**3GPP TSG RAN WG1 #107-e R1-2112763**

**e-Meeting, November 11th – 19th, 2021**

**Agenda item:** 8.1.1

**Source:** Moderator (Samsung)

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

**Document for:** Discussion and Decision

## CORESET framework

Summary:

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| **Proposal 1.I:** For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception, for intra-cell and inter-cell BM, support per CORESET determination as follows:* For any PDCCH reception on a CORESET [other than CORESET#0] that is associated with ~~[~~at least ~~or] [~~USS ~~and/or CSS type 3]~~ set(s) and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on [CORESET#0 or] a CORESET [(other than CORESET#0)] that is not associated with any ~~[~~USS ~~and/or CSS type 3]~~ set and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
	+ Note: It was agreed that a UE can receive non-UE dedicated signal/channel only from the serving cell
	+ ~~Above applies only for intra-cell beam indication~~
* ~~[~~For inter-cell beam management (i.e. when at least one of the RRC-configured TCI states is associated with a PCI different from that of the serving cell) ~~indication~~, a UE may expect that a CSS and a USS are not associated with a same CORESET~~]~~

The bracketed texts will be discussed and concluded during maintenance**FL Note**: 3 open issues to finalize, companies’ views**Working Assumption**For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception, for intra-cell and inter-cell BM, support per CORESET determination as follows:* For any PDCCH reception on a CORESET [other than CORESET#0] that is associated with [at least or only] [USS and/or CSS type 3] set(s) and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on [CORESET#0 or] a CORESET [(other than CORESET#0)] that is not associated with any [USS and/or CSS type 3] set and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
	+ Note: It was agreed that a UE can receive non-UE dedicated signal/channel only from the serving cell
	+ Above applies only for intra-cell beam indication
* [For inter-cell beam indication, a UE may expect that a CSS and a USS are not associated with a same CORESET]

**CORESET#0:*** **Remove brackets (include):** ZTE, Ericsson, NTT Docomo, Intel, vivo, Nokia/NSB
* **Remove text or keep brackets (FFS and address in maintenance):** QC, Apple, MTK, Samsung, CMCC, Xiaomi, LG, OPPO, CATT, Sony

FL assessment: No consensus on removing the brackets for now, continue discussion during maintenance**USS and/or CSS Type 3:*** **Only USS:** QC, Ericsson, CMCC, Samsung, Xiaomi, LG, CATT
* **USS and CSS Type 3:** Apple, ZTE, NTT Docomo, Intel, vivo, OPPO, Nokia/NSB, Sony

FL assessment: ‘USS only’ is default, no consensus on treating CSS Type 3 (non UE dedicated) similarly to USS. **Support CORESET association with both CSS and USS:*** **For both intra- and inter-cell:** Ericsson, NTT Docomo, Intel, Samsung (1st pref, NW implementation), ZTE, Nokia/NSB, CATT
* **Only for intra-cell:** Samsung (2nd pref), CMCC, NTT Docomo (2nd pref), LG, OPPO, Sony
* **Not supported:** QC, ZTE (except for CORESET#0), MTK, Lenovo/MotM, Apple, Xiaomi, vivo

FL assessment: Almost equal support for intra+inter vs none. ‘Only intra’ is a good compromise  |

**Table 1 Restructured CORESET-based framework proposal**

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| **Proposal 1.I’:** For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception: For discussion purposes, define ‘CORESET A’ and ‘CORESET B’ as follows:* ‘CORESET A’: CORESETs associated with UE-dedicated reception on PDCCH in a CC, comprising CORESETs in association with:
	+ USS
	+ [CSS Type 3]
* ‘CORESET B’: CORESETs associated with non-UE-dedicated (not associated with UE-dedicated) reception on PDCCH in a CC, comprising CORESETs in association with:
	+ CSS [other than Type 3]
	+ [CORESET#0]

For intra-cell BM (when [all of the RRC-configured TCI states are][the indicated TCI state is] associated with the serving cell), support per CORESET determination as follows:* For any PDCCH reception on a ‘CORESET A’ and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on a ‘CORESET B’ and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
* For intra-cell BM, a supported CORESET can be either a ‘CORESET A’ or a ‘CORESET B’

