**3GPP TSG RAN WG1 #103-e R1-2009574**

**e-Meeting, October 26th – November 13th, 2020**

**Agenda item:** 8.1.1

**Source:** Moderator (Samsung)

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

**Document for:** Discussion and Decision

1. Introduction

Picking up from where the group left off in the 1st moderator summary R1-2009499, the 1st GTW session, and the 1st check-point, below are the summaries and moderator proposals.

1. Summary

We will focus on some of the moderator proposals not included in the agreements from the first check-point as well as a few additional matters.

* 1. Issue 1 (unified TCI framework)

CA support

**Proposal 1.A**: On Rel.17 unified TCI framework, support 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:

* The above applies to intra-band CA
* The above applies to joint DL/UL and separate DL/UL beam indications
* FFS: Just as Rel.16, the UE will find the corresponding TCI state in the corresponding CC and apply the corresponding TypeA and TypeD QCL assumption from the TCI state ID
* FFS: The above also applies to inter-band CA
* FFS: sharing a single RRC TCI state pool for the set of configured CCs

There were two main unresolved points during the discussion:

1. TCI state vs TCI state ID:
	1. Huawei: “Similar in R16, it is more appropriate to say ‘common TCI state ID’, with which the UE will find the corresponding TCI state in the corresponding CC and apply the corresponding TypeA and TypeD QCL assumption. If it is about ‘common TCI state’, we don’t know how UE can obtain TypeA QCL assumption from another CC. As the proposal here is mainly for ‘data’ channels (e.g., PDCCH/PDSCH), it seems natural to go with ‘common TCI state ID’, which may refer to CSI-RS for tracking on each CC, for both TypeA and TypeD QCL.”
	2. Futurewei: “As we have not progress on TCI state and pool details, it is too early to talk about TCI state ID. Furthermore, what does it mean to have “common TCI state ID” if different CCs have different state pool? At this point, we suggest to remove “ID”.”
2. Suggestion from ZTE to make the 3rd bullet point as FFS in relation to the 5th bullet point:
	1. The newly added part "Note: Just as Rel.16, the UE will find the corresponding TCI state in the corresponding CC and apply the corresponding TypeA and TypeD QCL assumption from the TCI state ID" should be FFS. It may be relevant to sharing single RRC TCI state pool for the set of configured CCs or configuring TCI state pools per CC, i.e., the last FFS bullet.

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| Action: Interested companies are encouraged to provide their inputs on the above two points. Goal: Arrive at an agreeable formulation of proposal 1.A after resolving the two points. |

Table 1 Additional inputs for round-3 discussion: two unresolved points of proposal 1.A

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| **Company** | **Input** |
| Qualcomm | For TCI state vs TCI state ID, we prefer to keep ID. Otherwise, it may imply all CCs will use a common TCI with a common TypeA RS, which may not be compatible with current spec/implementationFor TCI pool, slightly prefer to reuse per-CC based pool as in R15/16. Because single TCI pool across CCs may require gNB to configure same TypeA and TypeD RS IDs for a given TCI ID across all CCs, and the rule for MAC-CE activating TCI per individual CC may also need to be changed accordingly.  |
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TCI state pool

The following was agreed in RAN1#102-e:

* For Rel.17 NR FeMIMO, on the unified TCI framework
	+ Support joint TCI for DL and UL based on and analogous to Rel.15/16 DL TCI framework
		- ...
		- FFS: When used for the purpose of joint beam indication for UL and DL, whether a joint TCI pool for DL and UL dedicated for the purpose is used, or the same TCI pool as that used for the purpose of separate DL/UL beam indication is used
		- ...

