**3GPP TSG RAN WG1 #102-e R1-2007007**

**e-Meeting, August 17th – 28th, 2020**

**Agenda item:** 7.2.6

**Source:** Moderator (LG Electronics)

**Title:** Summary#1 of email thread [102-e-NR-eMIMO-02]

**Document for:** Discussion and Decision

# Introduction

This contribution summaries discussion in email thread [102-e-NR-eMIMO-02]

# Background and Summary of Proposal

Since the feature of simultaneous TCI state activation for PDSCH has been agreed ‘at least for single TRP’, OPPO proposed the following TP.

**TP from OPPO for clause 5.1.5 of TS 38.21****4**

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| 5.1.5 Antenna ports quasi co-location The UE can be configured with a list of up to *M* *TCI-State* configurations within the higher layer parameter *PDSCH-Config* to decode PDSCH according to a detected PDCCH with DCI intended for the UE and the given serving cell, where M depends on the UE capability *maxNumberConfiguredTCIstatesPerCC*. Each *TCI-State* contains parameters for configuring a quasi co-location relationship between one or two downlink reference signals and the DM-RS ports of the PDSCH, the DM-RS port of PDCCH or the CSI-RS port(s) of a CSI-RS resource. The quasi co-location relationship is configured by the higher layer parameter *qcl-Type1* for the first DL RS, and *qcl-Type2* for the second DL RS(if configured). For the case of two DL RSs, the QCL types shall not be the same, regardless of whether the references are to the same DL RS or different DL RSs. The quasi co-location types corresponding to each DL RS are given by the higher layer parameter *qcl-Type* in *QCL-Info* and may take one of the following values:  - 'QCL-TypeA': {Doppler shift, Doppler spread, average delay, delay spread}  - 'QCL-TypeB': {Doppler shift, Doppler spread}  - 'QCL-TypeC': {Doppler shift, average delay}  - 'QCL-TypeD': {Spatial Rx parameter}  The UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321], used to map up to 8 TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'* in one CC/DL BWP or in a set of CCs/DL BWPs, respectively. When a set of TCI state IDs are activated for a set of CCs/DL BWPs, where the applicable list of CCs is determined by indicated CC in the activation command, the same set of TCI state IDs are applied for all DL BWPs in the indicated CCs. The set of CCs/DL BWPs shall not contain any CC/DL BWP where the UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in *ControlResourceSet* or at least one TCI codepoint indicates two TCI states.  When a UE supports two TCI states in a codepoint of the DCI field '*Transmission Configuration Indication'* the UE may receive an activation command, as described in clause 6.1.3.24 of [10, TS 38.321], the activation command is used to map up to 8 combinations of one or two TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'*. The UE is not expected to receive more than 8 TCI states in the activation command.  \*\*\* Unchanged text is omitted \*\*\* |

# Discussion

For discussion, we can split two cases.

* Case1(SDCI MTRP+Multi-CC PDSCH TCI): CC list includes a CC/BWP in which at least one TCI codepoint is mapped with two TCI states
* Case2(MDCI MTRP+Multi-CC PDSCH TCI): CC list includes a CC/BWP in which two CORESET pools are configured.

From FL’s understanding, it seems not an issue to support Case1 by the current specification because the newly introduced MAC-CE for SDCI MTRP is not applicable for Multi-CC TCI activation (see Appendix, MAC-CE part). Therefore, by the current specification, gNB can activate SDCI MTRP operation on one CC in the CC list by using Enhanced TCI States Activation/Deactivation for UE-specific PDSCH MAC CE and can update TCI states for multiple CCs together by using TCI States Activation/Deactivation for UE-specific PDSCH MAC CE to fall back to STRP operation for those CCs.

In Case2, two sets of TCI states can be activated, i.e. one set for each CORESET pool, so it can be ambiguous when TCI state IDs for multiple CCs are updated together. However, current TS38.331 already precludes this case (see Appendix, RRC part- CellGroupConfig IE).

FL’s proposal (for RAN1 conclusion):

* Case1 is supported and no RAN1 spec update is needed for this.
* Case2 is not supported and no RAN1 spec update is needed for this.

