3**: We are okay  **Proposal 1.G.1**: We are okay    **Proposal 1.G.2**: We are okay  **Proposal 1.H:** We did not propose this. We do not think this is necessary  **Proposal 1.I.1**: We are okay  **Proposal 1.I.2**: We are okay |
| CATT | **Proposal 1.C.1:**Ok  **Proposal 1.D**: Support  **Proposal 1.E**:  We can support extend the high performance scheme B to legacy <=32 ports but not for scheme A. The legacy Rel-15 Type I SP is a low complexity scheme by itself and we don’t see strong reason to introduce a redundant scheme A for legacy port numbers.  [Mod: Thanks for providing a possible compromise]  **Question 1.F.4**:  We prefer not to make extension for Rel-18 SD NES Type-2. For SD type 2 NES, part of antenna elements would be dynamically adapted (shutting down) and the total number of antenna ports would not be changed. However, the beam shape would vary due to each port with less number of antenna elements to associate with, which is equivalent to the change of codebook. Thus, it might have some issues for Type 2 SD with Rel-19 Type-I SP codebook refinement for P=48, 64, 128 CSI-RS ports.  **Proposal 1.G.1**: ok  **Proposal 1.G.2**: ok  **Proposal 1.I.1**: Support  **Proposal 1.I.2**: Support |
| Mod V34 | **P1.A: removed the brackets around the two highlighted texts given companies’ inputs. I’d appreciate if @IDC can be flexible after the responses from FL and Huawei (offline) re the first text. We will focus on the FFS in later round(s)**  **P1.E: put capability bullet in brackets for further discussion (per Intel’s input). The proposal doesn’t seem to be agreeable in round-1. Perhaps one compromise (round-2) is per CATT’s suggestion, i.e. extension only for Scheme-B since Scheme-A is redundant given Rel-15 Type-I SP mode-1**  **P1.F.1: need more discussion in round-2 re P vs P’ vs max(Pi), else the rest is agreeable in round-1**  **P1.F.3: clarification added per vivo’s suggestion**  **P1.G.1: clarification added per vivo’s question. Regardless this proposal doesn’t seem agreeable.** |
| TCL | **Proposal 1.A:** We are fine for this proposal, and we support remove the bracket for AP-SRS resource count.  **Proposal 1.C.1:** Support    **Proposal 1.D:** Support  **Proposal 1.E**: We don’t support this proposal. We think it might be an optimization for legacy Rel-15 type-I, but we are not sure about the performance gains. Additionally, it will introduce too many types of codebooks, making the codebook combination more complicated.  **Proposal 1.F.1** We support this proposal. However, for capability 2, we agree with Ericsson’s opinion that if the indicated number of ports for UE is small or equal to 32, the timelines will be same as legacy.  **Proposal 1.F.2/3/4:**We are open to discuss.  **Proposal 1.G.1:** We don’t support this proposal. We believe it can be achieved by gNB implementation.  **Proposal 1.G.2:** Support  **Proposal 1.I.1/2:**  Support |
| Spreadtrum | **Proposal 1.A**: Support. Regarding the mapping between CWs to CSI-RS ports, we prefer to always configure ‘*non-PMI-PortIndication*’ to the UE.  **Proposal 1.B**: Support.  **Proposal 1.C**: Since the power boosting procedure is not supported, we are fine with the compromised proposal.  **Proposal 1.D:** Support the proposal.  **Proposal 1.E**: Support the extension of R19 Type-I CB with <=32 ports. For UE supporting R19 Type-I CB with >32 ports, the UE can process R19 Type-I CB with <32 ports naturally. Supporting mode B only is also a good compromise.  **Proposal 1.F.1/1.F.2/1.F.3**: Support.  **Question 1.F.4**: We prefer to deprioritize the discussion.  **Proposal 1.G.1**: Agree with FL’s assessment, the proposal is not needed.  **Proposal 1.G.2**: Support.  **Proposal 1.H**: Up to UE implementation is OK.  **Proposal 1.I.1/1.I.2:** Support. |
| CMCC | **Proposal 1.A**: Support. Regarding the mapping between CWs to CSI-RS ports, rather than making optimization for the case of RRC parameter is not configured, we prefer to directly make sure ‘*non-PMI-PortIndication*’ is always configured to the UE and the issue is resolved by gNB implementation.  **Proposal 1.B**: Support.  **Proposal 1.C.1**: Support.  **Proposal 1.D:** Support the proposal.  **Proposal 1.E**: Support the proposal, extension to R19 Type-I CB with <=32 ports will not bring extra spec impacts and no other UE implementation efforts with separate UE capability.  **Proposal 1.F.1/1.F.2/1.F.3**: Support.  **Question 1.F.4**: NES Type-2 will consume too much CSI-RS resources, although the CMR configuration is a little similar with Rel-19 Doppler Type-II, we prefer not to discuss it.  **Proposal 1.G.1**: Agree with FL’s assessment, the issue exists but can be resolved by good gNB implementation..  **Proposal 1.G.2**: Support.  **Proposal 1.H**: It is up to UE implementation.  **Proposal 1.I.1/1.I.2:** Support. |
| Mod V39 | **No revision** |
| Qualcomm | Some late responses to NES-related proposals  **Proposal 1.F.1**: Following the “logic” of **1.F.2** and **1.F.3**, we tend to think the extended timeline for capability 2 should better be scaled with   |  | | --- | | * Capability 2 timeline: Scale the legacy timeline Z/Z’ (i.e., Z2 and Z’2) by ~~[ceil(P/32)]~~ |   **Proposal 1.F.2**: We tend to agree with the concept mentioned by DOCOMO, that we’d better have existing design as the starting point, and only consider the impact due to larger ports – anyway NES seems just to be a “side” topic impacted by Rel-19 Type-I.  But we should note that, Rel-19 Type-I, when >32 ports with K>1 CSI-RS resources, it does **not** support CRI, and therefore =1 for >32 ports.  Therefore, we support DOCOMO’s proposal in concept, but slightly different as following:   |  | | --- | | * For Capability 2 timeline, Rel-18 OCPU rule for NES is reused. * For <=32port codebook (if agreed for Rel-19 Type-I), Rel-18 OCPU rule for NES is reused. * For Capability 1 timeline and >32port codebook,   + for periodic CSI reporting, where is the total number of CSI-RS resources corresponding to the *i*-th sub-configuration, where is the number of CSI-RS ports in *i*-th sub-configuration derived from the corresponding antenna port subset indicator [*port-subsetIndicator*] according to clause 5.2.1.4.2 if configured, otherwise , the number of ports configured by *nrofPorts.*   + for aperiodic and semi-persistent CSI reporting, where is the total number of CSI-RS resources corresponding to the *i*-th sub-configuration, where is the number of CSI-RS ports in *i*-th sub-configuration derived from the corresponding antenna port subset indicator [*port-subsetIndicator*] according to clause 5.2.1.4.2 if configured, otherwise , the number of ports configured by *nrofPorts,* and where the *i*-th sub-configuration is from *N* indicated sub-configurations out of *L* sub-configurations contained in a *CSI-ReportConfig*, where and . |   **Proposal 1.F.3**: OK  **Proposal 1.F.4**: We prefer no support of NES Type2 |
| Mod V43 | **P1.F.1: revision per Qualcomm’s input which is also aligned with Ericsson and Nokia**  **P1.F.2: need more discussion in later rounds (current vs DOCOMO/Qualcomm)** |
| MediaTek | **Proposals 1.C.1, 1.D** OK  **Proposal 1.E** We are not sure if Rel-19 Type I SP codebook enhancements provide any performance/overhead gain compared to Rel-15 Type I SP codebooks for <=32 ports, since Rel-19 enhancements are optimized for narrow and a higher number of digital beams. However, we realize that it can unify implementation of Type I SP codebooks across #CSI-RS ports. Given this, we support the note by Qualcomm and can live with it if it is the majority view.  **Proposals 1.G.1, 1.G.2, 1.I.1, 1.I.2** OK |
| Fraunhofer IIS/HHI | **Proposal 1.C.1**: Fine  **Proposal 1.D**: Fine  **Proposal 1.E**: Not support. Although the WID doesn’t preclude support for less than 32 ports, it doesn’t mean we have to agree on this proposal without any study.  **Proposal 1.F.1/1.F.2/1.F.3**: Fine  **Proposal 1.G.1/1.G.2**: Fine  **Proposal 1.H**: we think this proposal is not needed.  **Proposal 1.I.1**: Support  **Proposal 1.I.2**: Support |
| LG | **Proposal 1.A**: Support. Regarding the mapping between CWs to CSI-RS ports without ‘non-PMI-PortIndication’, we prefer to use two separate CSIRS resources for 2 CWs and simply map CSI-RS port {0, 1, …, -1} for the first CSI-RS resource to SRS port group#0 and map CSI-RS port {0, 1, …, -1} for the second CSI-RS resource to SRS port group#1. |
| Mod V48 | **No revision** |
| Tejas | **Proposal 1.A:** We are fine for this proposal and the study aspects, along with the revisions.  **Proposal 1.C.1:** Support the proposal in principle with power boosting as a separate feature.  **Proposal 1.E**: We not sure of the benefits. We feel that for a gNB configured with <= 32 CSI-RS ports, there will be too many codebook design options based on the UE capability. Moreover, the study in Rel-19 analysed codebook performance gains from the perspective of finer SD beams, which is not the case for codebook <=32 ports.  **Proposal 1.I.1**: Support  **Proposal 1.I.2**: Support |
| Mod VFinal | **No revision** |

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

Table 2A Summary: issue 2

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 2.1 | **Proposal 2.A.1**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding priority 0 (G0) in CSI part 2, the UCI packing order is as follows:   * The G0 for the 1st configured CMR among the non-reported MR CRIs; * … * The G0 for the last configured CMR among the non-reported MR CRIs; * The G0 for the 1st reported CRI; * … * The G0 for the (M- MR)-th reported CRI;   The entire G0 is either reported or dropped entirely, following the legacy principle.  **Proposal 2.A.2**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding wideband CQI/PMI reporting, the UCI packing order is as follows:   * The wideband CQI/PMI for the 1st configured CMR among the non-reported MR CRIs; * … * The wideband CQI/PMI for the last configured CMR among the non-reported MR CRIs; * The wideband CQI/PMI for the 1st reported CRI; * … * The wideband CQI/PMI for the (M- MR)-th reported CRI;   **FL assessment**: This issue needs to be concluded. The proposal is analogous to the legacy principle. | **Support/fine**: Huawei/HiSi, Tejas, ZTE, CATT, HONOR, Lenovo/MotM, IDC, New H3C, Google, Samsung, Qualcomm, NTT DOCOMO, Ericsson, OPPO, Xiaomi, Nokia/NSB, NEC, Fujitsu, HONOR, Sharp, Intel, Apple, Spreadtrum, CMCC, Huawei/HiSi, MediaTek, Tejas,  **Not support**: |
| 2.2 | **Proposal 2.B**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports,  the following rule is supported:   * After the CSI report (re)configuration, serving cell activation, BWP change, or activation of SP-CSI, the UE reports a CSI report only after receiving at least one CSI-RS transmission occasion for each of the CSI-RS resources in the corresponding CSI-RS resource set for channel measurement and at least one CSI-RS and/or CSI-IM resource transmission occasion for each of the CSI-RS and/or CSI-IM resources in the corresponding resource set for interference measurement no later than the CSI reference resource and within the same DRX active time, when DRX is configured, and drops the report otherwise.   **FL assessment**: This is a natural extension of the legacy dropping rule and needed. | **Support/fine**: ZTE, Lenovo/MotM, Google, Samsung, Qualcomm, NTT DOCOMO, Ericsson, Xiaomi, Nokia/NSB, NEC, OPPO, Fujitsu, HONOR, Sharp, Intel, Apple, CATT, Spreadtrum, CMCC, Huawei/HiSi, MediaTek, Tejas,  **Not support**: IDC, |
|  |  |  |

