**3GPP TSG RAN WG1 #109-e R1-2205167**

**e-Meeting, May 9th – 20, 2022**

**Title:** **DRAFT** LS response on feMIMO RRC parameters

**Response to:** R2-2204361

**Release:** Rel-17

**Work Item:** NR\_feMIMO-Core

**Source:** Samsung

**To:** 3GPP TSG-RAN WG2

**Cc:** --

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**Attachments:** None

# 1. Overall Description:

This is a reply LS to RAN2 to address the RAN2 questions on several L1 parameter related open issues as well as overall the implementation of all L1 feMIMO RRC parameters.

**2. Questions and answers**

**Issue 1: Pathloss Reference RS for BM and PUCCH mTRP**

pathlossReferenceRS-Id-r17 was used originally for DLorJoint-TCIState-r17 and PUCCH-PowerControlSetInfo-r17 separately but changed to PUCCH-PathlossReferenceRS-Id/PUSCH-PathlossReferenceRS-Id due to RRC consistency issues. In order to finalize these parameters, it is necessary to know what the maximum number of pathloss Reference RSs is for BM and PUCCH mTRP respectively. In particular, for the unified TCI state, RAN1 agreement "Total of maintained PL-RS per CC is up to 4" is not clear: Does this refer to the maximum amount of configured PL-RS per serving cell? Or what does “maintained” mean in context of RRC configuration?

**Question 1:** What does the RAN1 "Total of maintained PL-RS per CC is up to 4" mean for signalling of PL-RS? Is it relevant for RRC/MAC specification? Please clearly express what is the maximum number of RRC configured Pathloss RS set for 1) unified TCI state and 2) PUCCH power control set?

**Answer 1**: “Total of maintained PL-RS per CC is up to 4” is only related to PL-RS measurement associated with activated UL or, if applicable, joint TCI states. It is irrelevant to RRC specification.

The maximum number of RRC-configured PL-RS for unified TCI state is 64 (the same as the maximum number of RRC-configured UL TCI states).

The maximum number of RRC-configured PL-RS for PUCCH PC set (multi-TRP PUCCH operation) in FR1 is 8.

**Issue 2: sfnScheme-r17 and sfnSchemePdsch-r17 in HST**

RAN1 indicates sfnScheme-r17 and sfnSchemePdsch-r17 as per BWP. However, there is a note that “In Rel-17, all downlink BWPs (except initial BWP and FFS: BWP-DownlinkCommon) within a CC should have the same configuration of SFN scheme”. In addition, it is not clear whether PDSCH and PDCCH can have different SFN schemes in the same serving cell?

**Question 2:** RAN2 has currently defined sfnScheme-r17 as part of PDCCH-Config and sfnSchemePdsch-r17 as part of PDSCH-Config, which are per BWP. But since the values are the same for all BWPs, a more efficient signalling would be to define them per serving cell. Is there a reason why the configuration needs to be per BWP?

**Answer 2**: In accordance to RAN1 agreements, the configuration of SFN scheme is per BWP. The restriction (same value for all BWPs) can be captured in 38.331.

**Question 3:** Can PDSCH and PDCCH use different SFN schemes in the same serving cell, e.g. can PDCCH use sfnSchemeA and PDSCH sfnSchemeB for the same BWP?

**Answer 3**: Per RAN1 agreement, it cannot.

**Issue 3: CSI-mTRP**

RAN2 introduced 2 types of RI restrictions and two codebook subset restrictions (CBSR) per CodebookConfig. However, it is not clear how those features are enabled: Currently, same as in previous releases, RAN2 signalling assumes both RI restrictions and CBSR are configured simultaneously, but RAN2 would like to verify this is the correct assumption for the signallling.