For inter-cell BM (when [at least one of the RRC-configured TCI states][the indicated TCI state] is associated with a PCI different from that of the serving cell), support per CORESET determination as follows:* For any PDCCH reception on a CORESET A and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* [For any PDCCH reception on a ‘CORESET B’ associated with the serving cell and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC]
* For inter-cell BM, a supported CORESET can be either a CORESET A or a CORESET B
 |

Table 2 Additional inputs: proposal 1.I’

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Share your inputs on proposal 1.I’**
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| Qualcomm | Do not support Proposal 1.1’. The fundamental issue is still there: for intra-cell BM, if a CORESET is both CORESET A (USS) and CORESET B (CSS), it should always apply the indicated TCI. AGAIN, this is against the previous agreement. As a compromise, we can only accept a CORESET to be either USS or CSS. Otherwise, we prefer per SS based classification, which has no such “CORESET for both USS and CSS” issue. [Mod: I see your point since we agreed for configurability for non-UE-dedicated. Modified the proposal but keep intra and inter separated since the second bullet only applies to intra]For intra-cell and inter-cell BM (when all of the RRC-configured TCI states are associated with the serving cell), support per CORESET determination as follows:* For any PDCCH reception on ~~at least~~ a ‘CORESET A’ and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on ~~only~~ a ‘CORESET B’ and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
* For intra-cell and inter-cell BM, a supported CORESET can be either ‘CORESET A’, ‘CORESET B’~~, or both~~
 |
| Huawei, HiSilicon | The separating condition of “when all of the RRC-configured TCI states are associated with the serving cell” and “when at least one of the RRC-configured TCI states is associated with a PCI different from that of the serving cell” may imply RRC reconfiguration when roaming across TRPs with different PCIs, which goes against the motivation of inter-cell BM. We suggest changing them as “when the indicated TCI state is associated with SSB from the serving cell” and “when the indicated TCI state is associated with SSB with PCI different from the serving cell”, respectively.[Mod: I see your point, let’s discuss if this is a common understanding] |
| Futurewei | The meaning of the following terms is not clear and needs some clarifications: * at least a ‘CORESET A’: We believe it intends to say “a CORESET which is either a ‘CORESET A’ or both a ‘CORESET A’ and a ‘CORESET B’”
* only a ‘CORESET B’: We believe it intends to say “a CORESET which is only a ‘CORESET B’”
* only a CORESET A: We believe it intends to say “a CORESET which is only a ‘CORESET A’”

Also, for the inter-cell BM case, there is only description for the case of “a CORESET which is only a ‘CORESET A’”. Another bullet for the case of “a CORESET which is only a ‘CORESET B’” is needed.[Mod: Thanks. Please check revised version where ‘at least’ and ‘only’ are not needed]In summary, we would like to suggest the modifications as follows:**Proposal 1.I’:** For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception: For discussion purposes, define ‘CORESET A’ and ‘CORESET B’ as follows:* ‘CORESET A’: CORESETs associated with UE-dedicated reception on PDCCH in a CC, comprising CORESETs in association with:
	+ USS
	+ [CSS Type 3]
* ‘CORESET B’: CORESETs associated with non-UE-dedicated (not associated with UE-dedicated) reception on PDCCH in a CC, comprising CORESETs in association with:
	+ CSS [other than Type 3]
	+ [CORESET#0]

For intra-cell BM (when all of the RRC-configured TCI states are associated with the serving cell), support per CORESET determination as follows:* For any PDCCH reception on a CORESET which is either a ‘CORESET A’ or both a ‘CORESET A’ and a ‘CORESET B’ and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on a CORESET which is only a ‘CORESET B’ and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
* For intra-cell BM, a supported CORESET can be either ‘CORESET A’, ‘CORESET B’, or both

For inter-cell BM (when at least one of the RRC-configured TCI states is associated with a PCI different from that of the serving cell), support per CORESET determination as follows:* For any PDCCH reception on a CORESET which is only a ‘CORESET A’ and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on a CORESET which is only a ‘CORESET B’ and is from the serving cell and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC.
* For inter-cell BM, a supported CORESET can be either CORESET A or CORESET B (but not both)