Table 2B SLS results: issue 2

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **SLS results** | | |
| **Issue #** | **Metric** | **Observation** |
| (no results) | -- | -- | -- |

Table 2C Additional inputs: issue 2

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 2A** |
| Lenovo/ MotM | **Proposal 2.A:**  Support  **Proposal 2.B:**  Support |
| InterDigital | **Proposal 2.A:** Support.  **Proposal 2.B:** The motivation of Rel-19 CRI-based CSI reporting is to help the gNB with MU-MIMO pairing. In our view, natural extension of the legacy dropping rule, i.e., proposal 2.B is not desirable. For example, when X number of CSI-RS resources among the M CSI-RS resources in the CSI-RS resource set are received after the CSI reference slot, the UE drops the CSI reporting for all the M CRIs even when the CSI-RS resources associated with the M-X CRIs are received before the CSI reference resource. In our view, reporting CSI for M-X CRIs is beneficial to the gNB as compared to dropping CSI reporting for M CRIs.  We propose the following change to **Proposal 2.B** [Changes highlighted in Red]  For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports,  the following rule is supported:   * After the CSI report (re)configuration, serving cell activation, BWP change, or activation of SP-CSI, the UE reports ~~a~~ CSI for a CRI ~~report~~ only after receiving at least one CSI-RS transmission occasion of a CSI-RS resource associated with the CRI ~~for each of the CSI-RS resources~~ in the corresponding CSI-RS resource set for channel measurement and at least one CSI-RS and/or CSI-IM resource associated with the CRI ~~transmission occasion for each of the CSI-RS and/or CSI-IM resources~~ in the corresponding resource set for interference measurement no later than the CSI reference resource and within the same DRX active time, when DRX is configured, and drops the reporting contents associated with the CRI otherwise.   [Mod: This is incorrect since the UE needs to receive and measure all the KS resources, not only M] |
| NewH3C | **Proposal 2.A：OK** |
| Google | **Proposal 2.A:** OK, but it seems some editorial change can be considered. CRI is reported in part 1. For each sub-bullet, we can add “G0 of”  **Proposal 2.B:** OK |
| Samsung | **Proposal 2.A/B**  Ok with the proposals. |
| Qualcomm | **Proposal 2.A**: OK  **Proposal 2.B**: OK |
| NTT DOCOMO | **Proposal 2.A**: Support  **Proposal 2.B**: Support |
| ZTE | **P2.A:** Support.  **P2.B:** Support. |
| Mod V11 | **P2.A: minor revision per Google**  **@IDC: please check my response re 2.B** |
| Ericsson | **Proposal 2.A**  Support  **Proposal 2.B**  Support |
| OPPO | **Proposal 2.A**:  Support.  **Proposal 2.B**:  In Rel-15, we also support CRI based CSI report with CSI-RS resource set. We wonder why we cannot directly reuse the dropping rule in Rel-15 but introduce a new rule for Rel-19 multi-CRI? Does that mean different UE behavior?  [Mod: Please check Nokia’s explanation below] |
| Xiaomi | **Proposal 2.A**  Support  **Proposal 2.B**:  Support |
| Nokia | **Proposal 2.A**  Support  **Proposal 2.B**  Support.  In RAN1#114bis, there was a discussion on the interpretation of the expression “CSI-RS transmission occasion” in Rel-15, which is used in several parts of the specifications.  For CSI dropping conditions after (re)configuration, cell activation, etc., and with DRX, no consensus was reached for R15. Consequently, for R15 reporting with CRI, whether it is sufficient for a UE to measure one or all the configured resources for channel measurement and interference measurement may be up to UE implementation. |
| Mod V17 | **No revision.**  **@OPPO: Re 2.B please check Nokia’s explanation** |
| NEC | Support the two proposals. |
| InterDigital | @Mod. Thanks for your comment. As you correctly, pointed out, our earlier comment had a typo (i.e., M was used instead of Ks in the sentence …”) which caused a confusion.  Our understanding of Proposal 2.B is as follows. The UE reports a CSI for M CRIs only after receiving all the Ks CSI-RS resources no later than the CSI-RS reference resource. For example, the UE drops the CSI report when at least one of the Ks CSI-RS resource is received after the reference resource. In our view, this seems a bit restrictive. When X out of Ks CSI-RS resources are received after the CSI reference resource, then instead of dropping the CSI report, the UE can do the following,   * Report a CSI for M CRIs if M =< Ks-X * Report a CSI for M1 (M1<M and M1=<Ks-X) CRIs if M>Ks-X   Reporting a CSI based on a partial number of received CSI-RS resources or a CSI for a partial number of CRIs is more beneficial to the gNB than dropping the CSI report. |
| OPPO | For proposal 2B, we are fine with it after checking the discussion summary in RAN1#114bis. |
| Fujitsu | **Proposal 2.A**  Support  **Proposal 2.B**:  Support |
| Fujitsu | **Proposal 2.A**  OK  **Proposal 2.B**:  OK |
| HONOR | **Proposal 2.A:** Priority 0 (G0) in CSI part 2 or wideband CQI/PMI reporting includes different UCI contents. In addition, the dropping rule is not applied to wideband CQI/PMI reporting. Thus, we prefer to have two separate proposals for priority 0 (G0) in CSI part 2 and wideband CQI/PMI reporting.  [Mod: Thanks for spotting this]  **Proposal 2.B**: Support. |
| Sharp | **Proposal 2.A:** Support.  **Proposal 2.B:** Support. |
| Intel | Support Proposal 2.A, Proposal 2.B. |
| Apple | **Proposal 2.A**: We are okay  **Proposal 2.B**: We are okay |
| CATT | **Proposal 2.B**: Support |
| Mod V34 | **P2.A is now split to P2.A.1 (G0) and P2.A.2 (wideband) per HONOR’s input for better clarity and accuracy. The essence is still the same.** |
| TCL | **Proposal 2.A:** Support.  **Proposal 2.B:** Support. |
| Spreadtrum | **Proposal 2.A**  Support  **Proposal 2.B**:  Support |
| CMCC | **Proposal 2.A**  Support  **Proposal 2.B**  Support |
| Huawei, HiSilicon | **Proposal 2.A.1:** Support.  **Proposal 2.A.2:** Support.  **Proposal 2.B:** Support. |
| Mod V39/43 | **No revision** |
| MediaTek | **Proposals 2.A.1, 2.A.2, 2.B** OK |
| Mod V48 | **No revision** |
| Tejas | **Proposal 2.A.1:** Support.  **Proposal 2.A.2:** Support.  **Proposal 2.B:** Support. |
| Mod VFinal | **No revision** |

