**3GPP TSG RAN WG1 #119 R1-2410752**

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

**Agenda item:** 9.2.2

**Source:** Moderator (Samsung)

**Title:** Moderator Summary#3 on Rel-19 CSI enhancements: Round 3

**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** |
| 1.2 | **Proposal 1.B**: For the Rel-19 Type-I SP codebook refinement for 48, 64, and 128 CSI-RS ports, extend the agreed Scheme-A and Scheme-B to 16, 24, and 32 CSI-RS ports, for all applicable RI values with K=1 only, and without any further modification/enhancement of the sub-features pertinent to the Rel-19 Type-I SP design (including, e.g. the Rel-19 Type-I SP CBSR, soft scaling).* For the Rel-19 Type-I SP codebook, the support for 16, 24, and 32ports are 3 separate UE capabilities from the support for the previously agreed number of ports (48, 64, 128 ports)
* The Rel-18 SD NES schemes applicable to Rel-15 Type-I SP codebooks are also applicable to the extension of the Rel-19 Type-I SP codebook to 16, 24, and 32 ports
* FFS: whether to adopt the extended orthogonal set for the 2nd SD basis for Scheme-A, RI=2-4 and 16, 24, and 32 CSI-RS ports

**FL assessment**: This was discussed OFFLINE [1] as well as OFFLINE-2. We have tried the possibilities of extending only Scheme-A, but the number of companies raising concerns is very large. The same goes with only Scheme-B. FFS:* Yes: Nokia/NSB,
* No: NTT DOCOMO, NTT CORP, ZTE, Tejas, MediaTek,
 | **Support/fine:** ZTE, IDC, Samsung, Xiaomi, Nokia/NSB, NEC, Fujitsu, NTT DOCOMO, NTT CORP, Spreadtrum, UNISOC, CMCC, MediaTek, Ericsson, Apple, Google, IDC, Tejas, Sharp, Orange, Lenovo/MotM (ok, low priority), China Telecom, KDDI, Intel (ok), New H3C,**Strong concern:** vivo, CATT, OPPO |
| 1.4. | **Proposal 1.D**: For the Rel-19 Type-I SP codebook refinement for P=48, 64, 128 CSI-RS ports, regarding Scheme-B, when the UE is configured to report wideband CSI on PUCCH:* For PUCCH format 2, one-part CSI is used
* For PUCCH formats 3 and 4, two-part CSI is used where SD basis selection is reported in CSI-part2
	+ CSI fields in CSI-part1 and part2 follows the legacy sub-band CSI

**FL assessment**: This proposal is scheme-B optimization for WB PUCCH reporting. Whether a two-part CSI is needed or not can be discussed, e.g. whether the difference in payload across RIs is enough to justify the use of two-part CSI on PUCCH F3/4 especially for WB.* From moderator perspective, **the difference in payload across RIs will be much larger when Nrep>1 is configured to be reported on the same PUCCH**.
	+ **[JD/Qualcomm] Nrep>1 on PUCCH is practical for CA, since only one (or optionally, two) cell can have PUCCH to convey all DL CCs’ CSI reports.**
* To minimize spec impact, PF2 is still kept 1-part (since 2-part isn’t supported for PF2 in legacy).
* Therefore, this proposal is technically sound
 | **Support/fine:** Qualcomm,Xiaomi (open), Fraunhofer IIS/HHHI (open), Samsung (ok), Tejas (open), vivo (open), Sharp, NTT DOCOMO, NTT CORP, Apple (open), TCL, **Not support:** Google, CMCC, Lenovo/MotM, OPPO, Fujitsu, ZTE, CATT, Spreadtrum, Intel, Huawei/HiSi, New H3C, |
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Table 1B SLS results: issue 1

