**3GPP TSG RAN WG1 #105-e R1-2106131**

**e-Meeting, May 10th – 27th, 2021**

**Agenda item:** 8.1.1

**Source:** Moderator (Samsung)

**Title:** Moderator summary for multi-beam enhancement: ROUND 2

**Document for:** Discussion and Decision

## Introduction

In this summary, the term “item 1” refers to the first item in the Rel.17 NR FeMIMO WID, i.e. multi-beam enhancement:

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| --- |
| * Enhancement on multi-beam operation, mainly targeting FR2 while also applicable to FR1:
	+ Identify and specify features to facilitate more efficient (lower latency and overhead) DL/UL beam management to support higher intra- and L1/L2-centric inter-cell mobility and/or a larger number of configured TCI states:
		1. Common beam for data and control transmission/reception for DL and UL, especially for intra-band CA
		2. Unified TCI framework for DL and UL beam indication
		3. Enhancement on signaling mechanisms for the above features to improve latency and efficiency with more usage of dynamic control signaling (as opposed to RRC)
	+ Identify and specify features to facilitate UL beam selection for UEs equipped with multiple panels, considering UL coverage loss mitigation due to MPE, based on UL beam indication with the unified TCI framework for UL fast panel selection
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This summary includes the following:

* Observation and proposal
* Summary of current companies’ positions on each of the aspects within the category

## Summary of companies’ inputs

The listed issues are structured primarily to facilitate some progress on pending issues identified in the agreements (see Appendix A).

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

PL-RS

**Proposal 1.2**: On path-loss measurement for Rel.17 unified TCI framework, a PL-RS (configured for path-loss calculation) is either included in UL TCI state or (if applicable) joint TCI state or associated with UL TCI state or (if applicable) joint TCI state.

* Whether a UE supports “beam misalignment or not” (detailed definition FFS) between the DL source RS in the UL or (if applicable) joint TCI state to provide spatial relation indication and the PL-RS is a UE capability
* Whether it is ‘included in’ or ‘associated with’ (including the manner it is performed and the signaling) is up to RAN2
* The UE maintains the PL-RS of the activated UL TCI state or (if applicable) joint TCI state
* The maximum number of activated UL TCI states or (if applicable) joint TCI states per band per cell is a UE capability
* FFS: detailed aspects of PL-RS, e.g. CSI-RS type(s), time-domain behavior(s), restriction on configuration

Support (20): Apple, AT&T, CATT, Ericsson, Fraunhofer IIS/HHI, Futurewei, Lenovo/MoM, MTK, Nokia/NSB, NTT Docomo, LG, OPPO, Qualcomm, Samsung, Spreadtrum, Xiaomi, ZTE

Not support (3): Huawei/HiSi (AltC), vivo (AltC)

UL PC parameters other than PL-RS

**Proposal 1.1B:** 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, PUCCH, and SRS, the setting of (P0, alpha, closed loop index) can be associated with UL or (if applicable) joint TCI state.
	+ In this case, multiple settings are configured where each setting is associated with at least one TCI state
	+ Details of the association (including the manner it is performed and the signaling) is up to RAN2
* If not associated, for each of the PUSCH, PUCCH, and SRS, the configured setting(s) of (P0, alpha, closed loop index) per channel/signal are applied independent of the UL or (if applicable) joint TCI states

Support (14): Apple, AT&T, CATT, Ericsson, Fraunhofer IIS/HHI, Futurewei, MTK, NTT Docomo, Samsung, Sony, Spreadtrum, Xiaomi, ZTE (ok)

Not support (7): Huawei, HiSi, LG, OPPO (ok, if SRS always not associated), Qualcomm, vivo, ZTE

QCL for CA

**Proposal 1.3A**: On Rel.17 unified TCI framework, for common TCI state ID update and activation to provide common QCL information and/or common UL TX spatial filter(s) across a set of configured CCs/BWPs, following the Rel-15/16 rules for cross-CC QCL indication

* The source RS determined from the indicated common TCI state ID to provide QCL Type-D indication and to determine UL TX spatial filter for a target CC can be configured in the target CC or other CC
* For intra-band CA, the source RSs determined from the indicated common TCI state ID to provide QCL Type-D indication and to determine UL TX spatial filter for the set of configured CCs are further associated with a same QCL-TypeD RS or a same UL TX spatial relation RS.

Support (16): Apple, CATT, Ericsson, Futurewei, Huawei/HiSi, Lenovo/MoM, LG, MTK, NTT Docomo, Samsung (ok), Spreadtrum, vivo, Xiaomi, ZTE (ok)

Not support (3): OPPO, [Qualcomm,] Sony

**Proposal 1.3X**: ‘A single RRC pool of TCI states’ for common TCI state ID update and activation to provide common QCL information and/or common UL TX spatial filter(s) across a set of configured CCs /BWPs is supported.

* The TCI states can be configured in the PDSCH configuration for each BWP /CC
* The TCI states can be absent in the PDSCH configuration in any BWP /CC, and replaced with a reference to the TCI states in a reference BWP /CC.
* As in Rel-15/16, if the CC ID is absent in a TCI state, it applies to the serving cell in which the TCI state is configured

Support (10): Apple, CATT, Ericsson, MTK, NTT Docomo, Qualcomm, Spreadtrum, vivo, Xiaomi, ZTE

Not support (separate pool) (6): Futurewei, [Huawei/HiSi], LG, OPPO, Sony

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

**Proposal 2.1**: On Rel.17 beam indication enhancements for L1/L2-centric inter-cell mobility, support the following:

* At least for UE reception (on PDSCH and PDCCH) and transmission (on PUSCH and PUCCH) associated with UE-dedicated CORESETs, Rel-17 MAC-CE-based and DCI-based beam indication (at least using DCI formats 1\_1/1\_2 with and without DL assignment including the associated MAC-CE-based TCI state activation)
	+ FFS: Whether the above is supported only for joint TCI, or both joint TCI and separate DL/UL TCI (including that, if separate DL/UL TCI is supported, the DL TCI and UL TCI associated with a same cell)
	+ FFS: Whether to support activation of TCI states for more than one cells simultaneously
* The DL QCL and UL spatial relation rules already agreed for intra-cell scenario
* The use of SSB associated with a physical cell ID different from that of the serving cell as an indirect QCL reference for UE-dedicated PDCCH/PDSCH
	+ Note: When RS X is an indirect QCL reference of a target channel, there exists at least one other source signal on the QCL chain between RS X and the target channel
	+ FFS (to be decided in RAN1#106-e): Whether SSB associated with a physical cell ID different from that of the serving cell can also be used as a direct QCL reference (source RS) for UE-dedicated PDCCH/PDSCH
* Note: It is assumed that serving cell and/or RNTI(s) are not mandated to change when L1/L2-centric inter-cell mobility is configured and utilized

Support (16): Apple, AT&T, CATT, Ericsson, Lenovo/MoM, LG, NTT Docomo, [OPPO], Qualcomm, Samsung, Sony, Spreadtrum, vivo, Xiaomi, ZTE

Not support (5): Futurewei, [Huawei/HiSi], Nokia/NSB

### Appendix

UL PC other than PL-RS

**Possible conclusion**: On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework, there is no consensus on whether and how to support TCI-state-specific setting for each of the PUSCH, PUCCH, and SRS.

Given the agreement in RAN1#104-e, the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) is only associated with UL channel or UL RS (therefore the setting is channel- and signal-specific). That is,

* For each of the PUSCH, PUCCH, and SRS, the configured setting(s) of (P0, alpha, closed loop index) per channel/signal are applied independent of the UL or (if applicable) joint TCI states