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

Table 3A Summary: issue 3

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 3.1.1/2 | **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset),   * The supported value(s) of x follows the supported configuration(s) of SRS resource for antenna switching xTyR used for reciprocity-based DL CSI acquisition   + Note: This doesn’t have any spec impact (no new RRC parameter is needed) * …   FFS:   * Whether/how to identify the transmission occasion of the Q=1 associated SRS resource to determine the reference UE antenna port in relation to the CSI request and/or SRS triggering * The supported time-domain behaviour(s) for the associated SRS resource (periodic, semi-persistent, aperiodic)   + In case the NW configures the Q=1 associated SRS resource from an existing SP and/or AP SRS antenna switching resource configuration for DL CSI acquisition (which utilizes dynamic signalling), whether/how to identify the Q=1 associated SRS resource   **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), the selection of PSRS=1 SRS port corresponding to the ‘reference UE antenna port’ (out of available port(s)) is NW-configured via higher-layer (RRC) signalling  **[118] Working Assumption**  For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), the configured associated SRS resource can be either periodic, semi-persistent, or aperiodic  **Proposal 3.A.1**: For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), the selection of PSRS=1 SRS port (corresponding to the ‘reference UE antenna port’) out of the y available SRS ports (from an xTyR SRS resource for antenna switching) is configured per CSI reporting setting.  **Proposal 3.A.2**: For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), regarding the configured associated SRS resource,   * Confirm the following working assumption as agreement: “the configured associated SRS resource can be either periodic, semi-persistent, or aperiodic” * When periodic or semi-persistent associated SRS resource is configured, the SRS transmission occasion for determining the reference UE antenna port corresponds to the latest SRS transmission occasion before the occasions of the NTRP CSI-RS resources used for measuring ‘cjtc-P’ report   + FFS: Whether ‘the earliest SRS transmission occasion after the NTRP CSI-RS occasions’ is also supported as an option   + FFS: Whether determination of SRS transmission occasion is needed for aperiodic associated SRS resource, and if so, how   **FL assessment**: This issue was discussed OFFLINE [2]. | **3.A.1:**  **Support/fine**: ZTE, vivo, Ericsson, Intel, OPPO, Qualcomm, MediaTek, Xiaomi, Samsung (ok), Apple, CATT, Google, Huawei/HiSi, NEC, Spreadtrum, NTT DOCOMO, Lenovo/MotM, IDC, Sharp, Sony, KDDI, TCL, Nokia/NSB, CMCC, New H3C, Fujitsu, HONOR,  **Not support**:  **3.A.2:**  **Support/fine**: ZTE, vivo, Ericsson, Intel, Samsung, OPPO, Qualcomm, MediaTek, Xiaomi, Apple, CATT (with FFS), Google (with FFS), NEC, Huawei/HiSi, Spreadtrum, NTT DOCOMO, Lenovo/MotM, IDC, Sharp, Sony, KDDI, TCL, Nokia/NSB, CMCC, New H3C, Fujitsu, HONOR,  **Not support**: |
| 3.1.3 | **Question 3.A.3**: For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), regarding the configured associated P/SP-SRS resource, please share your view whether an expiration window WEXP (in slots) should be supported such that only P/SP-SRS occasion(s) between slot-n and slot-(n+WEXP) can be used, where the CSI-RS occasion used for ‘cjtc-P’ measurement is received in slot-n. And if so, candidate value(s) of WEXP   * Support/fine: vivo (ok UE cap), Lenovo/MotM (open), Qualcomm (UE cap), ZTE, Xiaomi (UE cap), NEC, * Not support (NW implementation): CMCC, Google (need discuss), Ericsson, OPPO, Nokia/NSB, HONOR, Intel, KDDI, Apple, CATT, Sony, TCL, Spreadtrum, NTT DOCOMO,   **FL assessment**: This issue was briefly mentioned OFFLINE [2]. It was argued that this is needed to prevent stale SRS measurement. However, it can be argued that this can be handled via NW implementation. | |
| 3.2 | **[116bis] Agreement**  For the Rel-19 aperiodic standalone CJT calibration reporting, the resolution parameters for n, i.e. M, are NW-configured via higher-layer (RRC) signalling from the candidate values {16, 32}, where .  **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), regarding the support of sub-band reporting (>1):   * Denoting the number of reported sub-band phase-offset values as NSB-P, and the sub-bands are indexed as {0, 1, …, NSB-P –1}, support, as a separate UE capability from wideband (=1) phase offset reporting, reporting, in one CSI reporting instance, {(n,, n,, n,NSB-P), n=0, 1, …, NTRP – 1, n≠nref}   + The alphabet for n, follows the previously agreed alphabet for =1, including the ‘invalid’ state * FFS:   + …   + If needed, mechanism to limit CSI reporting overhead (e.g. maximum NSB-P)   + …   …  **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), regarding the support of sub-band reporting (>1) {(n,, n,, n,NSB-P), n=0, 1, …, NTRP – 1, n≠nref}:   * Supported sub-band size(s) {1, 2, 4, 8, 16} PRB * The NW configures, via higher-layer (RRC) signalling, which NSB-P sub-band(s) the UE reports   **Proposal 3.B.1**: For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), regarding the support of sub-band reporting (>1), the maximum value of configured NSB-P is 16 per CSI reporting setting,   * [Send a LS to check with RAN2 whether additional restriction(s) are needed to limit the RRC signalling overhead for selecting NSB-P out of all possible sub-bands within the configured CSI reporting band for ‘cjtc-P’ measurement]   **Conclusion 3.B.2**: For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), there is no consensus in supporting additional Mvalue(s).  **FL assessment**: This issue was discussed OFFLINE [2].  Re 3.B.1, at least 5 companies opined that the LS is *not needed* (if RAN2 sees an issue they will send us a LS anyway). | **3.B.1:**  **Support/fine**: ZTE, vivo, Ericsson, Samsung (only if M=256 is not introduced, else 8), OPPO, Huawei/HiSi, NEC, NTT DOCOMO, Lenovo/MotM, IDC (same as Samsung), Sharp, KDDI, TCL, Nokia/NSB, NICT, New H3C, Xiaomi, Fujitsu, HONOR, Spreadtrum,  **Support/fine but LS not needed**: Qualcomm, Apple, CATT, Google, Sony, Intel,  **Not support**: |
| 3.3.1 | **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific delay offset pre-compensation on PDSCH by the NW, support configuring a UE (via RRC ehaviour) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported delay offset (when ReportQuantity is ‘cjtc-Dd’).   * The two separately configured reports (i.e. Rel-18 eType-II CJT CSI report and the CJTC delay offset report) can be separately or jointly triggered [and carried on a same PUSCH (hence on a same slot)] following legacy joint triggering mechanism   + (Working Assumption) When separately triggered, the delay offset value to be compensated is the latest reported delay offset (DO) whose reporting instance’s last symbol is before the first symbol of DCI triggering of the CJT CSI reporting     - FFS: whether some expiration time interval is needed   + (Working Assumption) When jointly triggered, the delay offset value to be compensated is the reported delay offset (DO) in the same reporting instance   **Proposal 3.C.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, confirm the following working assumptions as agreement with the following refinement:   * When separately triggered, the delay offset value to be compensated is the latest reported delay offset (DO) whose reporting instance’s last symbol is before the first symbol of DCI triggering of the CJT CSI reporting * When jointly triggered, the delay offset value to be compensated is the reported delay offset (DO) in the same reporting instance   FFS: Whether an additional UE procedure is needed when the reported DO value is ‘out of range’  [FFS: Whether the Dd report codepoints need to be reinterpreted from intervals/ranges to values when the linkage mechanism is configured, or in general, a rule is needed to determine the value of DO for the compensation for each CMR for CJT CSI report (including if multiple Dos are reported)]  **FL assessment**: This issue was discussed OFFLINE [2]. | **Support/fine**: ZTE, vivo, Ericsson, Intel, OPPO, Qualcomm, MediaTek, Xiaomi, CATT (same as Apple), Fujitsu, Huawei/HiSi, Spreadtrum, NTT DOCOMO, IDC, Sharp, Sony, NEC, KDDI, TCL, Nokia/NSB, CMCC, HONOR, ETRI, Lenovo/MotM, New H3C, Google (ok with FFS), Samsung (ok) Apple (OK as long as only AP in 3.C.2),  **Not support**: |
| 3.3.2 | **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific delay offset pre-compensation on PDSCH by the NW, support configuring a UE (via RRC ehaviour) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported delay offset (when ReportQuantity is ‘cjtc-Dd’).   * …   …  FFS: Whether only AP-CSI-RS, or any type of CSI-RS (P, SP, or AP) can be configured as the CMR for the Rel-18 eType-II CJT reporting  ….  **Proposal 3.C.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, support at least AP-CSI-RS as the CMR for the Rel-18 eType-II CJT reporting   * FFS: The support for P/SP CSI-RS   **FL assessment**: This issue was discussed OFFLINE [2].  Alt1 (AP only, baseline): Samsung, Intel, Qualcomm, MediaTek, Apple, Google, OPPO, Fujitsu, Nokia/NSB, IDC, TCL, KDDI,  Alt2 (AP, also P/SP): Ericsson, ZTE, CATT, Huawei/HiSi, CMCC, ETRI,   * ***Concern with P/SP***: Samsung, Qualcomm, MediaTek, Apple, Fujitsu, IDC, TCL, | **Support/fine**: ZTE, vivo, Ericsson, Intel, Samsung, Qualcomm, MediaTek, , CATT, Google, OPPO, Fujitsu, Huawei/HiSi, Spreadtrum, NTT DOCOMO, IDC, Sharp, Lenovo/MotM, Sony, KDDI, TCL, ETRI, Nokia/NSB, New H3C, Xiaomi, NEC, HONOR, Apple (without at least & FFS, else can’t agree to 3.C.1),  **Not support**: |
| 3.3.3 | **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific delay offset pre-compensation on PDSCH by the NW, support configuring a UE (via RRC ehaviour) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported delay offset (when ReportQuantity is ‘cjtc-Dd’).  …  FFS: Whether this is also applicable for Rel-19 Type-I MP codebook  The above only applies when the CMRs do not share common QCL source for average delay indication  The above is UE optional feature.  **Proposal 3.C.3**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, support linking CJTC Dd and Rel-19 Type-I MP CSI reports using the same mechanism as that for linking CJTC Dd and Rel-18 eType-II CJT CSI reports  **FL assessment**: This issue was discussed OFFLINE [2]. | **Support/fine**: MediaTek, ZTE, TCL,  **Not support**: Intel, Ericsson, Samsung, CATT, OPPO, Fujitsu, Huawei/HiSi, Lenovo/MotM, TCL, Nokia/NSB, Spreadtrum, CMCC, IDC, New H3C, Google, HONOR, Sharp, Apple, Spreadtrum, NTT DOCOMO, |
| 3.3.4 | **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific delay offset pre-compensation on PDSCH by the NW, support configuring a UE (via RRC signalling) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported delay offset (when ReportQuantity is ‘cjtc-Dd’).   * The two separately configured reports (i.e. Rel-18 eType-II CJT CSI report and the CJTC delay offset report) can be separately or jointly triggered [and carried on a same PUSCH (hence on a same slot)] following legacy joint triggering mechanism   + (Working Assumption) When separately triggered, the delay offset value to be compensated is the latest reported delay offset (DO) whose reporting instance’s last symbol is before the first symbol of DCI triggering of the CJT CSI reporting   **Proposal 3.C.4**: 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, support to include an indicator in the trigger for a Rel-18 eType-II CJT CSI, which indicates whether the UE should perform delay offset (DO) compensation based on the linked CJTC Dd report when calculating the Rel-18 Type-II CJT CSI or not.   * This feature is a separate UE capability * No new DCI field is introduced * FFS: Details on signalling design for the indicator including whether it is per CSI-RS resource/Dd value and the associated UE behaviour(s)   **Question 3.C.4**: 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, please share your view on whether an “ACK/NACK” indication for the CJTC Dd report should be included in the trigger for a Rel-18 eType-II CJT CSI. The “ACK/NACK” indicates whether the latest CJTC Dd report is successfully decoded or not, or more generally, whether the UE should assume the latest CJTC Dd report for calculating the Rel-18 Type-II CJT CSI or not)   * Yes: Samsung, Qualcomm, Lenovo/MotM, ZTE (indicator), vivo (indicator, no new DCI field), * No: Google,   **FL assessment**: This issue was briefly discussed OFFLINE [2]. Its resolution may help confirming the WA for separate triggering (issue 3.3.1 proposal 3.C.1). While the proponent [28] claims that the extra indication is needed to prevent error propagation/misalignment (which is debatable since the NW can simply retrigger the Dd report similar to the NR adaptive asynchronous HARQ for PUSCH – without LTE PHICH), the clear benefit is to reduce the usage of (conserve) CSI Reporting Setting budget (which is a UE capability).  **Note**: Explicit DL signalling of DO value (via DCI, RRC, or MAC CE) for triggering Rel-18 Type-II CJT was also proposed (ZTE, MediaTek, Sony) which functions as a standalone enhancement solely for Rel-19 Type-II CJT rather than Rel-19 CJTC reporting. This proposal is out of scope in light of Objective 3 and will NOT be discussed (neither will the FFS on the support for SP CJTC report). | **Support/fine**: Samsung, Qualcomm, Lenovo/MotM, ZTE, vivo, Ericsson, Xiaomi, Nokia/NSB, Huawei/HiSi (ACK/NACK), NEC, Google, OPPO (ok), Fujitsu, HONOR, Sharp, KDDI, Sony (ACK/NACK), TCL, Spreadtrum, NTT DOCOMO, Apple (ok), MediaTek,  **Not support**: Intel, |
| 3.3.5 | **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific delay offset pre-compensation on PDSCH by the NW, support configuring a UE (via RRC signalling) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported delay offset (when ReportQuantity is ‘cjtc-Dd’).   * The two separately configured reports (i.e. Rel-18 eType-II CJT CSI report and the CJTC delay offset report) can be separately or jointly triggered [and carried on a same PUSCH (hence on a same slot)] following legacy joint triggering mechanism   + (Working Assumption) When separately triggered, the delay offset value to be compensated is the latest reported delay offset (DO) whose reporting instance’s last symbol is before the first symbol of DCI triggering of the CJT CSI reporting     - FFS: whether some expiration time interval is needed   **Proposal 3.C.5**: 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 an expiration timer for a CJTC Dd report   * The UE capability is used to inform the NW on the maximum duration for the latest CJTC Dd report, measured from the reception of the trigger for a Rel-18 eType-II CJT CSI   **Question 3.C.5**: 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, please share your view on whether an expiration time interval for a CJTC Dd report (measured from, e.g. the slot of the CJTC Dd report to the slot where the trigger for a Rel-18 eType-II CJT CSI is received) is needed.   * Yes: Lenovo/MotM, Samsung (UE cap), Qualcomm (UE cap), ZTE (UE cap), vivo (UE cap), * No (NW implementation): Spreadtrum, NTT DOCOMO, Google, Intel,   **FL assessment**: This issue was briefly mentioned discussed OFFLINE [2]. Its resolution may help confirming the WA for separate triggering (issue 3.3.1 proposal 3.C.1). 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, Samsung (but no timer in RAN1 spec), Qualcomm (same as SS), vivo (same as SS), Ericsson (same as SS), OPPO (same as SS), Xiaomi, Nokia/NSB, Huawei/HiSi, NEC, HONOR, Sharp, KDDI, MediaTek,  **Not support**: Google, Spreadtrum, NTT DOCOMO, Intel, Apple, CATT, Sony, TCL, Spreadtrum, |
| 3.3.6 | **[118] Agreement**  For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific delay offset pre-compensation on PDSCH by the NW, support configuring a UE (via RRC signalling) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported delay offset (when ReportQuantity is ‘cjtc-Dd’).  **…**  **Proposal 3.C.6**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, the linking of CJTC Dd and Rel-18 eType-II CJT CSI reports is applicable to the Rel-18 eType-II CJT only when the *codebookMode* is set to‘mode2’.  **FL assessment**: This proposal is needed since the linkage of Dd and Rel-18 Type-II CJT is intended to enable UE-specific digital DO pre-compensation on a PDSCH assignment, which is functionally equivalent (apart from the resolution) to Rel-18 Type-II CJT Mode-1. Therefore, the linkage shouldn’t apply to Mode-1 (i.e. is applicable only to Mode-2) | **Support/fine:** HONOR, Samsung, Qualcomm, Apple, MediaTek,  **Not support**: Google, ZTE, vivo, Ericsson, Nokia/NSB, Huawei/HiSi, NEC, Fujitsu, Intel, CATT, TCL, |
| 3.3.7 | **Question 3.C.7**: 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, please share your views, if any, on whether the WA in RAN1#118 on *“…in the same reporting instance”* needs to be relaxed (i.e. can also be *in two different reporting instances*).   * Yes: Lenovo/MotM, CATT, * No: Google (need discussion), Qualcomm, ZTE, vivo, Ericsson, OPPO, Nokia/NSB, Huawei/HiSi, HONOR, Intel, KDDI, Apple, TCL, Spreadtrum, NTT DOCOMO, MediaTek,   **FL assessment**: The above issue needs some discussion. For a given issue, if there is no consensus on ‘Yes’, we will assume that the answer is ‘No’ | |
| 3.5 | **Proposal 3.E:** For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when *ReportQuantity* is *‘cjtc-P’* (PO) and >1:   * The UCI parameters are captured in the tables below:  |  |  | | --- | --- | | Parameter | Details/description | | nref | Reference CSI-RS resource index, based on the ordering from RRC configuration: bits | | {(n,, n,, n,NSB-P), n=0, 1, …, NTRP – 1, n≠nref} | DL/UL phase offsets for CSI-RS resource n, (n=0, 1, …, NTRP – 1, n≠nref):  bits |  * The UCI mapping order is as follows:   + nref,   + {(n,, n,, n,NSB-P), n=0, 1, …, NTRP – 1, n≠nref} ordered from the lowest to highest CSI-RS resource ID   **FL assessment**: This proposal is needed to complete the UCI design for PO reporting (only =1 is completed) | **Support/fine:** IDC, Google (ok), Samsung, Qualcomm, ZTE, Ericsson, OPPO, Xiaomi, Nokia/NSB, Huawei/HiSi, vivo, Sharp, Intel, KDDI, Apple, CATT, Sony, TCL, Spreadtrum, NTT DOCOMO,  **Not support**: |
| 3.6 | **[117] Agreement**  For the Rel-19 aperiodic standalone CJT calibration reporting, regarding active resource counting and OCPU, when ReportQuantity is ‘cjtc-Dd’ (Doffset+d) or cjtc-F’ (frequency offset), fully reuse those from Rel-18 TDCP reporting   * OCPU =X.NTRP where X≥1 is defined based on UE capabilities and determined by the UE for each CJT calibration report type   **[117] Agreement**  For the Rel-19 aperiodic standalone CJT calibration reporting, regarding timeline, fully reuse those from Rel-18 TDCP reporting  **Proposal 3.F**: For the Rel-19 aperiodic standalone CJT calibration reporting, regarding active resource counting and OCPU, when ReportQuantity is ‘cjtc-P’ (phase offset), for both =1 and >1, fully reuse those from Rel-18 TDCP reporting   * OCPU =X.NTRP where X≥1 is defined based on UE capabilities and determined by the UE   **FL assessment**: Indeed there is no reason not to use the same solution on OCPU and ARC for phase offset reporting. The use of associated SRS resource shouldn’t alter the computational complexity for PO measurement. | **Support/fine:** NTT DOCOMO, IDC, Google, Samsung, Qualcomm, ZTE, Xiaomi, Nokia/NSB, Huawei/HiSi, NEC, vivo, Sharp, Intel, KDDI, Apple, CATT, Sony, TCL, Spreadtrum,  **Not support**: |
| 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), TCL,  **Not support**: Huawei/HiSi, MediaTek, NTT DOCOMO, NEC, Intel, Apple, TCL, Huawei/HiSi, Xiaomi, IDC, Sharp, KDDI, CMCC, ETRI, OPPO, Apple, vivo, New H3C, Nokia/NSB, Spreadtrum, |
| 3.7.2 | **Proposal 3.G.2:** For the Rel-19 aperiodic standalone CJT calibration reporting, support reporting, in one CSI reporting instance, 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) | **Support/fine:** NEC, NTT DOCOMO, Lenovo/MotM, Samsung (ok), Sony (open), TCL,  **Not support**: ZTE, Xiaomi, Fujitsu, Ericsson, Apple, Huawei/HiSi, OPPO, TCL, ETRI, New H3C, Google, Nokia/NSB, vivo, Sharp, Intel, KDDI, Spreadtrum, |
| 3.8.1 | **Proposal 3.H.1:** For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-Dd’ (delay offset), ‘cjtc-F’ (frequency offset), or, ‘cjtc-Dd-F’ (joint delay + frequency offset),   * after the CSI report (re)configuration, serving cell activation, BWP change, the UE reports a CSI report only after receiving at least one CSI-RS transmission occasion for each CSI-RS resource in the CSI-RS Resource Sets of the CSI-RS Resource Setting for channel measurement no later than the CSI reference resource within the same DRX active time, when DRX is configured, and drop the report otherwise   **FL assessment**: This proposal is a natural extension of the legacy behaviour and needed. | **Support/fine:** NTT DOCOMO, Lenovo/MotM, IDC, Google, Samsung, Qualcomm, ZTE, OPPO, Xiaomi, Nokia/NSB, Huawei/HiSi, Fujitsu, vivo, Sharp, Intel, KDDI, Apple, CATT, Sony, TCL, Spreadtrum,  **Not support**: |
| 3.8.2 | **Proposal 3.H.2:** For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset),   * after the CSI report (re)configuration, serving cell activation, BWP change, the UE reports a CSI report only after receiving at least one CSI-RS transmission occasion for each of the CSI-RS resources in the corresponding CSI-RS Resource Set for channel measurement no later than the CSI reference resource within the same DRX active time, when DRX is configured, and drop the report otherwise.   **FL assessment**: This proposal is a natural extension of the legacy behaviour and needed. | **Support/fine:** NTT DOCOMO, Lenovo/MotM, IDC, Samsung, Qualcomm, ZTE, OPPO, Xiaomi, Nokia/NSB, Huawei/HiSi, Fujitsu, vivo, Sharp, Intel, KDDI, Apple, CATT, Sony, TCL, Spreadtrum,  **Not support**: |
|  |  |  |