[Mod: OK] |
| Apple | We found the following agreement from inter-cell mTRP may be helpful for us to simplify the issue. **Updated Proposal 3v2:****UE is not required to monitor a Type0/0A/1[/2] CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI.** We have the following proposal:**Proposal: For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception, for intra-cell and inter-cell BM, support per CORESET determination as follows:*** **For CORESETs other than CORESET #0, UE always applies the indicated Rel-17 TCI state.**
* **For CORESET #0, whether or not UE to apply the indicated Rel-17 TCI state is configured by RRC**
	+ **For inter-cell mTRP, CORESET #0 shall not share the indicated Rel-17 TCI**
* **UE is not required to monitor a Type0/0A/1[/2] CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI.**

[Mod: Thanks, but this may raise concern from, e.g. Qualcomm, vivo. Please check Qualcomm’s commen] |
| Lenovo/MotM | We support this clear cut proposal. |
| MediaTek | We would suggest the following categories for a CORESET: * ‘CORESET A’: A CORESET associated with only UE-dedicated PDCCH (USS [and Type3 CSS])
* ‘CORESET B’: A CORESET associated with only non-UE-dedicated PDCCH (CSS [other than Type3 CSS] and [CORESET#0])
* ‘CORESET C’: A CORESET associated with both UE-dedicated and non-UE-dedicated PDCCH

Then, there are two alternatives are proposed:Alt1 (from QC’s suggestion)For intra-cell and inter-cell BM, support per CORESET determination as follows:* For any PDCCH reception on CORESET A and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on CORESET B and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
* For both intra-cell and inter-cell BM, CORESET C is not supported

[Mod: Thanks. This is almost the same as the modified proposal. I prefer your format better if possible ☺ But is the 2nd bullet applicable for inter-cell if inter-cell BM is defined per Huawei’s proposal? We will discuss so we reach a common definition]Alt2 (from current FL proposal and Futurewei?)For intra-cell BM, support per CORESET determination as follows:* For any PDCCH reception on CORESET A or CORESET C and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on CORESET B and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC

For inter-cell BM, support per CORESET determination as follows:* For any PDCCH reception on CORESET A and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on CORESET B and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
* For inter-cell BM, CORESET C is not supported

We slightly prefer Alt2 but Alt1 is also fine. |
| Mod V08  | Modified proposal per Qualcomm’s comment (valid)` |
| Samsun | Support, with some clarifications:**Proposal 1.I’:** For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception: For discussion purposes, define ‘CORESET A’ and ‘CORESET B’ as follows:* ‘CORESET A’: CORESETs associated with UE-dedicated reception on PDCCH in a CC, comprising CORESETs in association with:
	+ USS
	+ [CSS Type 3]
* ‘CORESET B’: CORESETs associated with non-UE-dedicated (not associated with UE-dedicated) reception on PDCCH in a CC, comprising CORESETs in association with:
	+ CSS [other than Type 3]
	+ [CORESET#0]

A CORESET can be CORESET A, CORESET B or CORESET A+BFor intra-cell BM (when all of the RRC-configured TCI states are associated with the serving cell), support per CORESET determination as follows:* For any PDCCH reception on at least a ‘CORESET A’ (CORESET A, CORESET A+B) and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on only a ‘CORESET B’ and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
* For intra-cell BM, a supported CORESET can be either ‘CORESET A’, ‘CORESET B’, or both

