3GPP TSG-RAN WG1 Meeting #117 R1-2xxxxxx

Fukuoka, Japan, May 20th – 24th, 2024

Agenda Item: 8.1

Source: Moderator (Ericsson)

Title: Moderator Summary for maintenance on Two TAs for multi-DCI

Document for: Discussion & Decision

*During RAN#94e, a new WID for Rel-18 MIMO evolution for DL and UL was agreed. The highlighted Part of objective 7 is relevant for this AI:*

1. Study, and if justified, specify the following
	* Two TAs for UL multi-DCI for multi-TRP operation
	* *Power control for UL single DCI for multi-TRP operation where unified TCI framework extension in objective 2 is assumed.*

For the case of simultaneous UL transmission from multiple panels, the operation will only be limited to the objective 6 scenarios.

*The proposals submitted by Tdocs submitted to RAN1#117 are summarized in this document.*

# **1. Text Proposals**

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| # | Text Proposal | Company Position |
| 1.1 | **Proposal:** Adopt draft CR for 38.212 Clause 7.3.1.2.1 [1] **Reason for change:** According to 38.212, when UE is configured with both LTM and mTRP operation with two TAs, Cell indicator and PRACH association indicator both exist in PDCCH order. In this case, how can UE understand the intention of the PDCCH order?Basically, there are following four cases:* Case 1: Cell indicator = 0 and PRACH association indicator = 0;
* Case 2: Cell indicator = 0 and PRACH association indicator = non-zero;
* Case 3: Cell indicator = non-zero and PRACH association indicator = 0;
* Case 4: Cell indicator = non-zero and PRACH association indicator = non-zero;

In Case 1 and 2, the PDCCH order can be interpreted to trigger RACH for the serving cell. Details of the triggered RACH, i.e., PL RS (when the serving cell is configured with intra-cell mTRP) or PCI (when the serving cell is configured with inter-cell mTRP), can be determined according to PRACH association indicator. While, in Case 3 and 4, the intention of the PDCCH order is unclear. One reasonable interpretation is that the PDCCH order is used to trigger RACH for a candidate cell. UE can determine the candidate cell according to Cell indicator. The PRACH association indicator is not applied.This issue has been discussed for some meetings and up to now the only outcome is to preclude Case 4 which is not sufficient to avoid ambiguity of the spec. A simple way to capture above rule is to restrict that **the PRACH association indicator field is reserved if the cell indicated by Cell indicator field is a candidate cell (i.e., Cell indicator = non-zero).**

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| **Conclusion***When a UE is configured with both the inter-cell multi-DCI based Multi-TRP operation with two TAs and Rel-18 LTM features, the UE does not expect the cell indicator field and PCI indicator field to be non-zero simultaneously.* * *FFS: cell indicator field and PCI indicator field are not non-zero simultaneously*
	+ *Including potential specification impact*
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Another issue for the PRACH association field is that the parameter name of the second TAG, i.e., *tag-Id2*, is not aligned with the one in 38.331 which is *tag2-Id*. **Summary of change:**  1. Introduce a restriction that PRACH association indicator field is reserved if the cell indicated by Cell indicator field is a candidate cell.2. Aligned the parameter name of the second TAG with 38.331.**Consequence if not approved:** The spec is unclear.**-----------------------------------------------------Start of draft CR--------------------------------------------------****7.3.1.2.1 Format 1\_0**DCI format 1\_0 is used for the scheduling of PDSCH in one DL cell. The following information is transmitted by means of the DCI format 1\_0 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:- Cell indicator -$ \left⌈log\_{2}\left(C+1\right)\right⌉$ bits indicating the cell for the corresponding PRACH transmission if the UE is configured with higher layer parameter *EarlyUlSyncConfig*, where *C* is the number of candidate cells configured with higher layer parameter *EarlyUlSyncConfig*; 0 bit otherwise. The bit field index 0 of the cell indicator field is mapped to the serving cell, and other bit field indexes are mapped to the candidate cells configured with higher layer parameter *EarlyUlSyncConfig* according to an ascending order of a candidate identity configured by *ltm-CandidateId*, with the bit field index 1 mapped to the candidate cell with the smallest candidate identity. - PRACH association indicator - 0 or 1 bit- 1bit if the UE is provided with *tag2-Id~~2~~*, and the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for the first CORESETs, and is provided *coresetPoolIndex* with value 1 for the second CORESETs. This field is reserved if the cell indicated by Cell indicator field is a candidate cell.- This field indicates the PCI associated with the PRACH transmission if the UE is provided *SSB-MTC-AddtionalPCI*. The bit field index 0 of this field is mapped to the PCI of the serving cell, and the bit field index 1 of this field is mapped to the additional PCI associated with active TCI states.- This field indicates the PL-RS for the PRACH transmission if the UE is not provided *SSB-MTC-AddtionalPCI*. The bit field index 0 of this field is mapped to the DL RS that the DM-RS of the PDCCH order is quasi-collocated with, and the bit field index 1 of this field is mapped to the SS/PBCH indicated by the SS/PBCH index field in this DCI format. - 0 bit otherwise.- PRACH retransmission indicator - 0 or 1 bit - 1bit if the UE is configured with higher layer parameter *EarlyUlSyncConfig*. This field indicates initial transmission or retransmission of PRACH according to Table 7.3.1.2.1-3 if the cell indicated by Cell indicator field is a candidate cell, and this field is reserved if the cell indicated by Cell indicator field is a serving cell but not a candidate cell. - 0 bit otherwise. **-----------------------------------------------------End of draft CR--------------------------------------------------** | **Support**: Huawei, HiSilicon, Google, Ericsson, Qualcomm**Not support**: |
| 1.2 | **Proposal:** Adopt the following draft CR for 38.212 Clause 7.3.1.2.1 [2] [3]**Reason for change:** Since LTM procedure and MTRP two-TA operation can be enabled simultaneously to a UE, the Cell indicator field for LTM and PRACH association indicator field for two-TA can be present in PDCCH order at the same time.The mapping of PRACH transmission triggered by PDCCH order and cell indicated by the Cell indicator or PRACH association indicator has been specified already. Besides the case that non-zero value is indicated to both fields, which can be assumed an error indication from network and is not needed to be specified, the mapping rule can be concluded as in the following Table.