Table 3B LLS/SLS results: issue 3

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| --- | --- | --- | --- |
| **Company** | **LLS/SLS results** | | |
| **Issue #** | **Metric** | **Observation** |
| Huawei/HiSi | 3.3 | UPT loss | Performance for misalignment for DO caused by error propagation  Under assuming UCI BLER=0.1%, it is shown that there is almost no performance loss caused by error propagation. |
| ZTE | 3.3 | UPT gain | SLS throughput results for non-compensated CJT and UE-specific DO/FO pre-compensated CJT  The SLS results show that UE-specific CJT DO/FO pre-compensation can significantly improve the throughput, especially for cell-edge UE. |
| MediaTek | 3.3 | Avg UPT gain vs overhead | Performance comparison of 64-port codebooks in 4x16 port CJT scenario  It is shown that for 4x16-port CJT, Type I MP provides up to 7 % (MU-MIMO) and 2 % (SU-MIMO) UPT gain over Type I SP Mode A, B codebooks for 64 ports, considering the baseline as Rel-18 Type II CJT. |
| Samsung | 3.3 | Avg UPT gain vs overhead | When gNB and UE are misaligned (i.e., when Dd report is failed to decode), it can incur significant amount of loss in a worst case scenario, similar to the case of no delay compensation. |
| 3.2 | Avg UPT gain vs Mphi | For SB PO reporting, the UPT gain of using >5 bits over using 5bits is marginal (<1.5%) even in the case of configuring the smallest SB size (i.e, 1RB). |
| 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. |
| Ericsson | 3.3 | Throughput vs SNR | Performance comparison between synchronized DO and CJT CSI reports and asynchronized DO and CJT CSI reports.  We can observe from the result that there is little performance difference between synchronized DO and CJT CSI reports and asynchronized DO and CJT CSI reports. |
|  |  |  |  |