For inter-cell BM (when at least one of the RRC-configured TCI states is associated with a PCI different from that of the serving cell), support per CORESET determination as follows:* For any PDCCH reception on only a CORESET A and the respective PDSCH reception, UE always applies the indicated Rel-17 TCI state.
* For any PDCCH reception on only a ‘CORESET B’ and the respective PDSCH reception, whether or not UE to apply the indicated Rel-17 TCI state is determined per CORESET by RRC
* For inter-cell BM, a supported CORESET can be either CORESET A or CORESET B (but not both, i.e. CORESET A+B)
 |
| NTT Docomo | Do not support Proposal 1.1’.We believe CORESET with CSS and USS should be allowed, same as Rel.15. We prefer Alt.2 of MediaTek.In Alt.1 of MediaTek (Qualcomm’s proposal), “For both intra-cell and inter-cell BM, CORESET C is not supported” is not acceptable for us. |
| LG | We have a similar view with Huawei that the selection of intra-/inter-cell BM more related to the indicated TCI state whether it is associated with SSB from the serving cell (w/ same PCI) or not (w/ different PCI) than the RRC configuration.For the inter-cell BM, it also needs to put the bracket on the 3rd bullet since the 2nd bullet for CORESET B is not determined yet. |
| Sony | Sorry for joining the discussion late. We add our view in FL’s summary table. Thank you for the classification on CORESET A, B or even C and separate discussion on intra-cell and inter-cell BM. On the definition of CORESET A and B, we would like to quote the agreement RAN1 made in AI 8.1.2.4 yesterday for reference. It reads that CSS Type3 along with USS can be transmitted by NW from two TRPs. In other words, the group common PDCCH can be used as UE-dedicated DL control channel. Hence, we think it seems no harm treat CSS Type3 similarly in AI 8.1.1 as well, meaning remove the bracket around CSS Type 3 for ‘CORESET A’. Possible Agreement**Alt 3**: If PDCCH candidates in CSS 3 are associated with CORESET that is activated with two TCI states and configured with enhanced SFN scheme 1 or TRP based pre-compensation, both TCI states can be applied for the CSS reception. * FFS: Whether/How specification change is needed is up to the editor

For intra-cell BM, we see a supported CORESET can be either ‘CORESET A’ or ‘CORESET B’. But we failed to dig out the reason why it cannot be CORESET A+B where CSS (other than CSS Type 3 in our view) and USS can be associated with this CORESET. Even for CORESET#0, such different search space sets combination seems allowed. If this could be clarified, that would be great. Thanks. Of course, we are not arguing this for inter-cell BM, where the common channel/signal should stay in serving cell. We also noticed that such CORESET is classified as ‘CORESET C’ in MTK’s response. In a conservative way, it can be treated similar as ‘CORESET A’. |
| ZTE | In principle, we prefer to have same solution for inter-cell and intra-cell operation. Then, CORESET#0 should be discussed separately. It should be considered as non-UE dedicated channel by default. Therefore, for inter-cell case, we need that CORESET#0 is explicitly mentioned for ‘to apply the indicated Rel-17 TCI state is determined per CORESET by RRC’.  |

## Other issues

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

Table 3 Summary: issue 1

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| **#** | **Issue** | **Companies’ views** |
| 1.1 | **Proposal 1.A.2**: On Rel-17 unified TCI framework, for any SRS resource or resource set that does not share the same indicated Rel-17 TCI state(s) as dynamic-grant/configured-grant based PUSCH and all of dedicated PUCCH resources, but can be configured as a target signal of a Rel-17 UL or, if applicable, joint TCI (hence the Rel-17 UL or, if applicable, joint TCI state pool), Rel-17 mechanism(s) which reuse mechanisms similar to the Rel-15/16 spatial relation info update signaling/configuration design(s) are used to update/configure such SRS (s) with Rel-17 UL or, if applicable, joint TCI state(s).* Applies for both intra-cell and inter-cell beam indication
* [In such a case, UE ignores the UL PC parameters associated with the UL or, if applicable, joint TCI state for SRS, and legacy Rel-15/16 UL PC parameter configuration/activation signaling is reused; otherwise, if SRS resource or resource set shares the same indicated Rel-17 TCI state(s) as dynamic-grant/configured-grant based PUSCH and all of dedicated PUCCH resources, UE does not expect legacy Rel-15/16 UL PC parameter configuration for SRS.]
* The MAC-CE signaling for the Rel-17 mechanism(s) shall fully reuse, to the fullest possible extent, the MAC-CE for the Rel-15/16 spatial relation info update
	+ Note: Strive, to the fullest possible extent, not to introduce any No new MAC-CE is introduced. The exact details are up to RAN2.
* Note: A Rel-17 UE is not required to support both this feature and Rel-16 AP SRS SpatialRelationInfo update within the same band.