The following was agreed in RAN1#103-e:

On Rel.17 unified TCI framework, to accommodate the case of separate beam indication for UL and DL:

* Utilize two separate TCI states, one for DL and one for UL
* FFS: Whether the UL TCI state is taken from a common/same or separate TCI state pool from DL TCI state

With the understanding that TCI state pool refers to a set of TCI states configured via higher-layer signaling, the following alternatives are available:

* Alt1. A joint DL/UL TCI state pool is used for joint DL/UL TCI, and the same joint DL/UL TCI state pool is used for separate DL/UL TCI
* Alt2. A joint DL/UL TCI state pool is used for joint DL/UL TCI, and separate DL/UL TCI state pools are used for separate DL/UL TCI
* Alt3. Separate DL/UL TCI state pools are used for joint DL/UL TCI, and the same separate DL/UL TCI state pools are used for separate DL/UL TCI
* Alt4. Separate DL/UL TCI state pools are used for joint DL/UL TCI, and a joint DL/UL TCI state pool is used for separate DL/UL TCI

Among the above four alternatives, Alt4 is less motivated for an apparent reason (if joint TCI uses separate pools for DL and UL, using a joint pool for separate DL/UL TCI is difficult to justify). Therefore, Alt4 can be precluded.

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| Action: Interested companies are encouraged to provide their preferences among Alt1, Alt2, and Alt3 (and their reasoning)Goal: Select one of the three alternatives and, after that, formulate a proposal for endorsement |

Table 2 Additional inputs for round-3 discussion: TCI state pool

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| **Company** | **Input** |
| Qualcomm | Prefer Alt.1. Otherwise, DCI for beam update may have to indicate the TCI ID is from the DL, UL, or joint pool, in addition to the TCI ID.  |
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* 1. Issue 2 (L1/L2-centric inter-cell mobility)

**Proposal 2.A**: On Rel.17 enhancements to enable L1/L2-centric inter-cell mobility:

* ...
* The following enhancement scope is assumed:
	+ No RRC reconfiguration signaling is needed during and after handover when a TCI associated with non-serving cell RS is indicated
		- A non-serving cell RS is an RS that is or has an SSB of a non-serving cell as direct or indirect QCL source
		- This implies no C-RNTI update during inter-cell mobility during and after handover
	+ ...

One unresolved point was related to whether the blue highlighted text should be made a Working Assumption. Those arguing as such (e.g. Nokia, OPPO) seem to be primarily concerned on making a premature agreement without checking with RAN2 (note: sending an LS to RAN2/4 is too premature at this point since there is no TU allocation for Rel.17 FeMIMO in RAN2/4 yet – the FL is compiling a list of potential issues for a planned LS later in 2021). Those arguing against making the blue highlighted text a Working Assumption (e.g. Ericsson) fails to see the relevance of a Working Assumption in a scope.

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| Action: Interested companies are encouraged to provide their inputs on the above point Goal: Arrive at an agreeable formulation of the blue highlighted text of proposal 2.A after resolving the point |

Table 3 Additional inputs for round-3 discussion: RRC point of proposal 2.A

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| **Company** | **Input** |
| Qualcomm | Prefer to leave those issues open for now, i.e. no WA or agreement on those bullets. Light RRC reconfig may be beneficial if gNB cannot ensure identical configurations across different cells. For potential LS to RAN2/4, we suggest to check with RAN4 for the feasibility to accomplish the feature of one-shot TA update in R17. Because this feature is our assumption for the TA part to work when the cell is changed. It would be good to check with RAN4 on their plan.  |
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* 1. Issue 3 (beam indication signaling medium)

“for joint beam indication” text

**Proposal 3.A**: (Yellow 3.1 of issue 3 agreement) “for joint beam indication” text can be addressed as follows:

* The existing DCI formats 1\_1 and 1\_2 are reused for joint DL/UL beam indication
	+ ~~FFS: If additional DCI format(s) are supported, e.g. existing DCI formats 0\_0, 0\_1, 0\_2, 1\_0 as well as new DCI format(s) dedicated for beam indication~~
	+ FFS: support of DCI format 1\_0 for joint DL/UL or separate DL/UL beam indication
	+ FFS: support new DCI format(s) dedicated for beam indication for joint or separate DL/UL beam indication
	+ FFS: support for reusing the existing UL-related DCI format(s) (e.g. 0\_0, 0\_1, 0\_2) for joint or separate DL/UL beam indication
	+ FFS: support for reusing DCI format 1\_1, and 1\_2 for separate DL/UL beam indication