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

Table 1C Additional inputs: issue 1

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| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 1A** |
| ZTE | **Proposal 1.B:**We have similar views as before. From our perspective, at least scheme-A should be extended to <= 32 ports to align the codebook structure for RI = 3-4, but we are also fine with extending both scheme-A and scheme-B to <=32 ports.Regarding the FFS, we have agreed to reuse R15 Type-I SP codebook structure for RI = 1-4 for scheme-A to facilitate the commercialization. It is strange to extend the orthogonal SD basis set for <= 32 ports but NOT extend the SD basis set for > 32 ports. Moreover, if the FFS is supported, the codebook structure would be NOT aligned for RI = 1-4 for <=32 ports and >32 ports again.**Proposal 1.D:**We did NOT see the necessity of breaking the legacy UCI mapping rule for only Rel-19 SP Type-I codebook scheme-B with >32 ports. |
| OPPO | **Proposal 1.B:**We still think RAN1 cannot introduce a new codebook with similar payload and performance as legacy one, considering Type I CB and eType II CB has been deployed or to be deployed. Also, we don’t see any issue on NES case. We have Type I codebooks for 1-128 ports, and gNB can configure any number of ports as it wants. Anyway N1/N2 and corresponding codebooks are different. **Proposal 1.D:**The PUCCH resources are determined assuming the rank with maximum payload. In this case, the impact of some padding bits in one part CSI seems marginal since the total payload is still lower than expected.  |
| MediaTek | **Proposal 1.B**Do NOT support the FFS for extended orthogonal set for Scheme A, RI = 2-4. Similar to ZTE’s comment, this is an entirely new codebook different from Rel-15 and Rel-19 designs for RI=2-4 and is not in line with the motivation of this proposal. |
| CATT | **Proposal 1.B：**We still have concern on introducing scheme A on legacy port. Simulation results from CATT, Samsung, Nokia and Vivo all shows that the scheme A has negligible performance gain, there is no motivation to introduce a new low complexity codebook for legacy port numbers considering existing Rel-15 Type I already works well.Also, we want to reply to @CMCC about the NES concern raised in online session yesterday. We understand the need from operator that NES feature to perform SD NES type 1 and the port number will be changed from 32-128 ports to legacy smaller than 32 ports. Our understanding is that current CSI report sub-configurations framework is quite flexible with individual codebookSubConfig and portSubsetIndicator, we are open to discuss any details to facilitate NES if needed. There is no point to introduce scheme A over legacy port numbers.  |

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

Table 2A Summary: issue 2

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| **#** | **Issue** | **Companies’ views** |
| 2.6 | Proposal 2.F: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding UCI omission for the UCI reported in CSI part-2, support the following method for assigning priority levels to multiple CRIs in a single CSI instance.* For the non-reported *MR* CRIs, priority order (from higher to lower) is assigned based on the RRC configured order of *MR*.
* For the reported *M*-*MR* CRIs (or *M* CRIs if *MR* is not configured), priority order (from higher to lower) is assigned based on a beam quality measure like, CRIs’ SINR or CRIs’ RSRP or a combination of resource specific RI and resource specific CQI.

**FL assessment**: The proposal introduces additional priority rules for the (M-MR) CRIs. Given the previous agreement on priority rules and packing order (along with M CRIs), it is unclear why this additional set of rules is needed.  | **Support/fine**: Tejas, IDC (open), Huawei/HiSi (open),**Not support**: Google, Qualcomm, NTT DOCOMO, NTT CORP, MediaTek, Xiaomi, CMCC (UE implementation), Lenovo/MotM, OPPO, ZTE, CATT, Spreadtrum, Intel, Apple, TCL, New H3C, |
| 2.7 | **Proposal 2.G**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports,select between the following priority functions:* Alt1: $Pri\_{iCSI}\left(y,k,c,s,m,M\right)=2∙N\_{cells}∙M\_{s}∙M\_{m}∙y+N\_{cells}∙M\_{s}∙M\_{m}∙k+M\_{s}∙M\_{m}∙c+s+M\_{s}∙M∙m$
* Alt2: $Pri\_{iCSI}\left(y,k,c,s,m,M, M\_{R}\right)=2∙N\_{cells}∙M\_{s}∙M\_{m}∙y+N\_{cells}∙M\_{s}∙M\_{m}∙k+M\_{s}∙M\_{m}∙c+s+M\_{s}∙(M-M\_{R})∙m$
* Alt3: No change to legacy $Pri\_{iCSI}\left(y,k,c,s\right)=2∙N\_{cells}∙M\_{s}∙y+N\_{cells}∙M\_{s}∙k+M\_{s}∙c+s$, and, when configured with a multi-CRI report with M>1 CRIs and *reportConfigID* “$s$”, UE does not expect to be configured with another CSI report with *reportConfigID* value from “$s+1$” to “$s+M-1$” while having the same parameter value “$y$” “$k$” and “$c$” as the multi-CRI report “$s$”

where * *m =* 0 for non-*M* CRI based CSI reports (legacy CSI reports up to Rel-18),
* *m =* 1 for *M* CRI based CSI reports. $M\_{m}$ is the maximum number of CRIs configured for multi-CRI CSI reports not carrying L1-RSRP or L1-SINR