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| --- | --- | --- | --- |
| Cell indicator | PRACH association indicator | Field interpretation | Mapping of PRACH transmission and serving cell/ candidate cell/ additionalPCI/ PL RS |
| 0 | 0 | The bit field index 0 of the cell indicator field is mapped to the serving cell.The bit field index 0 of PRACH association indicator field is mapped to the PCI of the serving cell/The bit field index 0 of PRACH association indicator field is mapped to the DL RS that the DM-RS of the PDCCH order is quasi-collocated with. | PRACH transmission is mapped to the serving cell. |
| 0 | 1 | The bit field index 0 of the cell indicator field is mapped to the serving cell.The bit field index 1 of this field is mapped to the additional PCI associated with active TCI states./The bit field index 1 of this field is mapped to the SS/PBCH indicated by the SS/PBCH index field in this DCI format. | Ambiguity on PRACH transmission is mapped to serving cell or additional PCI. |
| non-zero | 0 | Other bit field indexes (e.g., except 0) are mapped to the candidate cells.The bit field index 0 of PRACH association indicator field is mapped to the PCI of the serving cell./The bit field index 0 of PRACH association indicator field is mapped to the DL RS that the DM-RS of the PDCCH order is quasi-collocated with. | Ambiguity on PRACH transmission is mapped to candidate cell or serving cell.Misleading that PRACH transmission is mapped to DL RS that the DM-RS of the PDCCH order is QCLed, but it should be mapped to the SSB indicated by the DCI format. |
| non-zero | 1 | X | X |

It can be seen that ambiguity on the mapping of PRACH transmission and cell exists when one of the two field indicates a zero value. Hence, a clarification is needed for the mapping rule in such case.**Summary of change:** Adding a following condition for the mapping of PRACH transmission and cell indicated by PRACH association indicator field:* The bit field index 0 of this field is mapped to the PCI of the serving cell if the cell indicated by Cell indicator field is the serving cell;
* The bit field index 1 of this field is mapped to the additional PCI associated with active TCI states configured for the serving cell.

