**3GPP TSG RAN WG1 #104b-e R1-2103953**

**e-Meeting, April 12th – 20th, 2021**

**Agenda item:** 8.1.1

**Source:** Moderator (Samsung)

**Title:** Moderator summary#5 for multi-beam enhancement: Round 4

**Document for:** Discussion and Decision

## Summary of companies’ inputs

### Issue 1 (Rel.17 unified TCI framework for intra-cell beam management)

Table 1 Summary: issue 1

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| **#** | **Issue** | **Companies’ views** |
| 1.6 | Setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index): In addition to association with UL channel/RS,* Alt1. The setting of (P0, alpha, closed loop index) is also associated with UL or (if applicable) joint TCI state
* Alt2. The setting of (P0, alpha, closed loop index) is included with UL or (if applicable) joint TCI state
* Alt3. The setting of (P0, alpha, closed loop index) is neither associated with nor included in UL or (if applicable) joint TCI state
* Alt4. The setting of (P0, alpha, closed loop index) is determined as in Rel-16 without enhancement
 | **Alt1 (11)**: Lenovo, CMCC (PUCCH), Nokia/NSB, NTT Docomo, Spreadtrum, CATT, ZTE, OPPO (PUSCH, PUCCH), Qualcomm, Futurewei**Alt2 (6)**: IDC, Samsung, Intel (at least PUCCH), Apple, Qualcomm, LGE**Alt3 (5)**: Fraunhofer IIS/HHI, CMCC (PUSCH – SRI, SRS – SRSResourceSet), Ericsson (for P0 and alpha), Sony, **Alt4 (5)**: vivo, OPPO (SRS), MTK, Huawei, HiSi |
| 1.7 | Path-loss measurement (PL RS):* Alt1. PL-RS can be included in UL TCI state or (if applicable) joint TCI state.
	+ FFS: Whether it is always included or not. If not included, PL-RS is the periodic DL-RS used as a source RS for determining spatial TX filter or the PL RS used for the UL RS in UL or (if applicable) joint TCI state.
* Alt2. PL-RS can be associated with (but not included in) UL TCI state or (if applicable) joint TCI state
	+ FFS: Exact association mechanism
	+ FFS: Whether it is always associated or not. If not associated, PL-RS is the periodic DL-RS used as a source RS for determining spatial TX filter or the PL RS used for the UL RS in UL or (if applicable) joint TCI state
* Alt3. The periodic DL-RS used as a source RS for determining spatial TX filter can be used as PL-RS. In case the periodic DL-RS used as a source RS for determining spatial TX filter is not used as PL-RS, reuse Rel.16 procedure with the same signaling structure (MAC CE+SRI field in UL-related DCI) to indicate PL-RS for UL transmission with minimum enhancement (e.g. pertaining to the use for PUCCH, or using default PL-RS)
	+ PL-RS is not additionally configured in or associated to UL TCI state or (if applicable) joint TCI state
* Alt4. UE calculates path-loss based on periodic DL RS configured as the source RS or a periodic QCL-Type-D/spatialRelationInfo source of the source RS in UL TCI state or (if applicable) joint TCI state
	+ FFS: Whether UE can calculate path-loss based on DL periodic RS for path-loss calculation for UL RS in the UL TCI
 | **Alt1 (10)**: IDC, Fraunhofer IIS/HHI, Ericsson (if UL RS in TCI state), NTT Docomo, OPPO, Intel (at least PUCCH), Qualcomm, AT&T, LGE**Alt2 (14)**: Lenovo/MoM, CMCC, NTT Docomo, Huawei, HiSi, Spreadtrum, CATT, ZTE, MTK, Futurewei, Sony, Nokia/NSB**Alt3 (1)**: vivo**Alt4 (3)**: Ericsson (if DL RS in TCI state), Samsung, Apple,  |

**Table 2: UL PC par setting (other than PL-RS)**

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| **Proposal 1.4**: On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework, for each of PUSCH, and PUCCH, ~~and SRS,~~ further discuss to down-select or combine from the following alternatives:* AltA. The setting of (P0, alpha, closed loop index) is also associated with UL or (if applicable) joint TCI state
* AltB. The setting of (P0, alpha, closed loop index) is also included with UL or (if applicable) joint TCI state

The support of the above UL PC parameter setting scheme (the outcome of the above down selection or combining) is a UE optional feature.* If not supported, ~~or if a UE is configured with neither (P0, alpha, closed loop index) in UL/joint TCI state nor the association between (P0, alpha, closed loop index) and UL/joint TCI state,~~ for each of the PUSCH, and PUCCH, ~~and SRS,~~ the setting of (P0, alpha, closed loop index) will neither be associated with nor included in UL or (if applicable) joint TCI state.