Table 3C Additional inputs: issue 3

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 3A** |
| Lenovo/ MotM | **Question 3.A.3:**  Objective not clear since NW already knows/controls the SRS and CSI-RS config to begin with. Open to discuss if proponents of this proposal can further clarify  **Proposal 3.B.1:**  Support  **Conclusion 3.B.2:**  Support  **Proposal 3.C.1:**  Support (with expiration time interval configured for separate triggering). Further details provided under answer to Question 3.C.5  **Proposal 3.C.3:**  Not a priority  **Question 3.C.4/5:**  We believe the “expiration interval” is necessary for separate triggering, as follows:   * With CJTC and PMI reporting linkage, the UE can use finer granularity of CJTC measurement beyond that reported in the CJTC report, leading to further improvement in performance when using the pre-compensated PMI * Without the expiration time, the UE would store the last CJTC values indefinitely until configured with new CJTC reporting, which is not a good design. Clearly, the measurements may not be precise after some time, e.g., several seconds after which the channel PDP may have completely changed due to UE motion. For example, a UE moving with 10 km/hr speed cuts a distance of 28 meters in 10 seconds, leading to possible change in corresponding dominant paths per TRP. * The ACK/NACK configuration proposed in Question 3.C.4 has a similar objective of enabling/disabling Doppler pre-compensation in PMI calculation via Rel-18 CJT CB, where this configuration is part of the CSI report config for Rel-18 CJT CB. Both corresponds to expiration of CJTC measurement with one being “configured” and the other being “based on a fixed rule”   **Proposal 3.E:**  Support  **Proposal 3.G.1/2:**  Support  **Proposal 3.H.1/2:**  Support |
| InterDigital | **Proposal 3.C.1, Proposal 3.E, Proposal 3.F, Proposal 3.H.1, Proposal 3.H.2:** Support.  **Proposal 3.C.3:** Not support. Type-I MP is more suited for scenarios with small offsets so the benefit of a CJT calibration report is not clear. |
| New H3C | **Proposal 3.A.1: Ok**  **Proposal 3.A.2:Ok**  **Proposal 3.B.1: Ok**  **Proposal 3.C.1: Ok**  **Proposal 3.C.2: Ok**  **Proposal 3.C.3: Not support**  **Proposal 3.G.1: Not support**  **Proposal 3.G.2: Not support** |
| Google | **Proposal 3.A.1:** OK  **Proposal 3.A.2:** OK, but maybe one editorial change can be considered. N\_TRP CSI-RS occasions sound like N\_TRP instances of one CSI-RS.   * When periodic or semi-persistent associated SRS resource is configured, the SRS transmission occasion for determining the reference UE antenna port corresponds to the latest SRS transmission occasion before the NTRP CSI-RS ~~occasions~~ resources used for measuring ‘cjtc-P’ report   [Mod: OK, but we also need the term occasion. Please check revision]  **Proposal 3.A.3:** We do not quite understand the motivation. More discussion could be needed.  **Proposal 3.B.1:** Support without the LS  **Conclusion 3.B.2:** OK  **Proposal 3.C.1:** The working assumption should be revised at least by changing “delay offset” into “delay offset(s)”. Currently we allow the UE to report multiple Dos. Further, we think a FFS should be added as follows. If UE reports multiple Dos, it is unclear how to perform the DO compensation. Even if UE only reports 1 DO, UE does not know whether it should compensate the DO based on DO or -DO, since it does not know the TRP for each CMR for CJT-CSI and TRS.   * **FFS: how to determine the value of DO for the compensation for each CMR for CJT CSI report**   [Mod: Added and merged with the 2nd FFS]  **Proposal 3.C.3:** We do not see the necessity of this proposal.  **Proposal 3.C.4:** We do not see the necessity of this proposal. If the reliability of the DO report is a problem, separate report should not be supported.  **Proposal 3.C.5:** We do not quite understand the motivation. More discussion could be helpful.  **Proposal 3.C.6:** We do not see the necessity. We have the following statement in the previous agreement, which has a broader restriction.  “The above only applies when the CMRs do not share common QCL source for average delay indication  ”  **Proposal 3.C.7:** We do not quite understand the motivation. More discussion could be helpful.  **Proposal 3.E:** We suggest to introduce a RRC configuration to disable the nref report. For PO report, the range is (0, 2pi). The report of nef becomes useless.  [Mod: This is not related to the UCI table (we don’t write things like this in UCI tables). I will include this as a topic to discuss for next round(s). Regardless, including nref has been agreed very early for PO. Feature to disable via RRC can be discussed later]  **Proposal 3.F:** Support  **Proposal 3.G.2:** We failed to see the necessity  **Proposal 3.H.1:** OK |
| Samsung | **Proposal 3.C.1/Question 3.C.4**  We see the point from other companies and FL assessment that error propagation can be handled by gNB implementation, and admit that the performance degradation does not happen with good NW implementation. So we are OK to confirm the WA re separate triggering as well. However, we still think an indication whether the UE should assume the latest CJTC Dd report for calculating the CJT CSI or not should be included in the trigger to avoid the overuse of CSI reporting settings, given that the number of CSI reporting setting is subject to UE cap and very small. Since error propagation is no longer problem, we suggest to delete “ACK/NACK” terminology in Question 3.C.4, which seems better in terms of description.  **Question 3.C.5**  We are open as long as the expiration time interval is subject to UE capability.  **Proposal 3.C.6**  We support the proposal but can be open to consider Mode1 as well, if the benefit can be validated. But now, it is unclear to us how Mode-1 can help in the linking of Dd and CJT CSI reports, where DO is already pre-compensated for CJT CSI calculation.  **Proposal 3.E**  Support.  **Proposal 3.F**  Support.  **Proposal 3.G.2**  We can be OK with this proposal.  **Proposal 3.H.1/2**  Ok. |
| Qualcomm | **Question 3.A.3**: We suggest to define this expiration “timer” as UE capability.  (Reason is similar as what explained below for **Question 3.C.5**)  **Proposal 3.B.1**: We don’t understand why we need an LS to RAN2, since RAN1 has better knowledge for the need/requirement of this subband PO issue, while RRC overhead with the subband bitmap may only be a less important issue.  Please add us also with the notation “LS not needed”  **Question 3.C.4**: We are OK with this proposal.  In addition, we think similar mechanism is useful also to DMRS chanEst of CJT-PDSCH.   * Assuming two TRPs: TRP#1 and TRP#2, where PDSCH is DO-compensated, while TRSs / CSI-RSs are not  |  |  |  | | --- | --- | --- | |  | CJT-PDSCH | TRS / CSI-RS | | TRP#1 | Not compensated (Ref TRP) | Not compensated | | TRP#2 | DO-compensated | Not compensated |  * Without knowing the explicit DO value, UE can only rely on TRS#1 as delay-QCL source for DMRS chanEst; * If DO is known by UE, DMRS chanEst can also use TRS#2 as delay-QCL source   **Question 3.C.5**: We can be fine with this proposal, but based on UE capability.  We understand the motivation to avoid “stale” DO;  From NW implementation perspective, NW has full information of how long a most recent DO report it is.  UE implementation perspective, an expiration “timer” has both pros. And cons.:   * While the timer may help to dynamically release the memory (at most 3x8=24 bits, minor, although), the timer itself actually also increase a little burden to UE implementation (minor, too, although)   Therefore, UE capability would be more flexible for UE to determine tradeoff b/w memory and timer, and we suggest the following notes for a potential proposal:   |  | | --- | | * UE indicates a capability on the expiration timer;   + For UE not indicating this capability, it assumes UE always use a most recent DO to derive Type-II-CJT CSI when triggered with the DO linkage |   [Mod: Please check proposal 3.C.5]  **Proposal 3.C.6**: Support  **Proposal 3.C.7**: We don’t understand this proposal – under a same CSI triggering state within a UL-grant DCI, the scheduled PUSCH should be just one reporting instance.  Not sure whether we missed anything.  Not support at this point.  **Proposal 3.E**: OK  **Proposal 3.F**: OK  **Proposal 3.H.1** and **Proposal 3.H.2**: OK |
| ZTE | **3.A.1:**  Generally, we are fine with the proposal. However, it seems better if the selected SRS port is configured per AP CSI trigger state rather than per CSI reporting setting. In comparison, if the selected SRS port is indicated per AP CSI trigger state, fewer CSI reporting settings are needed.  [Mod: We can discuss next round as another level of flexibility]  **3.A.2:**   * For P/SP SRS: Fine with current proposal. * For aperiodic SRS: From RRC perspective, the ‘cjtc-P’ report is associated with one SRS resource in one AP SRS resource set. However, the SRS resource can be triggered multiple times. So, the definition of the associated AP SRS occasion also needs to be specified. The simplest solution is that, the ‘cjtc-P’ report is associated with the AP SRS occasion triggered by the latest/most recent DCI no later than the DCI triggering the ‘cjtc-P’ report.   [Mod: Next round]  **3.A.3:**  Generally, we think the expiration window is needed. However, the reference time point should NOT be a slot but a symbol (e.g., the first symbol of the NTRP CSI-RS occasions, based on 3.A.2). Then we prefer the following version to make the proposal clearer.  **Proposal 3.A.3**: For the Rel-19 aperiodic standalone CJT calibration reporting, when ReportQuantity is ‘cjtc-P’ (DL/UL phase offset), regarding the configured associated P/SP-SRS resource, only P/SP-SRS occasion(s) between symbol-n and symbol-(n-WEXP) can be used, where symbol-n is the first symbol of the NTRP CSI-RS occasions used for ‘cjtc-P’ report measurement.   * FFS: candidate value(s) of WEXP   **3.B.1:**  Support.  **3.B.2:**  Support.  **3.C.1:**  Support confirming the two Was. However, we do NOT think the two FFSs are needed.  [Mod: It’s just FFSs and legit topics to discuss 😊]  **3.C.2:**  Fine to support AP CSI-RS. However, P/SP CSI-RS is also very important, since P/SP CSI-RS are also often used in practical implementation. Our suggestion is that we can agree on AP CSI-RS first, and FFS whether P/SP CSI-RS can be additionally supported.  **3.C.3:**  Support.  **3.C.4:**  To our understanding, it is better to describe the “ACK/NACK” as an indicator indicating whether UE should assume the latest CJTC Dd report for calculating the Rel-18 Type-II CJT CSI or not. The indicator should be included in the AP CSI trigger state, then two separate trigger states can be configured with the indicator being configured and NOT configured. In this way, fewer CSI reporting settings need to be configured.  **3.C.5:**  To our understanding, one strong motivation behind this proposal is to avoid unlimited buffering time of the DO at UE side. So, it is better to describe the “expiration time interval” by “expiration timer at UE side”. Then UE can report a capability of the maximum DO buffering time, and NW implementation (the triggering time of CJTC Dd report and CJT Type-II report) should be based on the reported UE capability. In other words, it only requires spec changes for UE capabilities.  **3.C.6:**  Do NOT support. Even for CJT Type-II Mode-1, since the PMI subband size is limited, the maximum delay offset that can be overcame is also limited. So, the linkage is also beneficial for Mode-1, and should be configurable for Mode-1.  **3.C.7:**  Do NOT support. The relaxation makes joint triggering far more complicated but without any benefits.   1. **E:**   Support.   1. **F:**   Generally, we are fine with the proposal. However, different candidate values of X may need to be considered for wideband and subband PO reporting.  [Mod: This is for UE feature discussion]  **3.G.1:**  Support.  **3.G.2:**  Do NOT support. We failed to see the necessity or benefits of this proposal.  **3.H.1/3.H.2:**  Support |
| vivo | **Question 3.A.3**  We support this, as UE can only buffer the associated CSI-RS within a limited search window. This is to avoid UE to search a too long window to identify the SRS occasion, where the window may exceed UE coherence time or channel coherence time. An unlimited search window will not only complicate UE implementation, but also reduce the performance of this PO reporting and compensation.  **Proposal 3.C.1**  We support to confirm the Was first and then discuss the remaining details given no critical issue is identified. Otherwise there is no solid foundation for the discussion of details.  **Question 3.C.4**  Our understanding is this proposal does not aim to solve any reliability issue as there is no reliability issue at all. This proposal is just to optimize the number of report settings to be used.   * Without this proposal, gNB needs to configure a CSI report setting for DO reporting, a CSI report setting for Type II CJT CSI with linkage and a CSI report setting for Type II CJT CSI without linkage. gNB can determine to trigger a Type II CJT CSI with linkage or a Type II CJT CSI without linkage based on whether it decodes the DO report correctly, or whether the DO report is “invalid”. Thus in total 3 report settings are needed. * With this proposal, gNB only needs to configure a CSI report setting for DO reporting, and a CSI report setting linked to the DO reporting. gNB can trigger the Type II CJT CSI report with or without linage based on a indication together with the triggering. Then only two report settings are required.   Based on the above, we can be okay with this if the following two conditions are met.   * There is no new DCI field is introduced. gNB only needs to configure a flag indicating the use of linkage or not in each trigger state for Type II CJT CSI. Introducing new DCI field will cause too much spec impact. * This is a separate UE capability given it is just an optimization on the number of report settings.   **Question 3.C.5**  We are open if it is just a UE capability, based on similar reason as 3.A.3  **Proposal 3.C.6**  We don’t support to have any restriction on mode 1 or mode 2. We think mode 1 can also benefit from linked DO reporting. Type II CSI CSI is limited to delays within the subband granularity. The linked DO report can help to compensate the channel to make the delays within subband granularity and then mode 1 can be used to report the FD bases and inter-TRP phases.  **Question 3.C.7**  Our understanding is only one PUSCH can be scheduled based on the current spec. We are not sure how two occasions work for joint triggering. |