**Question 4:** Which of the following assumptions are correct?

* If two RI restrictions are configured, two CBSRs are configured and if two CBSRs are configured two CBSRs are configured (i.e. when two are configured for either RI restriction or CBSR, two are also configured for the other).
* UE can be configured with either RI restriction for sTRP or RI restriction for NCJT, but not both at the same time.
* If two CBSRs are configured, two CMR groups are configured and if two CMR groups are configured, two CBSRs are configured (i.e. when two are configured for either CBSR or CMR groups, two are also configured for the other and there cannot be configuration of e.g. one CBSR but two CMR groups)

**Answer 4**:

* The following revision of Assumption 1 is correct (the original formulation from RAN2 lacks precision): “If two RI restrictions are configured, two CBSRs are can be configured and if two CBSRs are configured two CBSRs RI restrictions are can be configured (i.e. when two are configured for either RI restriction or CBSR, two are can also be, but are not necessarily configured for the other).
	+ RI restriction and CBSR are two independent features”
* Assumption 2 is incorrect.
	+ UE is configured with one RI restriction for NCJT if csi-ReportMode-r17 is set to ‘Mode1’ and numberOfSingleTRP-CSI-Mode1-r17 is set to ‘n0’, otherwise UE is configured with two RI restrictions for sTRP and NCJT respectively.
* Assumption 3 is correct

**Issue 4:**

There are several parameters to support mTRP PUSCH (i.e. PUSCH repetition). RAN2 configuration assumes those parameters are only configured when two SRS resource sets are configured and the *usage in SRS-Config* is set to *codebook* or *noncodebook*. However, it is not clear the what "two SRS resource sets" means since in Rel-15/16 up to SRS resource sets can be configured and there are separate lists of SRS resource sets for DCI formats 0\_1 and 0\_2, as shown below. RAN2 would need to know this to set the configuration constraints correctly.

    srs-ResourceSetToAddModList             SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSet                  OPTIONAL,   -- Need N

    srs-ResourceSetToAddModListDCI-0-2-r16  SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSet          OPTIONAL, -- Need N

**Question 5:** When mTRP PUSCH repetition is used, what is the definition of "two SRS resource sets" being used? Can those be SRS resource sets as in the Rel-15/16 configuration, or are those only configured with Rel-17 fields?

**Answer 5**: When “two SRS resource sets” are configured in one of the following settings, the Rel-17 mTRP PUSCH repetition can be applied:

- Two SRS resource sets in srs-ResourceSetToAddModList with usage = ‘codebook’

- Two SRS resource sets in srs-ResourceSetToAddModList with usage = ‘nonCodebook’

- Two SRS resource sets in srs-ResourceSetToAddModList-0-2 with usage = ‘codebook’

- Two SRS resource sets in srs-ResourceSetToAddModList-0-2 with usage = ‘nonCodebook’

In Rel-15/16, only up to one SRS resource set can be configured in each of the above four settings.

**Issue 5:**

The Rel-17 parameter *ul-powerControl-r17* configures power control parameters for PUCCH, PUSCH and SRS when UE is configured with unified TCI state. Current RRC enables the configuration in a dedicated UL BWP and also in configured unified TCI states that contains UL (i.e. joint or UL TCI state). Hence the current field description states:

***ul-powerControl***

Configures power control parameters for PUCCH, PUSCH and SRS when UE is configured with unifiedtci-StateType .The field is present here only if UL power control is not configured for any UL TCI state and DLorJoint-TCIState.

However, as it is understood that UE can be configured only with unified TCI state or Rel-15/16 TCI state framework, it is not clear if can be configured with Rel-15/16 power control parameters when UE is configured with parameter *ul-powerControl-r17*.

**Question 6:** Is the UE always configured with parameter *ul-powerControl-r17* when the UE is configured with unified TCI states? If yes, will the UE use a Rel-15/16 UL power control configuration when the UE is configured with unified TCI states?

**Answer 6**: Yes, the UE is always configured with parameter ul-powerControl-r17 in BWP-UplinkDedicated or, optionally, in DLorJointTCIState/UL-TCIState. In this case, the UE will not use a Rel-15/16 UL PC configuration.