**FL assessment**: The proposal introduces additional priority rule for the (M-MR) CRIs. Whether this is needed or not can be discussed (currently unclear to the moderator).  | **Support/fine**: Tejas (Alt1/2), Qualcomm (Alt3), MediaTek, Lenovo/MotM (Alt3), IDC, Samsung (ok), Huawei/HiSi (open), Xiaomi (Alt3)**Not support**: Google, NTT DOCOMO, NTT CORP, CMCC, OPPO, Fujitsu, ZTE, Spreadtrum, vivo, Ericsson, Apple, TCL, New H3C,  |
| 2.8 | **Proposal 2.H**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, support dropping of CSI part-2 (PMI, LI, CQI for 2nd CW) for a CRI corresponding to out-of-range WB CQI reported in the CSI part-1**FL assessment**: The proposal intends to reduce CSI part-2 overhead | **Support/fine**: Intel, Google, NTT DOCOMO, NTT CORP, Fujitsu, Huawei/HiSi (open), Xiaomi (open), **Not support**: Spreadtrum, CATT, Lenovo/MotM, ZTE, OPPO, Apple, vivo, Ericsson,  |

Table 2B SLS results: issue 2

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Table 2C Additional inputs: issue 2

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 1A** |
| Nokia | **Proposal 2.G**No need for this proposal in our view. The legacy formula in Alt3 works without need for restriction on the reportID values**Proposal 2.H**No need to optimize such a corner case |
| Xiaomi | **Proposal 2.G**:Our comments given in Round 2 may be not enough clear. Our view is not accurately captured. We think the proposal is not needed. The legacy $Pri\_{iCSI}\left(y,k,c,s\right)$ could be reused without any restriction.  |
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### Issue 3 (WID objective 3): CJT calibration reporting for non-ideal synchronization and backhaul

Table 3A Summary: issue 3

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| **#** | **Issue** | **Companies’ views** |
| 3.2.1 | **[119] Agreement**For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with a joint trigger, the timeline (Z/Z’) is determined as Z/Z’ associated with the Rel-18 eType-II CJT, plus Drelax * The value of Drelax is a UE capability, taken from {0, drelax}
	+ FFS: The value of drelax (>0), including whether it depends on SCS
* For linking CJTC Dd and Rel-18 eType-II CJT CSI, joint triggering is a separate UE feature group from separate triggering