On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework, for SRS, further discuss to down-select or combine from the following alternatives:* AltA. The setting of (P0, alpha, closed loop index) is also associated with UL or (if applicable) joint TCI state
* AltB. The setting of (P0, alpha, closed loop index) is also included with UL or (if applicable) joint TCI state
* AltC. The setting of (P0, alpha, closed loop index) is neither associated with nor included in UL or (if applicable) joint TCI state

Note: It has been agreed that the setting of (P0, alpha, closed loop index) is associated with UL channel or UL RS (therefore the setting is channel- and signal-specific).Note: It has been agreed that the setting of (P0, alpha, closed loop index) is associated with UL channel or UL RS (therefore the setting is channel- and signal-specific). |

**Table 3: PL-RS**

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| **Proposal 1.5A**: On Rel.17 unified TCI framework, in RAN1#105-e, further discuss to down select or combine from the following two alternatives for PL-RS (note: the text below is based on the agreed description in RAN1#104-e): * Alt1. PL-RS [can be][is] included in UL TCI state or (if applicable) joint TCI state.
* Alt2. PL-RS [can be][is] associated with (but not included in) UL TCI state or (if applicable) joint TCI state
	+ FFS: Exact association mechanism
* Depending on the final outcome, FFS on exact association mechanism and whether to support a unified mechanism for the setting of (P0, alpha, closed loop index) and PL-RS, if PL-RS can be associated with (but not included in) UL TCI state or (if applicable) joint TCI state

The support of the above PL-RS (the outcome of the above down selection or combining) is a UE optional feature.* If not supported, ~~or if a UE is configured with neither PL-RS in UL/joint TCI state nor the association between PL-RS and UL/joint TCI state,~~ the UE estimates path-loss based on the periodic DL-RS provided as a source RS for determining spatial TX filter in UL or (if applicable) joint TCI state
	+ FFS: If supported, but if a UE is configured with neither PL-RS in UL/joint TCI state nor the association between PL-RS and UL/joint TCI state
	+ FFS: If the PL-RS used for the UL RS provided as a source RS for determining spatial TX filter in UL or (if applicable) joint TCI state can also be used for path-loss estimation. And if so, how to select between the periodic DL-RS and the PL-RS used for the UL RS
	+ FFS: investigate the condition(s) agreed in Rel-17 and, if needed, study whether a UE can simultaneously maintain more than four path-loss estimates based on UE capability
* FFS: UE capability for maximum number of active PL-RS across CCs per band

The above behavior is optionally supported by the UE for Rel-17 unified TCI framework.**Proposal 1.5B**: On Rel.17 unified TCI framework, in RAN1#105-e, further discuss to down select or combine from the following two alternatives for PL-RS (note: the text below is based on the agreed description in RAN1#104-e): * Alt1. PL-RS is included in UL TCI state or (if applicable) joint TCI state.
* Alt2. PL-RS is associated with (but not included in) UL TCI state or (if applicable) joint TCI state
	+ FFS: Exact association mechanism
* Depending on the final outcome, FFS on exact association mechanism and whether to support a unified mechanism for the setting of (P0, alpha, closed loop index) and PL-RS, if PL-RS can be associated with (but not included in) UL TCI state or (if applicable) joint TCI state
* FFS whether/when a fallback scheme is needed and if so further details
* The total maintained PL RS # per CC is no more than 4
* FFS: maximum number of active PL-RS per band

Proposal 1.5A:* Support: vivo, ZTE, Apple, Fraunhofer IIS/HHI, Ericsson, ZTE, Samsung, Nokia/NSB, CATT, OPPO, Intel, NTT Docomo, [Qualcomm]
* Concern: Futurewei

Proposal 1.5B: * Support: Futurewei, Qualcomm
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Argument from Futurewei (Round 2 discussion):

* There is no real need to support a default/fallback mode. As pointed out by a few companies, PL-RS needs to be explicitly configured/associated at least when aperiodic DL-RS is the source RS and hence Alt1/2 must work all the time and be supported by the UE. Using periodic DL-RS only works for sometime and its benefit is questionable and has the problem of PL RS # per UE maintained at the UE.
* Though we now don’t see any need for default/fallback mode, as a compromise, we can agree to put it as FFS in case we missed some situation.
* Again, We still do not agree to deviate from current power control framework where a list of PL-RS is maintained at the UE and then is indexed for usage. Alt1/2 follows this framework but not the one using “periodic DL-RS”.
* For UE supporting Rel-17 unified TCI framework, PL-RS (and over power control feature) determination is always needed. The statement “the above behavior is optionally supported by the UE for Rel-17 unified TCI framework” should be deleted.

### Issue 2 (L1/L2-centric inter-cell mobility)

**Table 4**

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| **Proposal 2.1**: On Rel.17 multi-beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP, * For [periodic, semi-persistent, and aperiodic] reporting, in one reporting instance, depending on NW configuration, beam(s) associated with a non-serving cell can be mixed with that associated with serving-cell
	+ FFS: whether this applies to periodic and semi-persistent
	+ FFS: How to report the K beams and corresponding qualities if the Tx power among the non-serving cell and with serving-cell is not the same
	+ Note: The supported numbers of non-serving cells (in terms of measurement/reporting) have not yet been decided. The above description doesn’t imply only one non-serving cell is allowed to be configured for measurement. Nor does this imply that only one non-serving cell is allowed in one reporting instance.