**Issue 6: MPE reporting in ICBM (inter-cell beam management):**

RAN2 has currently defined MPE resource pool as only using serving cell SSB/CSI-RS indexes. However, it was not clear if the MPE resource pool should also allow indicating SSB/CSI-RS indexes for the additional PCI so RAN2 would like to verify that.

**Question 7:** In one MPE resource pool, can a MPE resource containing SSBRI/CRI be associated with an additional PCI?

**Answer 7**: Yes, with the following clarification (exact details are up to RAN2)

* For SSB, an “additional PCI” can be added in MPE-Resource-r17 (hence conditioned on choosing SSB for mpe-ReferenceSignal-r17).
* For NZP CSI-RS, since each NZP CSI-RS resource is associated with a TCI state (which already includes a PCI), no “additional PCI” needs to be added in MPE-Resource-r17
* Note: Depending on the outcome of UE capability discussion, this can be subject to UE capability

**Issue 7: Max values FFS in Rel-17 TS 38.331**

Some maximum values are still missing from RRC configuration and RAN2 needs those for ASN.1 freezing.

**Question 8:** Please provide value for maxNrofCandidateBeams-r17 and maxNrofBFDResourcePerSet-r17.

**Answer 8**:

* maxNrofCandidateBeams-r17 is 64 per set per CC according to the latest LS reply
* Regarding maxNrofBFDResourcePerSet-r17, RAN1 has agreed to introduce MAC-CE for BFD-RS activation (in addition to RRC configuration):
	+ If UE supports MAC-CE based BFD RS activation, maxNrofBFDResourcePerSet-r17 is 64
	+ The intended operation is for MAC-CE to activate 1 or 2 out of the (maximum of) 64 configured BFD-RS resources from the set
* Otherwise, maxNrofBFDResourcePerSet-r17 is 2

**Issue 8: Possibilities for BFD-RS configuration**

The existing RRC signalling for BFD-RS configuration allows the following possibilities:

* Alt.1: Two explicit BFD-RS sets: e.g. failureDetectionSet1-r17 and failureDetectionSet2-r17 with respective bfdRSSetId-r17
* Alt.2: Only one explicit BFD-RS set: e.g. failureDetectionSet1-r17 or failureDetectionSet2-r17 with bfdRSSetId-r17. It requires that the UE determines BFD-RS for the other BFD-RS set, e.g. according to TCI state(s) for PDCCH reception and the corresponding coreset pool index.
* Alt.3: BFD-RS without explicit BFD-RS set: e.g. failureDetectionSet1-r17 or failureDetectionSet2-r17 without bfdRSSetId-r17. It requires that the UE determines the BFD-RS set which each BFD-RS belongs to.

RAN2 thinks that at least Alt.1 is possible, but would like to understand whether RAN1 specifications support Alt.2 or Alt.3.

**Question 9:** Please confirm whether Alt.2 and Alt.3 are allowed configurations according to the existing RAN1 specifications, or whether RRC signalling for BFD-RS configuration should exclude Alt.2 and Alt.3.

**Answer 9**: Based on RAN1 agreements and Rel-17 RAN1 specification,

* Alt1 is allowed.
* Alt2 is excluded.
* The current formulation of Alt3 in the LS is unclear. If the only difference between Alt1 and Alt3 is that Alt1 includes an explicit bfdRSSetId parameter in BeamFailureDetectionSet-r17 IE whereas Alt3 doesn’t, Alt3 is excluded.

**2. Actions:**

**To RAN2 group:**

**ACTION:** RAN1 respectfully asks RAN2 to take the answers to the questions into account in your further work.

**3. Date of Next TSG-RAN WG1 Meetings:**

TSG-RAN WG1 Meeting #110 22 – 26 August 2022 Toulouse, France

TSG-RAN WG1 Meeting #110-bis-e 10 – 19 October 2022 Electronic Meeting