**Proposal 3.B.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 a joint trigger, drelax is Z1’ of table 5.4-2 in TS38.214 (corresponding to WB Type I CSI report with at most 4 ports)**FL assessment**: Discussed during OFFLINE-1. The FFS needs to be resolved**Question 3.B.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 a joint trigger, please share your view, if any, on the value of drelax (>0):* Z1’ of table 5.4-2 in TS38.214 (corresponding to WB Type I CSI report with at most 4 ports): MediaTek, Google, Lenovo/MotM, ZTE,
* *Z2/Z2’:* ZTE
* $\frac{1}{2}\left(Z\_{2}/Z\_{2}^{'}\right)$*:* ZTE
* *Z1/Z1’:* ZTE
* UE feature session: Samsung, CATT, OPPO, Spreadtrum, Apple,
 | **Support/fine**: MediaTek, Google, Lenovo/MotM, ZTE, Xiaomi, NEC, OPPO, **Not support (UE feature session, or need more time):** vivo, Samsung, CATT, Spreadtrum, Apple, Ericsson, Huawei/HiSi,  |
| 3.2.2 | **Proposal 3.B.2**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with a joint trigger, the UE does not perform DO compensation on the Rel-18 type II CJT CSI associated with TRP(s) that are either ‘out of range’ **FL assessment**: Since linkage assumes UE-specific PDSCH digital DO pre-compensation akin to Rel-18 Type-II CJT Mode-1, a proper use case would assume that the selection of NTRP TRPs already removes TRPs that result in dn=’outside’. So the need for this proposal is unclear. | **Support/fine**: MediaTek, Samsung, Xiaomi, NEC, Spreadtrum, vivo (open), Sharp, Sony, Apple, Google (OOR), Lenovo/MotM, Sony, **Not support**: NTT DOCOMO, NTT CORP, Nokia/NSB, OPPO, Fujitsu, ZTE, CATT, Rakuten, Huawei/HiSi, KDDI, TCL,  |
| 3.4 | **[118] Agreement**For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific frequency offset pre-compensation on PDSCH by the NW, *decide*, by RAN1#118, whether to support configuring a UE (via RRC ignalling) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported frequency offset (when ReportQuantity is ‘cjtc-F’). And if supported, whether any of the following is additionally supported or not: * NW indicates the frequency offset value to be compensated for the Rel-18 eType-II CJT CSI report, and/or
* The two separately configured reports (i.e. Rel-18 eType-II CJT CSI report and the CJTC frequency offset report) are always jointly triggered and carried on a same PUSCH (hence on a same slot)
* The frequency offset value to be compensated is the latest reported fO before the DCI triggering the CJT CSI reporting

FFS: AP-CSI-RS can be configured for the Rel-18 eType-II CJT reportThe above only applies when the CMRs do not share common QCL source for Doppler shift indication**Proposal 3.D.1**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, to facilitate UE-specific frequency offset pre-compensation on PDSCH by the NW, support configuring a UE (via RRC signalling) to perform PMI calculation for the Rel-18 eType-II CJT CSI report assuming pre-compensation using the UE-reported frequency offset (when ReportQuantity is ‘cjtc-F’), using the same mechanisms as that for UE-reported delay offset (when ReportQuantity is ‘cjtc-Dd’).* This implies that all the supported sub-features associated with ReportQuantity = ‘cjtc-Dd’ linked to Rel-18 eType-II CJT CSI are extended to ReportQuantity = ‘cjtc-F’ linked to Rel-18 eType-II CJT CSI

**FL assessment**: The above issue needs some discussion.  | **Support/fine**: vivo, Xiaomi, Fujitsu, Sony, Samsung, ZTE, Rakuten,**Not support (NW implementation)**: Huawei/HiSi, MediaTek, CMCC, CATT, Nokia/NSB, Qualcomm, Lenovo/MotM, NTT DOCOMO, NTT CORP, OPPO, Google, Spreadrum, Sharp, Intel, Apple, KDDI, TCL, New H3C,  |
| 3.5.1 | **Proposal 3.E.1**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with two separate triggers, introduce a UE capability for the following: * The UE capability is used to inform the NW on the maximum duration of 2 sec the UE can store the latest CJTC Dd report, measured from the transmission of the linked CJTC Dd report
* When the UE does not report this UE capability, it is assumed that the UE can store a CJTC Dd report [indefinitely]