| Mod V11 | **Revision per inputs**  **Added proposals 3.C.4, 3.C.5 per inputs**  **@Google, ZTE, Qualcomm: please check my response** |
| Ericsson | **Proposal 2.A**  Support  **Proposal 3.A.3**  Tend to agree with FL’s assessment that this can be handled by NW implementation.  **Conclusion 3.B.2**  On this issue, we understand the current situation. However, RAN4 still hasn’t decided on other details such as measurement accuracy etc. We can let RAN4 evaluate and let us know if there are any issues. The current conclusion is only based on evaluations without taking measurement errors into account. We don’t see the need to capture no consensus conclusion in chairman’s notes in this meeting.  **Proposal 3.C.2**  Similar comment as ZTE. We can agree to support ‘at least AP CSI-RS’. Then an FFS can be added on the support of P/SP CSI-RS.  **Proposal 3.C.4**  Assuming we’ll have support for AP CSI-RS (according to 3.C.2), introducing an indicator to the UE whether to pre-compensate the AP CSI-RS or not can have some merit. For instance, the gNB may pre-compensate the AP CSI-RS if the AP CSI-RS is UE specific in which case, UE doesn’t need to pre-compensate the AP CSI-RS. However, it is also possible that the AP CSI-RS triggered by the gNB may be a cell specific CSI-RS in which case the gNB won’t pre-compensate the AP CSI-RS and the UE needs to pre-compensate the AP CSI-RS. With this reasoning, we can be supportive of the proposal. Following is a small modification:  **Proposal 3.C.4**: 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, support to include an indicator in the trigger for a Rel-18 eType-II CJT CSI, which indicates whether the UE should assume that the Dd value in the latest CJTC Dd report is pre-compensated when calculating the Rel-18 Type-II CJT CSI or not.   * This feature is a separate UE capability * FFS: Details on signalling design for the indicator and the associated UE behaviour(s)   [Mod: Thanks]    **Proposal 3.C.5**  If the intention is to have a UE capability on how long the UE will buffer the DO report, we are open to discuss it further. But then, our assumption is that we don’t capture this as a timer in RAN1 specs.  [Mod: Correct. Only UE cap for NW benefit]  **Proposal 3.C.6**:  This needs further discussion. We are not sure why the feature has to be restricted to ‘mode2’ only.  **Question 3.C.7**:  We are not sure about the motivation why we need this further relaxation.  **Proposal 3.E**:  Fine with proposal. But in 2nd row of 2nd column, it should be multiple CSI-RS resources excluding the reference CSI-RS.  DL/UL phase offset for CSI-RS resources n (n=0, 1, …, NTRP – 1, n≠nref):  bits  [Mod: Thanks]  **Proposal 3.G.1**  Can be open to discuss. |
| OPPO | **Question 3.A.3**  We also think it can be up to gNB scheduling.  **Proposal 3.B.1**  Generally fine and the LS to RAN2 seems necessary. However, we think min(16,X) is redundant since the value of X would not be larger than 16 (which is meaningless). Our proposal is that “the maximum value of configured NSB-P is up to UE capability X with maximum value of X=16”.  [Mod: min(16,X) is not redundant. Without X, the max of 16 will apply to all Ues]  **Conclusion 3.B.2**:  Fine.  **Proposal 3.C.4**:  We think the functionality is redundant considering there is parameter in CSI-report-Config to indicate whether there is linkage between DO report and CJT-CSI. UE would use the latest CJTC Dd report for calculating the CJT CSI if it is configured.  [Mod: Not redundant. The linkage parameter (if any) in Report Setting indicates that linkage (conditioning on latest Dd report) is always assumed. The proposal allows using the same Report Setting to report Type-II CJT CSI with and without such conditioning]  **Proposal 3.C.5**:  We think it can be up to gNB implementation, and a UE capability only is sufficient.  **Proposal 3.C.7**:  Not need.  **Proposal 3.F:**  Fine  **Proposal 3.H.1/2**  Fine. But maybe many similar proposals for dropping condition can be combined to reduce the spec. impact.  [Mod: This is up to the spec editors. I can only make agreements one by one] |
| Xiaomi | **Question 3.A.3**  Fine with UE capability.  **Proposal 3.B.1**  Fine to limit the number of reported sub-band.  **Proposal 3.C.1**  Support to confirm the WA and open to discuss the FFS  **Proposal 3.C.2**  Support  **Proposal 3.C.4**  We share same understanding as ZTE and vivo that it can reduce the number of trigger state. We are fine with this proposal if no new DCI field is introduced. Otherwise, we prefer to configure different trigger state for CJT CSI with or without Dd compensation.  **Proposal 3.C.5**  Fine with UE capability.  **Proposal 3.C.6**  Does it mean for mode 1 even without CJT calibration, UE also has to compensate the delay offset first for calculating the common FD basis?  [Mod: Note that the Dd report used for linkage is not for calibration. As said this is digital DO precompensation, UE-specific on the assigned PDSCH. As I noted, linkage functions similarly to Mode-1 which includes digital DO precompensation – albeit at a lower resolution]  **Proposal 3.E/F**  Ok  **Proposal 3.H.1/2**  Ok |
| Nokia | **Question 3.A.3**  Agree with FL that this can be handled by NW implementation. A UE capability does not seem needed either because there is no buffering issue from UE perspective  **Proposal 3.C.1**  Support  **Proposal 3.C.2**  Fine with the FFS on P/SP. Similar views as expressed by ZTE and Ericsson  **Question/Proposal 3.C.4**  We can see the usefulness of this optimisation to address also a use case where the gNB indicates that some TRPs are pre-compensated for DO by the NW, others should be compensated by the UE.  We are also fine with Ericsson’s proposed wording and we suggest a small addition to the FFS  **Proposal 3.C.4**: 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, support to include an indicator in the trigger for a Rel-18 eType-II CJT CSI, which indicates whether the UE should assume that the Dd values in the latest CJTC Dd report are pre-compensated when calculating the Rel-18 Type-II CJT CSI or not.   * This feature is a separate UE capability * FFS: Details on signalling design for the indicator including whether it is per CSI-RS resource/Dd value and the associated UE behaviour(s)   [Mod: Thanks]  **Question/Proposal 3.C.5**  Similar views as Ericsson. We can see the usefulness of a UE capability as long as it does not restrict gNB implementation  **Proposal 3.C.6**  We have concern on this proposal as the restriction on NW configuration is not needed. The gNB may still configure DO compensation for CJT CSI report with Mode1, because the range of delays for Mode 1 and DO are different. Mode 1 has a delay offset range from 0 to 1/(PMI subband size), which can be much smaller than that of DO covering the entire CP. So DO compensation and Mode 1 can complement each other.  **Question 3.C.7**  In our view, this relaxation can cause problems with NW implementation, because the gNB needs to apply DO compensation to the CJT PDSCH transmission, hence the DO measurements CJT CSI should be reported in the same reporting instance for joint triggering  **Proposal 3.E**  Ok with a small correction on second line   |  |  | | --- | --- | | {(n,, n,, n,NSB-P), n=0, 1, …, NTRP – 1, n≠nref} | DL/UL phase offsets for NTRP – 1 CSI-RS resources:  bits |   **Proposal 3.F**  ok  **Proposals 3.G.1 – 3.G.2**  Agree with FL that these are optimisations and not needed in our view  **Proposals 3.H.1 – 3.H.2**  Support |
| Huawei, HiSilicon | **Proposal 3.A.1/3.A.2:** fine with the proposals.  **Proposal 3.B.1/3.B.2**: fine with the proposals, and also be fine with the LS, if there’s some problem from RAN2 some early communication is helpful for RAN1 discussion.  **Proposal 3.C.1:** support the proposal.  **Proposal 3.C.2:** fine with the proposal although we don’t any issue on P/SP CSI-RS.  **Proposal 3.C.4:** we believe an ACK/NACK or confirmation of previous DO reports will be more useful, if the latest DO reports fails, UE can still use the successfully received DO report before the failed DO. The current proposal is equivalent to configuration of two CJT CSI reports, one configured with linkage and the other without linkage.  [Mod: ACK/NACK-like is not precluded. This will be addressed when we discuss further details]  **Proposal 3.C.5:** fine with it.  **Proposal 3.C.6:** for mode 1, we see it’s also beneficial to link with a DO, which can reduce the frequency selectivity within the subband.  **Question 3.C.7:** the relaxation will result in some problems, such as multiple PUSCH triggered by one DCI corresponding to multiple instances, timeline between two instances etc. So we don’t think it’s needed.  **Proposal 3.E**: fine with it.  **Proposal 3.F:** fine with it.  **Proposal 3.H.1/3.H.2:** fine with it. |
| Mod V17 | **Revisions per inputs**  **@OPPO, Xiaomi, Huawei: please check my responses to your inputs** |
| Samsung | On **Proposal 3.C.4,**  @Google: The benefit is to avoid the overuse of the number of CSI reporting settings (as vivo commented in detail), when NW needs to configure different flavors of CJT CSI reporting, i.e., with or without assuming Dd pre-compensation. Using an indicator in the trigger for a CJT CSI report as described in the proposal, the overuse could be resolved, although the detail signaling need to be discussed further. Also, as we mentioned in our previous reply, error propagation can be handled by good NW implementation so the reliability issue of the DO report is not a problem under the good NW implementation.  @Oppo: As the FL commented and vivo commented, without this proposal, it is need to configure one additional reporting setting which consumes inefficiently the IE resource of Max # of CSI Reporting settings subject to UE cap and small (1 to 4). So it is not redundant but needed to save the resource. |
| NEC | **Question 3.A.3:** Fine.  **Proposal 3.B.1:** Support the proposal. In addition, regarding the configuration of NSB-P subbands, we think a comb-like structure (e.g. with a starting index and interval value) is beneficial for both reduced ehaviour overhead and for UE complexity (such as interpolation complexity).  **Conclusion 3.B.2:** OK.  **Proposal 3.C.1:** Support.  **Proposal 3.C.2:** Support  **Proposal 3.C.4:** We think the indicator is beneficial to ensure the calibration report is received by the network.  In addition, we think if CJT CSI itself is based on assumption of ideal synchronized, such as co-located, there is no need of CJT calibration in the framework. While there can be a valid case that, the assumption is non-ideal synchronized/backhaul (i.e. delay offset calibration is needed), and one CJT CSI reporting can be with pre-compensation or no pre-compensation (e.g. based on the indicator),   * if the CJT CSI reporting is with pre-compensation, the reporting mode can be mode-2 (especially when the network configures the parameters suitable, there is no need of FD basis offset reporting) * if the CJT CSI reporting is without pre-compensation, the reporting mode should be mode-1 (i.e. the FD basis offset reporting is needed).   So we would like to add one FFS as follows  Updated Proposal 3.C.4: 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, support to include an indicator in the trigger for a Rel-18 eType-II CJT CSI, which indicates whether the UE should assume the latest CJTC Dd report for calculating the Rel-18 Type-II CJT CSI or not.   * This feature is a separate UE capability * FFS: Details on signalling design for the indicator and the associated UE behaviour(s) * FFS: *codebookMode* assumption is based on the indicator, e.g. if the indicator indicates UE assuming the latest CJTC Dd report for calculating the CJT CSI, the *codebookMode* is assumed as ‘mode2’ (no FD basis offset reporting), and if the indicator indicates UE not assuming the latest CJTC Dd report for calculating the CJT CSI, the *codebookMode* is assumed as ‘mode1’ (with FD basis offset reporting)   [Mod: This proposal has nothing to do with linkage indication. So I will not add this FFS for 3.C.4. I will add your proposal for discussion in later rounds]  **Proposal 3.C.5:** Support.  **Proposal 3.C.6:** As discussed in **Proposal 3.C.4**, we think if CJT CSI itself is based on assumption of ideal synchronized, such as co-located, there is no need of CJT calibration in the framework. While there can be a valid case that, the assumption is non-ideal synchronized/backhaul (i.e. delay offset calibration is needed), and one CJT CSI reporting can be with pre-compensation or no pre-compensation (e.g. based on the indicator),   * if the CJT CSI reporting is with pre-compensation, the reporting mode can be mode-2 (especially when the network configures the parameters suitable, there is no need of FD basis offset reporting) * if the CJT CSI reporting is without pre-compensation, the reporting mode should be mode-1 (i.e. the FD basis offset reporting is needed).   Not sure whether this added in Proposal 3.C.4 or Proposal 3.C.6 is better, so I put it to both proposals.  **Proposal**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, for one Rel-18 eType-II CJT codebook configuration linked with CJTC Dd and if configured with two separate triggers, the *codebookMode* is assumed as ‘mode1’ if pre-compensation with CJTC Dd is not indicated, and the *codebookMode* is assumed as ‘mode2’ if pre-compensation with CJTC Dd is indicated.  **Proposal 3.F:** As we agreed phase offset reporting can be wideband only (i.e. =) or subband reporting (i.e. ), and it’s natural that subband phase reporting requires more complexity at UE side, and subband phase reporting has a separate UE capability. So we prefer to define different OCPU for different values of , e.g. to define different UE capabilities on value of X for wideband only () and for subband reporting (  **Updated Proposal 3.F**: For the Rel-19 aperiodic standalone CJT calibration reporting, regarding active resource counting and OCPU, when ReportQuantity is ‘cjtc-P’ (phase offset), fully reuse those from Rel-18 TDCP reporting   * OCPU =X.NTRP where X≥1 is defined based on UE capabilities and determined by the UE for each CJT calibration report type and for each of  and    [Mod: Thanks]  **Proposal 3.G.2:** Support. We think combined with RSRP reporting, more information can be provided to network for better scheduling and configuration. |
