**3GPP TSG RAN WG1 #104b-e R1-2103930**

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

**Agenda item:** 8.1.1

**Source:** Moderator (Samsung)

**Title:** Moderator summary#4 for multi-beam enhancement: Round 3

**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

|  |  |  |
| --- | --- | --- |
| **#** | **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)**

|  |
| --- |
| **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, 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, 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.

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).[**OPPO, the above only for PUSCH and PUCCH, and below for SRS:**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).]* Support: Ericsson, ZTE, LG, MTK, Samsung, OPPO (except SRS, add AltC neither be associated with nor included in UL or (if applicable) joint TCI state and no “default”, but associated with SRS resource set), Qualcomm
* Concern:
 |

**Table 3: PL-RS**

|  |
| --- |
| **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
 |

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)

### Issue 3 (signaling medium)

**Table 4**

|  |
| --- |
| Possible Agreement:For beam indication with Rel-17 unified TCI, ...For beam indication with Rel-17 unified TCI, support DCI format 1\_1/1\_2 without DL assignment:* Use ACK/NACK mechanism analogous to that for SPS PDSCH release with both type-1 and type-2 HARQ-ACK codebook:
	+ Upon a successful reception of the beam indication DCI, the UE reports an ACK
		- Note that upon a failed reception of the beam indication DCI, a NACK can be reported.
		- For type-1 HARQ-ACK codebook, a location for the ACK information in the HARQ-ACK codebook is determined based on a virtual PDSCH indicated by the TDRA field in the beam indication DCI, based on the time domain allocation list configured for PDSCH
		- For type-2 HARQ-ACK codebook, a location for the ACK information in the HARQ-ACK codebook is determined according to the same rule for SPS release
	+ The ACK is reported in a PUCCH *k* slots after the end of the PDCCH reception where *k* is indicated by the PDSCH-to-HARQ\_feedback timing indicator field in the DCI format, or provided *dl-DataToUL-ACK* or *dl-DataToUL-ACK-ForDCI-Format1-2-r16* if the PDSCH-to-HARQ\_feedback timing indicator field is not present in the DCI
* When used for beam indication:
	+ CS-RNTI is used to scramble the CRC for the DCI
	+ The values of the following DCI fields are set as follows:
		- RV = all ‘1’s
		- MCS = all ‘1’s
		- NDI = 0
		- Set to all ‘0’s for FDRA Type 0, or all ‘1’s for FDRA Type 1, or all ‘0’s for dynamicSwitch (same as in Table 10.2-4 of TS38.213)
		- FFS: Whether HPN is also used
* Use at least the existing TCI field (always present) to signal the following: 1) Joint DL/UL TCI state, 2) DL-only TCI state (for separate DL/UL TCI), 3) UL-only TCI state (for separate DL/UL TCI)
	+ FFS: Whether both DL TCI and UL TCI states can be signaled in one instance of beam indication DCI
	+ FFS: Relation with joint vs separate TCI (DL and/or UL) switching, including M/N>1 if supported
* In addition, use (at least) the following DCI fields:
	+ Identifier for DCI formats
	+ Carrier indicator
	+ Bandwidth part indicator
	+ TDRA
	+ Downlink assignment index (if configured)
	+ TPC command for scheduled PUCCH
	+ PUCCH resource indicator
	+ PDSCH-to-HARQ\_feedback timing indicator (if present)
* The remaining unused DCI fields and codepoints are reserved

**Supported by Nokia/NSB, NTT Docomo, Verizon, KDDI, AT&T, SKT, LG Uplus, APT/FGI, OPPO, Spreadtrum (only Alt1, and no other DCI formats such as Alt2 and Alt3), CATT, Sam-sung (2nd preference), ZTE, MTK, Intel, Apple, Qualcomm, Sony, Convida, NEC, Lenovo/MoM, KT, Fujitsu****Objected by Huawei/HiSi, Ericsson, Futurewei, LG, Xiaomi** |

### Issue 4 (MP-UE)

### Issue 5 (MPE mitigation)

# References

|  |  |  |  |
| --- | --- | --- | --- |
| 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) |