**FL assessment**: Wording is based on the outcome of Monday and Wednesday **OFFLINE** sessions in RAN1#118bis.This is intended to avoid stale Dd report from being utilized. However, it can be argued that this can be handled via NW implementation. | **Support/fine**: Lenovo/MotM, ZTE, Qualcomm, vivo, Xiaomi, Huawei/HiSi, NEC, HONOR, Sharp, KDDI, MediaTek, NTT DOCOMO, NTT CORP, Apple, Google, Spreadtrum, CATT, China Telecom, TCL, New H3C, **Not support**: Intel, Ericsson, Nokia/NSB, OPPO,  |
| 3.5.2 | **Proposal 3.E.2**: For the Rel-19 aperiodic standalone CJT calibration (CJTC) reporting, when linking CJTC Dd and Rel-18 eType-II CJT CSI reports is configured with two separate triggers, when at least one of the NTRP reported delay offset (DO) values in a linked CJTC Dd report is ‘out of range’, the UE does not perform DO compensation on the triggered Rel-18 eType-II CJT CSI associated with TRP(s) that are ‘out of range’**FL assessment**: Tuesday **OFFLINE** outcome in RAN1#118bis.  | **Support/fine**: Huawei/HiSi, Qualcomm, Samsung, Ericsson, Sony, Lenovo/MotM, Xiaomi, NEC, HONOR, OPPO, Google, NTT DOCOMO, NTT CORP, MediaTek, Spreadtrum, vivo (open), Sharp, Intel (ok), Sony, Apple, KDDI, New H3C, **Not support**: Nokia/NSB, ZTE, IDC, CATT, Fujitsu, Rakuten, TCL, |
| 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: $\left⌈log\left(N\_{TRP}\right)\right⌉$ bits |
| nref2 | Reference TRS resource set index for PO, based on the ordering from RRC configuration: $\left⌈log\left(N\_{TRP}\right)\right⌉$ bits |
| {Dn,offset, n=0, 1, …, NTRP – 1 n≠nref1} | Delay offset for CSI-RS resource set n:$\left(N\_{TRP}-1\right)\left⌈log\left(M\_{D}\right)\right⌉$ bits |
| {dn, n=0, 1, …, NTRP – 1, n≠nref1 } | 1-bit inside/outside indicator for CSI-RS resource set n: $\left(N\_{TRP}-1\right)$ bits |
| {POn , n=0, 1, …, NTRP –1, n≠nref2} | Wideband phase offset for CSI-RS resource n: $\left(N\_{TRP}-1\right)\left⌈log\left(M\_{Φ}\right)\right⌉$ 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, Ericsson (open), Apple,**Not support**: Huawei/HiSi, MediaTek, NTT DOCOMO, NTT CORP, NEC, Intel, TCL, Huawei/HiSi, Xiaomi, IDC, Sharp, KDDI, CMCC, ETRI, OPPO, Apple, vivo, New H3C, Nokia/NSB, Spreadtrum, TCL, Lenovo/MotM, Rakuten, |
| 3.7.2 | **Proposal 3.G.2:** For the Rel-19 aperiodic standalone CJT calibration reporting, support reporting, as a new ReportQuantity in one CSI reporting instance and one CSI Reporting Setting, L1-RSRPs associated with the configured NTRP CSI-RS resources and the following CJT calibration report type: * ReportQuantity is ‘cjtc-Dd’ (delay offset)

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

**FL assessment**: This proposal (from RAN1#118) is an optimization primarily for TRP selection (which utilizes both RSRP and CJTC report). As a possible compromise, the proposal is limited to Dd only to add NW to select TRP with only one CSI Report Setting. @Those not supporting or against: please check if this helps 😊 | **Support/fine:** NEC, NTT DOCOMO, NTT CORP, Lenovo/MotM (low priority), Samsung, Sony, **Not support**: ZTE, Xiaomi, Fujitsu, Ericsson, Apple, Huawei/HiSi, OPPO, TCL, ETRI, New H3C, Google, Nokia/NSB, vivo, Sharp, Intel, KDDI, Spreadtrum, TCL, China Telecom, CMCC, IDC, Rakuten,  |
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Table 3B LLS/SLS results: issue 3

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

*For non-MRT-precoded CSI-RS), the benefit of Opt1 (wideband/initial PO + delay/TAE) over Opt2 (subband PO) is reduced.* |
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Table 3C Additional inputs: issue 3