**Companies’ view (to be updated)**

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| Company name | View |
| Ericsson | Support the FL proposal not to update RAN1 specification: it would seem that the RAN2 specifications already prohibit simultaneous update of TCI states across CCs for mTRP. |
| Huawei, HiSilicon | After checking RAN2 specs, we found that indeed RAN2 has ruled out simultaneous TCI update for multiple CCs with mTRP operation. However, we want to check with the group whether the restriction at RAN2 side is aligned with RAN1 intention. In RAN1 specs, such restrictions are added as that UE can only be configured with one CORESETPoolIndex (either 0 or 1), but RAN2 seems more restrictive that UE can only be configured with CORESETPoolIndex 0 (1 is ruled out). In our view, it would give more flexibility to NW side if RAN1 can recommend RAN2 to follow the RAN1 way of enforcing such restrictions. |
| Apple | Support FL proposal |
| MediaTek | Agree in principle. We share the same view as Huawei. It is better to align the definition of ‘S-TRP’ with RAN2. |
| Qualcomm | It would be good to have a conclusion to say activating TCI state for mTRP across CCs is not allowed based on RAN2 spec, if this is common understanding. |
| LG | Support the FL’s proposal |
| OPPO | We share the same view as QC. If we do not update the RAN1 specification, it is better to make conclusion that multi-CC TCI state update is not supported for multi-TRP CC according to the RAN2 specification to clarify the understanding in RAN1. |
| ZTE | Support the FL’s proposal. We do not have strong preference of making conclusion for this issue, but the motivation may not be strong since we already have the following agreement and no more additional agreement.  **Agreement**  When a set of TCI-state IDs for PDSCH are activated by a MAC CE for a set of CCs/BWPs at least for the same band, where the applicable list of CCs is indicated by RRC signalling, the same set of TCI-state IDs are applied for the all BWPs in the indicated CCs.   * Further signaling details are up to RAN2. * Whether to support the inter-band CA for this feature will be decided in RAN1#99. * Whether to indicate the applicable list of bands for the feature of single MAC-CE to activate the same set of PDSCH TCI state IDs for multiple CCs/BWPs is up to capability discussion.   + FFS on the UE capability signaling details * Note: This at least applies to single TRP case. * FFS: How many combinations of CCs can be configured by RRC and relevant UE capability |

# Conclusion (to be updated)

# Appendix: Related RRC and MAC-CE parameters

6.1.3.14 TCI States Activation/Deactivation for UE-specific PDSCH MAC CE

The TCI States Activation/Deactivation for UE-specific PDSCH MAC CE is identified by a MAC subheader with LCID as specified in Table 6.2.1-1. It has a variable size consisting of following fields:

- Serving Cell ID: This field indicates the identity of the Serving Cell for which the MAC CE applies. The length of the field is 5 bits. If the indicated Serving Cell is configured as part of a *simultaneousTCI-UpdateList1-r16* or *simultaneousTCI-UpdateList2-r16* as specified in TS 38.331 [5], this MAC CE applies to all the Serving Cells configured in the set *simultaneousTCI-UpdateList1-r16* or *simultaneousTCI-UpdateList2-r16*, respectively;

- BWP ID: This field indicates a DL BWP for which the MAC CE applies as the codepoint of the DCI *bandwidth part indicator* field as specified in TS 38.212 [9]. The length of the BWP ID field is 2 bits. This field is ignored if this MAC CE applies to a set of Serving Cells;

- Ti: If there is a TCI state with *TCI-StateId* i as specified in TS 38.331 [5], this field indicates the activation/deactivation status of the TCI state with *TCI-StateId* i, otherwise MAC entity shall ignore the Ti field. The Ti field is set to 1 to indicate that the TCI state with *TCI-StateId* i shall be activated and mapped to the codepoint of the DCI *Transmission Configuration Indication* field, as specified in TS 38.214 [7]. The Ti field is set to 0 to indicate that the TCI state with *TCI-StateId* i shall be deactivated and is not mapped to the codepoint of the DCI *Transmission Configuration Indication* field. The codepoint to which the TCI State is mapped is determined by its ordinal position among all the TCI States with Ti field set to 1, i.e. the first TCI State with Ti field set to 1 shall be mapped to the codepoint value 0, second TCI State with Ti field set to 1 shall be mapped to the codepoint value 1 and so on. The maximum number of activated TCI states is 8;

- CORESET Pool ID: This field indicates that mapping between the activated TCI states and the codepoint of the DCI *Transmission Configuration Indication* set by field Ti is specific to the *ControlResourceSetId* configured with CORESET Pool ID as specified in TS 38.331 [5]. This field set to 1 indicates that this MAC CE shall be applied for the DL transmission scheduled by CORESET with the CORESET pool ID equal to 1, otherwise, this MAC CE shall be applied for the DL transmission scheduled by CORESET pool ID equal to 0. If the *coresetPoolIndex* is not configured for any CORESET, MAC entity shall ignore the CORESET Pool ID field in this MAC CE when receiving the MAC CE. If the Serving Cell in the MAC CE is configured in a cell list that contains more than one Serving Cell, the CORSET Pool ID field shall be ignored when receiving the MAC CE.

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**Figure 6.1.3.14-1: TCI States Activation/Deactivation for UE-specific PDSCH MAC CE**

6.1.3.24 Enhanced TCI States Activation/Deactivation for UE-specific PDSCH MAC CE

The Enhanced TCI States Activation/Deactivation for UE-specific PDSCH MAC CE is identified by a MAC PDU subheader with eLCID as specified in Table 6.2.1-1b. It has a variable size consisting of following fields:

- Serving Cell ID: This field indicates the identity of the Serving Cell for which the MAC CE applies. The length of the field is 5 bits;

- BWP ID: This field indicates a DL BWP for which the MAC CE applies as the codepoint of the DCI *bandwidth part indicator* field as specified in TS 38.212 [9]. The length of the BWP ID field is 2 bits;

- Ci: This field indicates whether the octet containing TCI state IDi,2 is present. If this field is set to "1", the octet containing TCI state IDi,2 is present. If this field is set to "0", the octet containing TCI state IDi,2 is not present;