**Proposal (working assumption) 2.2**: On Rel.17 multi-beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP, * For L1-RSRP measurement and at least aperiodic reporting, support MAC CE based dynamic activation/deactivation of a subset of higher-layer-configured measurement for non-serving cell SSBs
	+ FFS: Additionally activated non-serving cell information for SSBs to be measured, or activated non-serving cell SSBs
	+ FFS: Dynamic (MAC CE and/or DCI) activation for semi-persistent

**Proposal 2.3**: Send LS to RAN4 to ask their views on DL measurement timing assumptions for L1/L2-centric inter-cell mobility and inter-cell mTRP. |

**Table 5**

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| Mod V00 | Proposal 2.1: A few companies argue that mixed SC/NSC report is mainly for aperiodic. Nokia argues that if mixed SC/NSC report is agreed, it should be for P, SP, and AP:* **Please share your view on the cyan text above on supporting mixed report for P, SP, and AP**

Proposal 2.2: A few companies argue that MAC CE activation of SSBs can be instrumental if at least one maximum K is agreed to be large. But most companies support this feature at least for UE power saving. * **Would a working assumption be acceptable, which can be confirmed if a large value of max K is supported?**

Proposal 2.3: After a proposal on timing assumption didn’t go through vivo proposed to send an LS to RAN4. **Please share your view on this** |
| **Company** | **Input** |
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### Issue 3 (signaling medium)

**Table 6**

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### Issue 4 (MP-UE)

The previous agreement deals with UE reporting for UE-initiated panel selection/activation. In addition, there are two more types of UE reporting proposed by companies:

* Opt1. UE report on panel-specific information (related to UE capability): Information related to the panels equipped by UE for gNB to configure UL resources accordingly
	+ E.g., the total number of DL/UL panels, the max number of antenna ports/layers per panel, maximum achievable EIRP per panel, minimal switching delay between panels
	+ Support: Huawei, HiSi, ZTE, LG, MediaTek, Apple, Nokia/NSB
* Opt2. UE report on panel activation/selection status (L1/L2 report): Information related to the change of activated/selected panels to refresh/reset UL measurement at gNB accordingly
	+ Support: Huawei, HiSi, CATT (via MAC-CE or with existing UL transmission occasions like RACH), APT/FGI, Fraunhofer IIS/HHI, LG, Qualcomm (updating panel ID for UL resources), Samsung, Sony, NTT Docomo

In addition, some companies propose to extend the Rel-15 SRS resource definition by allowing resources with different number of ports. This is aligned with an agreed assumption that different UE panels can have different number of ports.

In light of the above, the following 3 proposals can be a good starting point for discussion.

**Table 7**

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| **Proposal 4.1**: On Rel.17 enhancements for MPUE, support UE to report panel-specific information as a UE capability. Select from at least the following:* Information related to the total number of DL/UL panel entities
* Information related to the number of antenna ports/layers per panel entity
* Information related to the maximum number of resources per panel entity for SRS BM
* Information related to maximum achievable EIRP per panel entity
* Information related to panel switching delay
* Note: above ‘panel entity’ is a logical entity and how to map physical panels to the logical entities is up to UE implementation

**Proposal 4.2**: On Rel.17 enhancements for MPUE, for codebook based UL transmission, support CB based SRS resources with different numbers of ports (e.g. 2 ports+4 ports).* FFS details (e.g. per resource or per resource set)
* Note: the above is not for Rel-16 full power transmission but for Rel-17 panel-specific UL transmission

**Proposal 4.3**: On Rel.17 enhancements for MPUE, support UE to report information related to panel activation/selection status* FFS on reporting parameter and method (e.g. L1 or L2, updated panel ID for a UL resource (set), etc.)
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**Table 8**

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| Mod V00 | **Please share your views on the above proposals** |
| **Company** | **Input** |
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### Issue 5 (MPE mitigation)

# References

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| --- | --- | --- | --- |
| 1 | R1-2103830 | Moderator summary for offline discussion on multi-beam enhancement: SSB and SRS as QCL Type-D source RS | Moderator (Samsung) |
| 2 | R1-2103220 | Moderator summary for multi-beam enhancement | Moderator (Samsung) |
| 3 | R1-2103854 | Moderator summary#2 for multi-beam enhancement: Round 1 | Moderator (Samsung) |
| 4 | R1-2103892 | Moderator summary#3 for multi-beam enhancement: Round 2 | Moderator (Samsung) |
| 5 | R1-2103930 | Moderator summary#4 for multi-beam enhancement: Round 3 | Moderator (Samsung) |