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | **Please share your inputs on each of the issues and, if applicable, proposals in TABLE 3A** |
| ZTE | **Proposal 3.E.2:**We do NOT think this proposal is needed. For separate triggering, if UE reports ‘out-of-range’ in the CJTC Dd report, NW should NOT trigger the subsequent CJT eType-II report. Besides, we did NOT see how it works if UE does NOT perform delay pre-compensation when the delay offset is already ‘out-of-range’. |
| OPPO | **Proposal 3.B.4:**Fine with either z1’ or reported by UE.**Proposal 3.B.2**:We are fine with the proposal (please remove us from opponents). |
| MediaTek | **Proposal 3.B.2 and 3.E.2**We think these two proposals have the same functionality. However, for separate triggering (3.E.2), while it is still possible for NW to remove out of range TRPs for the linked CJT CSI report, it is not possible so for joint triggering (3.B.2) because the NW cannot perform TRP selection until the DO is reported. In our understanding, the appropriate UE behaviour in these cases is that UE does not consider such TRPs in the CJT hypothesis (i.e., TRP selection by UE, rather than not compensate DO). In Rel-18 CJT CSI, TRP selection by UE is optional and configured by gNB, while for these two proposals, UE mandatorily must perform TRP selection based on DO irrespective of capability. |
| Nokia | **Proposal 3.G.2**No need to introduce this new report quantity in our view |
| Sony | **Proposal 3.B.4:**Okay with this proposal.**Proposal 3.B.2 and Proposal 3.E.2:**Support.**Proposal 3.G.1**: Support as an optimization.**Proposal 3.G.2:** We are okay with this proposal. The network can use the RSRP values to assess the quality of the main reported quantity. For example, two UEs can report FOs, and the network can use the associated RSRP values to merge the reported Fos for frequency compensation of the TRPs. |

# References

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | RP-242394 | Revised WID: NR MIMO Phase 5 | Samsung (Moderator) |
| 2 | R1-2409587 | Moderator Summary for OFFLINE discussion on Rel-19 CSI enhancements | Moderator (Samsung) |
| 3 | R1-2409371 | CSI enhancements | MediaTek Inc. |
| 4 | R1-2409378 | Discussion on CSI enhancements | ZTE Corporation, Sanechips |
| 5 | R1-2409428 | On 128 CSI-RS ports and UE reporting enhancement | Huawei, HiSilicon |
| 6 | R1-2409432 | CSI enhancements for Rel. 19 MIMO | Fraunhofer IIS, Fraunhofer HHI |
| 7 | R1-2409460 | Further Details on Rel-19 Enhancements of CSI | InterDigital, Inc. |
| 8 | R1-2409505 | Discussion on CSI enhancements | CMCC |
| 9 | [R1-2409589](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_119/Docs/R1-2409589.zip) | Views on Rel-19 CSI enhancements | Samsung |
| 10 | R1-2409630 | Discussion on CSI enhancements | Spreadtrum, UNISOC |
| 11 | R1-2409674 | Remaining issues on Rel-19 CSI enhancements | vivo |
| 12 | R1-2409747 | CSI enhancements for MIMO | Intel Corporation |
| 13 | R1-2409761 | CSI enhancements  | Tejas Networks Limited |
| 14 | R1-2409793 | Views on R19 MIMO CSI enhancement | Apple |
| 15 | R1-2409851 | Discussion on CSI enhancements | NEC |
| 16 | R1-2409889 | Further discussion on Rel-19 MIMO CSI enhancements | Xiaomi |
| 17 | R1-2410657 | Views on NR MIMO CSI enhancements Phase 5 | CATT |
| 18 | R1-2409970 | Discussion on CSI enhancements | Lenovo |
| 19 | R1-2410040 | CSI enhancements | TCL |
| 20 | R1-2410054 | Discussion on Rel-19 CSI enhancements | Fujitsu |
| 21 | R1-2410109 | CSI enhancements for Rel-19 MIMO | OPPO |
| 22 | R1-2410154 | CSI Enhancement for NR MIMO | Google |
| 23 | R1-2410176 | Discussion on CSI enhancements | HONOR |
| 24 | R1-2410220 | Further views on CSI enhancements | Sony |
| 25 | R1-2410303 | Discussion on Open Issues of CSI Enhancement | Rakuten Mobile, Inc |
| 26 | R1-2410667 | CSI enhancement for NR MIMO Phase 5 | Nokia |
| 27 | R1-2410353 | Remaining issues on CSI enhancements for large antenna arrays and CJT | Ericsson |
| 28 | R1-2410382 | Discussion on CSI enhancements | NTT DOCOMO, INC., NTT CORPORATION |
| 29 | R1-2410436 | CSI enhancements | Sharp |
| 30 | R1-2410472 | CSI enhancements for >32 ports and UE-assisted CJT | Qualcomm Incorporated |
| 31 | R1-2410549 | Discussion on CSI enhancements for NR MIMO Phase 5 | KDDI Corporation |
| 32 | R1-2410586 | Discussion on CSI enhancements | NICT |
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