| Google | Proposal 3.C.4: We can be open to the updated proposal. But we would like to suggest some editorial changes. Since spec defines UE ehaviour instead of NW ehaviour, the indicator should tell UE whether the UE needs to calculate the CSI based on the reported DO or not, instead of telling the UE whether the NW has performed the pre-compensation or not (although this is implied by telling UE not to perform the DO compensation).  **Proposal 3.C.4**: 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, support to include an indicator in the trigger for a Rel-18 eType-II CJT CSI, which indicates whether the UE should perform the DO compensation based on the linked DO report ~~assume that the Dd values in the latest CJTC Dd report are pre-compensated~~ when calculating the Rel-18 Type-II CJT CSI or not.   * This feature is a separate UE capability * No new DCI field is introduced * FFS: Details on signalling design for the indicator including whether it is per CSI-RS resource/Dd value and the associated UE behaviour(s)   [Mod: Thanks for the good comments] |
| OPPO | **Proposal 3.C.4**:  In the previous releases, the argument and consequence on many issues was being that it can be solved by gNB via different CSI report configurations, which seem not so important. But now we are trying to optimize the number of CSI-report-config. That said, we could be fine with the updated proposal if majority companies like it. |
| Fujitsu | **Proposal 3.A.1/3.A.2:** Fine with the proposals.  **Proposal 3.B.1/3.B.2:** fine with the proposals.  **Proposal 3.C.1:** Support to confirm the WA and support to discuss the FFS  **Proposal 3.C.2:** Support  **Proposal 3.C.4:** Fine with the proposal. We are confusing about the new added part in FFS “indicator including whether it is per CSI-RS resource/Dd value”. Dose it mean that only partial CMRs in one set can be assumed to be pre-compensated by UE?  [Mod: Correct – from Nokia to be discussed as a part of the FFS]  **Proposal 3.C.6**: Not support. Even if the delay spread of CSI-RS among N TRPs CSI-RS pre-compensated by UE, the delay spread across multiple delay paths in each TRP cannot be pre-compensated. Thus, we believed that mode 1 by independent FD basis can provide more performance gain for Rel-18 CJT PMI.  **Proposal 3.H.1/2:** Support |
| vivo | **Question 3.A.3**  We are also okay to add only a UE capability, following similar principle as 3.C.5.  **Proposal 3.B.1**  We are okay to limit the number of sub-bands due to overhead issue. But we are not clear why a UE capability X is needed to be introduced. We can simply set the maximum number to be 16, given the only motivation to drive this proposal is the overhead limit.  **Proposal 3.C.4**  We support the wording change from Google on the main bullet, which is more clear than the current version. It is better to describe whether the compensation is done by UE when calculating Type II CJT.  **Proposal 3.E**  OK  **Proposal 3.F**  OK  **Proposal 3.G.2**  We are not sure about the need to specify this.  **Proposal 3.H.1**  OK  **Proposal 3.H.2**  OK |
| HONOR | **Proposal 3.A.1**, **Proposal 3.A.2**: Support.  **Question 3.A.3**: Up to network implementation.  **Proposal 3.B.1**: Fine.  **Proposal 3.C.1**: Support. In addition, we should further study that whether the CMRs in the two report settings should be linked so that UE knows which CMRs in the two report settings correspond to the same TRP.  [Mod: Later rounds]  **Proposal 3.C.2**: Support.  **Proposal 3.C.3**: Not necessary.  **Proposal 3.C.4**: Prefer the suggestion from Google that the proposal should be formulated from UE perspective.  **Proposal 3.C.5**: Fine with the proposal. One minor comment: it should be a maximum time duration for buffering the delay offset for compensation rather than an expiration timer. There is no timer in RAN1 spec.  [Mod: The actual name would be up to the spec editors. The bullet describes the functionality]  **Proposal 3.C.6**: Support. The intention is that network should know which delay offset (Rel-19 Dd or Rel-18 CJT FD basis offset) has been used for PMI calculation so that network can know how to reconstruct the PMI.  **Question 3.C.7:** Our understanding is that two CSI reports are in the same PUSCH scheduled by the DCI for CSI report triggering. |
| Sharp | **Proposal 3.A.1:** We are OK with the proposal.  **Proposal 3.A.2:** Support.  **Proposal 3.B.1:** Support.  **Conclusion 3.B.2**: OK  **Proposal 3.C.1:** Support  **Proposal 3.C.2:** Support.  **Proposal 3.C.3:** Not support.  **Proposal 3.C.4:** Support. It is important to avoid the mis-alignment of the delay offset value between UE and gNB.  **Proposal 3.C.5:** In terms of memory/buffer, we are fine to introduce a UE capability for an expiration timer.  **Proposal 3.E:** Support.  **Proposal 3.F:** Support.  **Proposal 3.G.2:** Not support.  **Proposal 3.H.1:** Support.  **Proposal 3.H.2:** Support. |
| Intel | **Proposal 3.A.1:** Support  **Proposal 3.A.2:** Proposal is OK, prefer to not have the FFS points  **Question 3.A.3:** Not support – it is up to the network to determine the level of staleness it can accept – why do we add constraints in the specifications ?  **Proposal 3.B.1**: We don’t support the LS, the proposal may not be essential because a Polar code limit of 1706 can be handled by NW implementation. But if majority is OK with the proposal, we can be OK.  **Conclusion 3.B.2:** No strong opinion, perhaps the proponent can clarify the use-case  **Proposal 3.C.1**: We are ok with the proposal – prefer to have the original proposal with no refinement  **Proposal 3.C.2**: Support  **Proposal 3.C.3**: we are not supportive of this proposal.  **Proposal 3.C.4**: Not support, we don’t see the need to optimize trigger states.  **Proposal 3.C.5:** Not support, what happens for UEs without this cap, unnecessary restriction for scheduling  **Question 3.C.5**: No  **Proposal 3.C.6**: Needs further discussion, not clear why limited to mode2  **Question 3.C.7**: We don’t see the use-case - not needed  **Proposal 3.E:** OK  **Proposal 3.F:** OK  **Proposal 3.G.1:** Not support  **Proposal 3.G.2:** Not support  **Proposal 3.H.1:** OK  **Proposal 3.H.2:** OK |
| KDDI | **Question 3.A.3**: We agree with the FL assessment, and think the NW implementation can handle this.  **Proposal 3.C.4**: Support. We also think that it can be helpful to reduce the number of CSI reporting settings as vivo and Samsung explained.  **Proposal 3.C.5**: Support.  **Question 3.C.7**: We do not understand the motivation for this relaxation. So, we do not believe this is necessary at this time.  **Proposal 3.E**: Support.  **Proposal 3.F**: Support.  **Proposal 3.G.2**: We agree with the FL assessment that this is an optimization, so we don't think there is any need to force to specify it.  **Proposal 3.H.1**: Support.  **Proposal 3.H.2**: Support. |
| Apple | **Proposal 3.A.1**: We are okay  **Proposal 3.A.2**: We are okay  **Question 3.A.3**: Do not see the necessity  **Proposal 3.B.1**: We are okay, we do not see the need of LS  **Conclusion 3.B.2**: We are okay  **Proposal 3.C.1:** We are okay only if we can agree that for this feature, only AP CSI-RS can be used for the associated CJTC Dd report (P/SP CSI-RS) cannot be used. Otherwise, it will significantly complicate the UE CSI processing timeline since P/SP CSI-RS can be received well before DCI that triggers the AP report  [Mod: It is a fair point]  **Proposal 3.C.2**: If we agree on Proposal 3.C.1, we do not support P/SP CSI-RS, so the FFS should be removed. We think Proposal 3.C.1 and 3.C.2 should be discussed together.  [Mod: Noted. We can discuss 3.C.2 first along with the resolution of the FFS – which, based on the current situation, would most likely imply no support for P/SP – 7 companies including Apple, Qualcomm, Samsung have serious concern]  **Proposal 3.C.3**: Not support  **Proposal 3.C.4**: We think this is low priority. The linkage can be also configured in CSI-ReportConfig  **Proposal 3.C.5**: Do not understand why we need to make this so complicated.  **Proposal 3.C.6**: We are okay.  **Question 3.C.7**: No relaxation is needed  **Proposal 3.E**: We are okay.  **Proposal 3.F**: We are okay  **Proposal 3.G.1:** We think it is low priority  **Proposal 3.G.2:** We think it is low priority  **Proposal 3.H.1:** We are okay  **Proposal 3.H.2:** We are okay |
| CATT | **Proposal 3.A.1**:  We are generally ok. Shouldn’t it be “The selection of PSRS=1 SRS port out of the **x** available SRS ports”? Since the associated Q=1 SRS resource (selected from y/x SRS resources) is with x ports.  [Mod: As I explained to Sharp in OFFLINE 😊, I made a mistake in Fukuoka with x. JD (Qualcomm) pointed out in Maastricht (perhaps round-2, documented in FL summaries) that since we have y/x resources and x ports per resource, the total number of ports is x\*(y/x)=y. So this selection also performs Q=1 resource selection at the same time.]  **Proposal 3.A.3**:  We understand the motivation to limit the time gap between SRS and CSI-RS so as to guarantee the channel reciprocity, but we prefer to handle it via NW implementation.  **Proposal 3.C.5**:  We prefer NW implementation.  **Proposal 3.C.6**:  We fail to see the reason to solely limit to CJT mode 2. CJT mode 1 does not work very well when the DOs between TRPs are large and the DO-induced frequency selectivity becomes more severe.    **Question 3.C.7**:  We think “in two different reporting instances (slots)” is ok.  **Proposal 3.E:** Support  **Proposal 3.F**: OK  **Proposal 3.H.1:** Support  **Proposal 3.H.2:** Support |
| Sony | **Proposal 3.A.1:**  Okay with the proposal.  **Proposal 3.A.2:**  Okay with the proposal.  **Proposal 3.A.3:**  The motivation is not clear to us. As pointed out by the FL and others, the NW has full knowledge of the overall situation and should be able to avoid stale SRS when triggering a ‘cjtc-P’ report.  **Proposal 3.B.1:**  Fine with the proposal. We can then discuss how to select out of all possible sub-bands.  **Conclusion 3.B.2:**  OK.  **Proposal 3.C.1:**  We support confirming the WAs and to discuss the FFSs.  **Proposal 3.C.2:**  OK.  **Proposal 3.C.4:**  We are okay with this proposal since it can help reducing the number of used CSI-RS resource settings. Similar to Huawei, we think the mechanism could be more useful if the latest ACK:ed DO is used when the network fails to decode a DO report, rather than skipping DO pre-compensation entirely.  [Mod: Yes, we will discuss the FFS and detailed issues including interpretation (procedure) will encompass the above]  **Proposal 3.C.5:**  We don’t think this is needed.  **Proposal 3.E:**  Okay with this proposal.  **Proposal 3.G.1:**  Support.  **Proposal 3.G.2:**  Open to discuss.  **Proposal 3.H.1/3.H.2:**  OK. |
| Mod V34 | **Revisions (mostly minor) to address inputs**  **P3.C.1 and 3.C.2: Per Apple’s request we will try to resolve 3.C.2 first including the FFS point. Given the situation, the chance of supporting P/SP is very small, if any, but we can conclude first – before we conclude on 3.C.1.**  **P3.C.4: revision per Google’s comment (which is clearer)**  **@CATT: please check my response re x vs y (also mentioned during OFFLINE, i.e. my mistake in Fukuoka for the FFS, corrected by JD in Maastricht)** |
| TCL | **Proposal 3.A.1/2:** Fine.  **Question 3.A.3:** Not support, depend on NW implementation.  **Proposal 3.B.1**: Fine.  **Proposal 3.C.1/2/3**: Fine.  **Proposal 3.C.4**: Support  **Proposal 3.C.5:** Not support.  **Proposal 3.C.6**: Not support. We don’t see the necessity for distinguishing mode 2.  **Question 3.C.7**: No  **Proposal 3.E:** Support  **Proposal 3.F:** Support  **Proposal 3.G.1:** Fine  **Proposal 3.G.2:** Fine  **Proposal 3.H.1:** Support  **Proposal 3.H.2:** Support |
| Spreadtrum | **Proposal 3.A.1/3.A.2**: Support.  **Question 3.A.3**: We don’t think expiration window is needed.  **Proposal 3.B.1**: OK  **Proposal 3.C.1/3.C.2**: Support  **Proposal 3.C.3**: Not support.  **Proposal 3.C.4**: We are fine to configure an indicator in the trigger.  **Proposal 3.C.5**: NW implementation.  **Question 3.C.7**: No need to relax the condition.  **Proposal 3.E/3.F:** Support  **Proposal 3.G.1**: No need to report Dd and PO together.  **Proposal 3.G.2:** We don’t support the optimization  **Proposal 3.H.1/3.H.2:** Fine. |
| Mod V39 | **No revision** |
| Lenovo/ MotM | **Re Proposal 3.C.5**:  We do not believe this issue is a NW implementation since the CSI processing to derive the DL precoder at the NW is based on knowledge of this timer value. The NW side needs to know the timer value. If the delta between the two separate triggers is within the timer value, the NW assumes the UE has applied the DO in computing the CSI based on Type-2 CJT CB, whereas if the delta between the two separate triggers is larger than the timer value, the NW will have to apply the DO to the PMI coefficients to each of the corresponding TRPs in CJT based on function of the values obtained in the last CJTC report |
| NTT DOCOMO | **Question 3.A.3:** Not support (NW implementation)  **Proposal 3.C.3:** Not support  **Proposal 3.C.4:** Support  **Question 3.C.7:** No  **Proposal 3.E:** Support |
| Mod V43 | **No revision**  **@Those not supporting 3.C.5, please check Lenovo’s comment above.** |
| MediaTek | **Proposals 3.C.4, 3.C.5, 3.C.6** OK  **Question 3.C.7** We don’t see the need for relaxation. Relaxation would further complicate the linkage as pointed out by Huawei. |
| CMCC | **Proposal 3.A.2**:  We support this proposal in principle. Regarding the first FFS: Whether ‘the earliest SRS transmission occasion after the NTRP CSI-RS occasions’ is also supported as an option. I remember that it was clarified in FL summary Round 0 by Samsung that for the case of **precoded CSI-RS**, the latest SRS transmission occasion before the NTRP CSI-RS occasions should be considered. Regarding the precoded CSI-RS transmission scheme, we spot another issue that should be considered. That is, if the latest SRS transmission occasion is very close to the NTRP CSI-RS occasions, it is possible that the gNB does not have enough time to do precoding based on the SRS transmission occasion. |
| Mod V48/Final | **No revision** |