**FL Note**: Discussed offline [1] | **Support/fine (27)**: Sony, Nokia/NSB, Ericsson, Samsung, MTK, Fraunhofer IIS/HHI, CMCC, Futurewei, Intel, vivo, NEC, AT&T, NTT Docomo, QC, CATT, Xiaomi, TCL, Lenovo/MotM, Convida, Huawei, HiSi, ZTE, Apple, OPPO **Concern**: LG, [Qualcomm] |
| 1.2 | **Proposal 1.E:** On Rel.17 unified TCI framework, for Rel-17 unified TCI, for DL channels/signals that share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH (via Rel-17 MAC-CE/DCI TCI state update), the following option on source RSs and QCL-Types is also supported:* Option 3: CSI-RS for CSI is configured for QCL-TypeA and QCL-TypeD source RS

**FL Note**: It was explained that the so-called “circular” issue is avoided in practice via NW implementation, i.e. NW will not configure the same CSI-RS for CSI both as source and target RSs. | **Support/fine (22)**: Huawei/HiSi, Ericsson, CMCC, Samsung, Sony, Qualcomm, Fraunhofer IIS/HHI, Futurewei, MTK, NTT Docomo, AT&T, Lenovo/MotM, Intel, Xiaomi, CATT, TCL, ZTE, Nokia/NSB **Concern**: Apple (object), OPPO |

Table 4 Additional inputs: issue 1

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 3**
2. **Share more inputs here if needed**
 |
| Qualcomm | For 1.A.2, * Do not support the red text, which unnecessarily require both legacy and R17 PC configurations. R17 config is sufficient. We are fine for restriction rule on top of R17 config.
* Also suggest wording update for the note below
	+ Note: Strive, to the fullest possible extent, not to introduce any ~~No~~new MAC-CE ~~is introduced~~. The exact details are up to RAN2.
 |
| Apple | 1.A.2: The PC issue needs to be resolved, since now we have 2 PC framework, which one is valid needs to be decided. We think the red text should be supported1.E: We already have another 2 options, this would be redundant and it is also not aligned with previous agreements. |
| Lenovo/MotM | Proposal 1.A.2: We tend to agree with Qualcomm on not requiring both legacy and R17 power control configurations. Restricting the same PC parameters for TCI states applied to SRS resources in the same resource sets is better.Proposal 1.E: Support. |
| Samsung | **Proposal 1.A.2**: Does the red text imply that either all SRS resources follow the indicated TCI state, or all SRS resources don’t follow the indicated TCI state. There will be no mixed case, where some SRS resources follow indicated TCI state and some don’t.**Proposal 1.E**: OK |
| NTT Docomo | Proposal 1.A.2: We are fine.We feel the later red texts “*otherwise, if SRS resource or resource set shares the same indicated Rel-17 TCI state(s)…*” contradicts with the main bullet “*On Rel-17 unified TCI framework, for any SRS resource or resource set that does not share the same indicated Rel-17 TCI state(s) …*”.Proposal 1.E. Support. |
| Sony | **Proposal 1.A.2**, support.The editorial change from QC seems correct. **Proposal 1.E,** support. We would like to remind that if CSI-RS for CSI cannot be applied as QCL Type A+D source RS for Rel.17 unified TCI state. One consequence would be that the Rel.17 TCI state is somehow functional different from Rel.15/16 TCI state/spatial relation information. If NW applies CSI-RS for CSI as QCL source as in Rel.15/16, then it seems impossible for UE to be served by Rel.17 TCI state within the same band, as both mechanisms are mutual exclusive within a band (if Proposal 1.A.3 is agreed as it is).  |
| ZTE | **Proposal 1.A.2**: We are fine only if the red part is captured. Regarding DOCOMO’s comment, the highlighted part is to clarify the opposite case. It is the reason why we have ‘otherwise’ at the very beginning.**Proposal 1.E,** support.  |
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### Issue 4 (MP-UE)

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# References

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| 1 | R1-2111716 | Summary of offline discussion on unified TCI, inter-cell beam management, and MPUE | Moderator (Samsung) |