- TCI state IDi,j: This field indicates the TCI state identified by *TCI-StateId* as specified in TS 38.331 [5], where i is the index of the codepoint of the DCI *Transmission configuration indication* field as specified in TS 38.212 [9] and TCI state IDi,j denotes the jth TCI state indicated for the ith codepoint in the DCI *Transmission Configuration Indication* field. The TCI codepoint to which the TCI States are mapped is determined by its ordinal position among all the TCI codepoints with sets of TCI state IDi,j fields, i.e. the first TCI codepoint with TCI state ID0,1 and TCI state ID0,2 shall be mapped to the codepoint value 0, the second TCI codepoint with TCI state ID1,1 and TCI state ID1,2 shall be mapped to the codepoint value 1 and so on. The TCI state IDi,2 is optional based on the indication of the Ci field. The maximum number of activated TCI codepoint is 8 and the maximum number of TCI states mapped to a TCI codepoint is 2.

- R: Reserved bit, set to "0".

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**Figure 6.1.3.24-1: Enhanced TCI States Activation/Deactivation for UE-specific PDSCH MAC CE**

CellGroupConfig IE in TS38.331,

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| *CellGroupConfig* field descriptions |
| ***bap-Address***  BAP address of the parent node in cell group. |
| ***bh-RLC-ChannelToAddModList***  Configuration of the backhaul RLC entities and the corresponding MAC Logical Channels to be added and modified. |
| ***bh-RLC-ChannelToReleaseList***  List of the backhaul RLC entities and the corresponding MAC Logical Channels to be released. |
| ***f1c-TransferPath***  The F1-C transfer path that an EN-DC IAB-MT should use for transferring F1-C packets to the Donor-CU. If IAB-MT is configured with lte, IAB-MT can only use LTE leg for F1-C transfer. If IAB-MT is configured with nr, IAB-MT can only use NR leg for F1-C transfer. If IAB-MT is configured with both, it is up to IAB-MT to select an LTE leg or a NR leg for F1-C transfer. |
| ***mac-CellGroupConfig***  MAC parameters applicable for the entire cell group. |
| ***rlc-BearerToAddModList***  Configuration of the MAC Logical Channel, the corresponding RLC entities and association with radio bearers. |
| ***reportUplinkTxDirectCurrent***  Enables reporting of uplink and supplementary uplink Direct Current location information upon BWP configuration and reconfiguration. This field is only present when the BWP configuration is modified or any serving cell is added or removed. This field is absent in the IE *CellGroupConfig* when provided as part of *RRCSetup* message. If UE is configured with SUL carrier, UE reports both UL and SUL Direct Current locations. |
| ***rlmInSyncOutOfSyncThreshold***  BLER threshold pair index for IS/OOS indication generation, see TS 38.133 [14], table 8.1.1-1. *n1* corresponds to the value 1. When the field is absent, the UE applies the value 0. Whenever this is reconfigured, UE resets N310 and N311, and stops T310, if running. Network does not include this field. |
| ***sCellState***  Indicates whether the SCell shall be considered to be in activated state upon SCell configuration. |
| ***sCellToAddModList***  List of secondary serving cells (SCells) to be added or modified. |
| ***sCellToReleaseList***  List of secondary serving cells (SCells) to be released. |
| ***secondaryDRX-GroupConfig***  The field is used to indicate whether the SCell belongs to the secondary DRX group. All serving cells in the secondary DRX group shall belong to one Frequency Range and all serving cells in the legacy DRX group shall belong to another Frequency Range. |
| ***simultaneousTCI-UpdateList1, simultaneousTCI-UpdateList2***  List of serving cells which can be updated simultaneously for TCI relation with a MAC CE. The *simultaneousTCI-UpdateList1* and *simultaneousTCI-UpdateList2* shall not contain same serving cells. Network should not configure serving cells that are configured with CORESETPoolID=1 in these lists. |
| ***simultaneousSpatial-UpdatedList1, simultaneousSpatial-UpdatedList2***  List of serving cells which can be updated simultaneously for spatial relation with a MAC CE. The *simultaneousSpatial-UpdatedList1* and *simultaneousSpatial-UpdatedList2* shall not contain same serving cells. Network should not configure serving cells that are configured with CORESETPoolID=1 in these lists. |
| ***spCellConfig***  Parameters for the SpCell of this cell group (PCell of MCG or PSCell of SCG). |
| ***uplinkTxSwitchingOption***  Indicates which option is configured for dynamic UL Tx switching for inter-band UL CA or EN-DC. The field is set to *switchedUL* if network configures option 1 as specified in TS 38.214 [19], or *dualUL* if network configures option 2 as specified in TS 38.214 [19]. Network always configures UE with a value for this field in inter-band UL CA case and EN-DC case where UE supports dynamic UL Tx switching. |

# Reference

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| **TDoc** | **Title** | **Source** |
| [**R1-2005976**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_102-e/Docs/R1-2005976.zip) | Text proposals for Multi-beam Operation Enhancement | OPPO |