# References

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| --- | --- | --- | --- |
| 1 | RP-242394 | Revised WID: NR MIMO Phase 5 | Samsung (Moderator) |
| 2 | R1-2408636 | Moderator Summary for OFFLINE discussion on Rel-19 CSI enhancements | Moderator (Samsung) |
| 3 | R1-2407679 | On 128 CSI-RS ports and UE reporting enhancement | Huawei, HiSilicon |
| 4 | R1-2407699 | Discussion on CSI enhancements | Spreadtrum Communications |
| 5 | R1-2407755 | CSI enhancements | Tejas Network Limited |
| 6 | R1-2407774 | Discussion on CSI enhancements | ZTE Corporation, Sanechips |
| 7 | R1-2407813 | CSI enhancements | MediaTek Inc. |
| 8 | R1-2407824 | Discussion on Rel-19 CSI enhancements | New H3C Technologies Co., Ltd. |
| 9 | R1-2407854 | Remaining issues on Rel-19 CSI enhancements | vivo |
| 10 | R1-2407898 | Discussion on CSI enhancements | CMCC |
| 11 | R1-2407962 | Discussion on Rel-19 MIMO CSI enhancements | Xiaomi |
| 12 | R1-2407993 | CSI Enhancement for NR MIMO | Google |
| 13 | R1-2408040 | On Rel-19 MIMO CSI enhancements | CATT |
| 14 | R1-2408109 | Discussion on Rel-19 CSI enhancements | Fujitsu |
| 15 | R1-2408165 | CSI enhancements for Rel-19 MIMO | OPPO |
| 16 | R1-2408188 | Discussion on Rel-19 Enhancements of CSI | InterDigital, Inc. |
| 17 | R1-2408200 | Discussion on CSI enhancements | Lenovo |
| 18 | R1-2408210 | Discussion on CSI enhancements | NEC |
| 19 | R1-2408231 | Discussion on CSI enhancements | HONOR |
| 20 | R1-2408295 | CSI enhancements for MIMO | Intel Corporation |
| 21 | R1-2408337 | Discussions on CSI enhancements | LG Electronics |
| 22 | R1-2408349 | CSI enhancements | Sharp |
| 23 | R1-2408395 | CSI enhancements for Rel. 19 MIMO | Fraunhofer IIS, Fraunhofer HHI |
| 24 | R1-2408405 | More views on CSI enhancements | Sony |
| 25 | R1-2408458 | Views on R19 MIMO CSI enhancement | Apple |
| 26 | R1-2408496 | Discussion on CSI enhancements | TCL |
| 27 | R1-2408563 | Discussion on Rel-19 CSI enhancements | ETRI |
| 28 | R1-2409017 | Views on Rel-19 CSI enhancements | Samsung |
| 29 | R1-2408739 | CSI enhancement for NR MIMO Phase 5 | Nokia |
| 30 | R1-2408779 | Discussion on CSI enhancements | NTT DOCOMO, INC., NTT CORPORATION |
| 31 | R1-2408843 | CSI enhancements for >32 ports and UE-assisted CJT | Qualcomm Incorporated |
| 32 | R1-2408876 | CSI enhancements for large antenna arrays and CJT | Ericsson |
| 33 | R1-2408926 | CSI Enhancements | CEWiT |
| 34 | R1-2408948 | Discussion on CSI enhancements for NR MIMO Phase 5 | KDDI Corporation |
| 35 | R1-2408964 | Discussion on CSI enhancements | NICT |
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