The part of the agreed text was “(for) beam indication” (“joint” was in red since it was suggested and discussed but without conclusion). During the discussion several versions were proposed:

1. V1. “for joint and separate DL/UL beam indication”: This is equivalent to “for joint beam indication” since the unified TCI framework comprises joint and separate DL/UL.
	1. At least Intel raised some concern on this version
2. V2. “for joint DL/UL beam indication”: This keeps the separate DL/UL mode open. The rationale is that DCI 1\_1/1\_2 only includes DL assignment (but not UL grant). In this case, UL-only beam indication (used when, e.g. MPE event occurs) can only be done when DL assignment is available thereby resulting in poor latency performance.
	1. At least Huawei raised some concern on this version
3. V3. (reworded) “for joint DL/UL beam indication, as well as DL-only beam indication when configured with separate DL/UL beam indication”: This keeps only the UL part for separate DL/UL mode open. The rationale is the same as V2 and there is no reason not to use DCI 1\_1/1\_2 for DL-only beam indication.

The list of FFS doesn’t seem controversial. It only needs to be consistent with the main statement (either V1, V2, or V3).

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| Action: Interested companies are encouraged to provide their inputs on selecting among versions V1, V2, and V3 (or in general if/how to revise “for beam indication”)Goal: Arrive at an agreeable (potential) revision of “for beam indication” and its corresponding list of FFS in Proposal 3.A |

Table 4 Additional inputs for round-3 discussion: Joint beam indication proposal 3.A

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| **Company** | **Input** |
| Qualcomm | Slightly prefer V3. It seems reasonable for DL DCI to also indicate DL common beam. |
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UE capability for latency

**Proposal 3.B**: On Rel.17 DCI-based beam indication:

* Regarding application time of the beam indication: if beam indication is received, down-select from the following:
	+ Alt1: the first slot that is at least X ms or Y symbols after the DCI with the joint or separate DL/UL beam indication
	+ Alt2: the first slot that is at least X ms or Y symbols after the acknowledgment of the joint or separate DL/UL beam indication
	+ FFS: whether any existing timing defined for DCI based TCI/spatial relation update can be used for X/Y
* FFS: When and how to apply the minimum beam indication delay
* Support a UE capability for the minimum value of X or Y
	+ FFS: the beam application time X or Y is configured by the gNB via higher-layer (RRC) signaling based the UE capability
	+ FFS: the exact minimum values of X (e.g., 0.5ms, 2ms, 3ms) or Y supported by UE
	+ FFS: Whether to support more than one values of X/Y and UE capabilities for the minimum values of X/Y
	+ FFS: whether existing UE capability (e.g. beamSwitchTime) can be reused as this UE capability.
* The latency of the DCI design (with or without specification impact) should be significantly improved with respect to the utilization of MAC CE

Only the blue highlighted text was still in flux during the discussion.

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| Action: Interested companies are encouraged to provide their inputs on the blue highlighted text.Goal: Arrive at an agreeable formulation of the blue highlighted text of Proposal 3.B |

Table 5 Additional inputs for round-3 discussion: UE capability of proposal 3.A

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| **Company** | **Input** |
| Qualcomm | Suggest to remove 1st FFS or merge it into 3rd FFS, since 1st FFS seems similar to the 3rd FFSSuggest to remove 2nd FFS, since UE capability may not make too much sense if there is only a single candidate value. In this case, the spec may simply define a fixed value |
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* 1. Issue 4 (MP-UE)

[To be added later]

* 1. Issue 5 (MPE mitigation)

**Proposal 5.A**: On UE reporting for MPE mitigation for Rel.17, investigate and, if needed, specify the following:

* ...
* ...
* Any additional reporting: down-select from the following in RAN1#104-e
	+ Alt0: no additional reporting content
	+ Alt1: P-MPR + L1-RSRP
	+ Alt2: virtual PHR + L1-RSRP
	+ Alt3: L1-RSRP/SINR with and without MPE effect
	+ Alt4: virtual PHR
	+ Alt5: P-MPR or virtual PHR + CRI/SSBRI
	+ Other options are not precluded
	+ Note that PHR including PH and Pcmax is calculated based on P-MPR and the L1-RSRP

