**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]):

|  |
| --- |
| 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

|  |  |  |
| --- | --- | --- |
| **#** | **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 caseNote: 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 WIFFS (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.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,
 | **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 (ok), Spreadtrum, CMCC, Intel (ok), New H3C, Qualcomm (ok), Fraunhofer IIS/HHI, Lenovo/MotM (with 2 modes), IDC (ok), TCL, CEWiT, **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 concludeSince 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, **Not support (only for Cap1):** Fujitsu, Apple  |
| 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)

**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), **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 2Wideband 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 2Wideband 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, **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).**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. | **Support/fine:** ZTE, **Not support:** |
| 1.6.1 | **Proposal 1.F.1**: For the Rel-19 Type-I SP codebook refinement for P=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 ceil(P/32)

**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, **Not support:** |
| 1.6.2 | **Proposal 1.F.2**: For the Rel-19 Type-I SP codebook refinement for P=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, **Not support:** |
| 1.6.3 | **Proposal 1.F.3**: For the Rel-19 Type-I SP codebook refinement for P=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 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, **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,
* No: Lenovo/MotM,

**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**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, **Not support:** |
| 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, **Not support:** |
| 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, Apple, Tejas, **Not support:** vivo, Samsung, Fujitsu, NTT DOCOMO (study), Huawei/HiSi, CMCC, OPPO, Xiaomi, TCL, Ericsson, Lenovo/MotM (open discuss), |
| 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, **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, **Not support:** |
|  |  |  |

Table 1B SLS results: issue 1

|  |  |
| --- | --- |
| **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 boostingThe average throughput comparison of power boosting and non-power boostingIt 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** |
|  |  |
|  |  |
|  |  |

### 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**: For the Rel-19 CRI-based CSI refinement for up to 128 CSI-RS ports, regarding priority 0 (G0) in CSI part 2 or wideband CQI/PMI reporting, the UCI packing order is as follows:* The 1st configured CMR among the non-reported MR CRIs;
* …
* The last configured CMR among the non-reported MR CRIs;
* The 1st reported CRI;
* …
* The (M- MR)-th reported CRI;

The entire G0 is either reported or dropped entirely, following the legacy principle.**FL assessment**: This issue needs to be concluded. The proposal is analogous to the legacy principle.  | **Support/fine**: Huawei/HiSi, Tejas, ZTE, CATT, HONOR, **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, **Not support**: |
|  |  |  |

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** |
|  |  |
|  |  |
|  |  |

### 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 NTRP CSI-RS occasions 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, **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, **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,
* Not support: CMCC,

**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 min(16,X) per CSI reporting setting, where X is a UE capability * [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 3 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, Intel, Samsung (only if M=256 is not introduced, else 8), OPPO, Qualcomm, Apple (LS not needed), CATT (LS not needed), Google, Huawei/HiSi, NEC, NTT DOCOMO, Lenovo/MotM, IDC (same as Samsung), Sharp, Sony (LS not needed), KDDI, TCL, Nokia/NSB, NICT, **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 signaling) 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]**FL assessment**: This issue was discussed OFFLINE [2]. | **Support/fine**: ZTE, vivo, Ericsson, Intel, OPPO, Qualcomm, MediaTek, Xiaomi, Apple (OK as long as only AP in 3.C.2), CATT (same as Apple), Fujitsu, Huawei/HiSi, Spreadtrum, NTT DOCOMO, IDC, Sharp, Sony, NEC, KDDI, TCL, Nokia/NSB, CMCC, HONOR, ETRI, **Not support**: Samsung (need ACK/NACK for separate), Lenovo/MotM (need expiration time for separate, relax same reporting instance for joint), Google (need ‘out of range’ behaviour), |
| 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 signaling) 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 AP-CSI-RS as the CMR for the Rel-18 eType-II CJT reporting**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, Apple, CATT, Google, OPPO, Fujitsu, Huawei/HiSi, Spreadtrum, NTT DOCOMO, IDC, Sharp, Lenovo/MotM, Sony, KDDI, TCL, ETRI, Nokia/NSB, **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 signaling) 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 codebookThe above only applies when the CMRs do not share common QCL source for average delay indicationThe 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, **Not support**: Intel, Ericsson, Samsung, CATT, OPPO, Fujitsu, Huawei/HiSi, Lenovo/MotM, TCL, Nokia/NSB, Spreadtrum, CMCC,  |
| 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

**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,
* No:

**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).  |
| 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

**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, ZTE,
* No (NW implementation): Spreadtrum, NTT DOCOMO,

**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. |
| 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, **Not support**: |
| 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 offset for CSI-RS resource n: 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:** X **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), 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

**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, **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, **Not support**: Huawei/HiSi, MediaTek, NTT DOCOMO, Ericsson, NEC, Intel, Apple, TCL, Huawei/HiSi, Xiaomi, IDC, Sharp, KDDI, CMCC, ETRI, OPPO, Lenovo/MotM, Apple, vivo, |
| 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, **Not support**: ZTE, Xiaomi, Fujitsu, Ericsson, Apple, Huawei/HiSi, OPPO, Lenovo/MotM, TCL, Sony, ETRI,  |
| 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, **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, **Not support**:  |
|  |  |  |

Table 3B LLS/SLS results: issue 3

|  |  |
| --- | --- |
| **Company** | **LLS/SLS results** |
| **Issue #** | **Metric** | **Observation** |
| Huawei/HiSi | 3.3 | UPT loss | Performance for misalignment for DO caused by error propagationUnder 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 CJTThe 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 scenarioIt 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. |
| 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.
 |
| 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** |
|  |  |
|  |  |
|  |  |

# References

|  |  |  |  |
| --- | --- | --- | --- |
| 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 | R1-2408638 | 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 |
|  |  |  |  |