Intel inquired and argued: “... we wanted to clarify if the additional reporting *applies to the current MPE impacted beam or the new candidate beam* which is targeted to be used. In our understanding this should be further clarified... *explicit alternatives* are listed under bullet 3 for down-selection in RAN1#104-e. In this case, it is not clear to us how we are supposed to down-select without knowing *which options apply to which use case*.” (emphasis added)

Intel proposed a more compact alternative text:

* Any additional reporting: down-select from the following in RAN1#104-e
	+ Alt0: no additional reporting content
	+ Alt1: Additional reporting is supported (for example P-MPR + L1-RSRP, virtual PHR + L1-RSRP, L1-RSRP/SINR with and without MPE effect, virtual PHR, P-MPR or virtual PHR + CRI/SSBRI)
		- Note: Other options are not precluded

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| Action: Interested companies are encouraged to provide their inputs on which of the two versions (blue vs. red) they prefer (or perhaps another)Goal: Arrive at an agreeable formulation of the text for ‘Any additional reporting’ of Proposal 5.A |

Table 6 Additional inputs for round-3 discussion: ‘other reporting’ of proposal 5.A

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| **Company** | **Input** |
| Qualcomm | We prefer Intel’s compact proposal at this stage. It can have other report metric combinations. Suggest to add in Alt.1 one more metric “estimated max UL RSRP”, which is equal to max allowed UL Tx power minus path loss* + Alt1: Additional reporting is supported (for example P-MPR + L1-RSRP, virtual PHR + L1-RSRP, L1-RSRP/SINR with and without MPE effect, virtual PHR, P-MPR or virtual PHR + CRI/SSBRI, estimated max UL RSRP)
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* 1. Issue 6 (beam refinement/tracking)

**Proposal 6.A**: Investigate and, if needed, specify *at least* the following enhancements for beam refinement/tracking in Rel.17:

* Beam measurement and reporting enhancement via RACH during initial access (e.g. RO for measurement and MSG3 for reporting)
* Improving efficiency (latency and/or overhead) of beam refinement assuming the unified TCI framework (issue 1):
	+ Enabling joint DL TX and RX beam refinement/tracking (P2+P3)
	+ Additional UE report to aid P1/P2/P3 related measurement/report configuration (triggering frequency or periodicity)
* Beam management with reduced DL signaling assuming the unified TCI framework (issue 1):
	+ Dynamic beam update based on beam report (without beam indication)
	+ Dynamic beam measurement and report triggered by beam indication (without CSI-RS/CSI triggering)
	+ Configuring/indicating to UE multiple SSBs for beam tracking
	+ Semi-static/pre-planned (RRC based) beam transition (for, e.g. isolated HST deployment)
	+ Reducing activation delay of TCI states (e.g. via storing QCL properties of a subset of source RSs for a time period)

Several companies (Convida, Huawei, vivo, ZTE) propose to deprioritize the work for this issue. In particular, Huawei raised some concern on agreeing to Proposal 6.A because of the perceived scope. Note that this is a proposal to “investigate and, if needed, specify”.

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| Action: Interested companies are encouraged to provide their inputs on how to modify Proposal 6.A to make it more acceptable to the concerned companies – such as adding a statement on priority relative to the other five issues. Goal: Arrive at an agreeable formulation of Proposal 6.A |

Table 7 Additional inputs for round-3 discussion: proposal 6.A

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| **Company** | **Input** |
| Qualcomm | We are fine to keep item 6 with lower priority than issue 1 and issue 3 but same priority as the other 3 issues, whose direction is also not very clear so far.  |
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# References

1. R1-2009499 Moderator summary#2 for multi-beam enhancement Moderator (Samsung)
2. R1-2008147 Moderator summary#1 for multi-beam enhancement Moderator (Samsung)