The bit field index 0 of PRACH association indicator field is mapped to the DL RS that the DM-RS of the PDCCH order is quasi-collocated with, if the cell indicated by Cell indicator field is the serving cell.**Consequence if not approved:** Specification interpretation on the mapping of PRACH transmission and cell when non-zero index is indicated by Cell indicator field and zero index is indicated by PRACH association indicator field UE is ambiguous.**-----------------------------------------------------Start of draft CR (Alt 1)--------------------------------------------------****7.3.1.2.1 Format 1\_0**<Unchanged part is omitted>- Cell indicator -$ \left⌈log\_{2}\left(C+1\right)\right⌉$ bits indicating the cell for the corresponding PRACH transmission if the UE is configured with higher layer parameter *EarlyUlSyncConfig*, where *C* is the number of candidate cells configured with higher layer parameter *EarlyUlSyncConfig*; 0 bit otherwise. The bit field index 0 of the cell indicator field is mapped to the serving cell, and other bit field indexes are mapped to the candidate cells configured with higher layer parameter *EarlyUlSyncConfig* according to an ascending order of a candidate identity configured by *ltm-CandidateId*, with the bit field index 1 mapped to the candidate cell with the smallest candidate identity. - PRACH association indicator - 0 or 1 bit- 1bit if the UE is provided with *tag-Id2*, and the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for the first CORESETs, and is provided *coresetPoolIndex* with value 1 for the second CORESETs.- This field indicates the PCI associated with the PRACH transmission if the UE is provided *SSB-MTC-AddtionalPCI*. The bit field index 0 of this field is mapped to the PCI of the serving cell if the cell indicated by Cell indicator field is the serving cell, and the bit field index 1 of this field is mapped to the additional PCI associated with active TCI states configured for the serving cell.- This field indicates the PL-RS for the PRACH transmission if the UE is not provided *SSB-MTC-AddtionalPCI*. The bit field index 0 of this field is mapped to the DL RS that the DM-RS of the PDCCH order is quasi-collocated with, if the cell indicated by Cell indicator field is the serving cell, and the bit field index 1 of this field is mapped to the SS/PBCH indicated by the SS/PBCH index field in this DCI format. - 0 bit otherwise. **-----------------------------------------------------End of draft CR (Alt 1)--------------------------------------------------****-----------------------------------------------------Start of draft CR (Alt 2)--------------------------------------------------****7.3.1.2.1 Format 1\_0**<Unchanged part is omitted>- Cell indicator -$ \left⌈log\_{2}\left(C+1\right)\right⌉$ bits indicating the cell for the corresponding PRACH transmission if the UE is configured with higher layer parameter *EarlyUlSyncConfig*, where *C* is the number of candidate cells configured with higher layer parameter *EarlyUlSyncConfig*; 0 bit otherwise. The bit field index 0 of the cell indicator field is mapped to the serving cell, and other bit field indexes are mapped to the candidate cells configured with higher layer parameter *EarlyUlSyncConfig* according to an ascending order of a candidate identity configured by *ltm-CandidateId*, with the bit field index 1 mapped to the candidate cell with the smallest candidate identity. - PRACH association indicator - 0 or 1 bit- 1bit if the UE is provided with *tag-Id2*, and the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for the first CORESETs, and is provided *coresetPoolIndex* with value 1 for the second CORESETs. - This field indicates the PCI associated with the PRACH transmission if the UE is provided *SSB-MTC-AddtionalPCI*. If the cell indicator field is absent or the cell indicator field is present and indicates index 0, ~~T~~the bit field index 0 of this field is mapped to the PCI of the serving cell, and the bit field index 1 of this field is mapped to the active additional PCI. If the cell indictor filed is present and indicates index other than 0, the bit field index 0 of this field is mapped to the PCI of the candidate cell. - This field indicates the PL-RS for the PRACH transmission if the UE is not provided *SSB-MTC-AddtionalPCI*. The bit field index 0 of this field is mapped to the DL RS that the DM-RS of the PDCCH order is quasi-collocated with, and the bit field index 1 of this field is mapped to the SS/PBCH indicated by the SS/PBCH index field in this DCI format. - 0 bit otherwise. **-----------------------------------------------------End of draft CR (Alt 2)--------------------------------------------------** | **Support (Alt 1)**: ZTE**Support (Alt 2)**: OPPO**Not support**: |
| 1.3 | **Proposal:** Adopt the following draft CR to 38.212 Clause 7.3.1.2.1 [4]**Reason for change:** The UE can be configured with 2TA only for multi-DCI multi-TRP, and this configuration restriction is captured in a field description in 38.331:

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| ***tag-Id, tag2-Id***Timing Advance Group ID, as specified in TS 38.321 [3], which this cell or set of TCI-States of this cell are associated with. The *tag2-Id* is optionally configured in a serving cell if and only if the serving cell is configured with more than one value for the *coresetPoolIndex* |

However, in addition, this configuration restriction is captured also 38.212, where it is stated that the DCI field “PRACH association indicator” is present only when 2TA and multi-DCI multi-TRP is configured. This additional description will only introduce complications for the maintenance of the specification. It is sufficient to state that the PRACH association indicator can only be present for 2TA.**Summary of change:** State that the “PRACH association indicator” can only be configured for 2TA and remove the additional condition of multi-DCI multi-TRP, since this is superfluous.**Consequence if not approved:** Unclear specification.**-----------------------------------------------------Start of draft CR--------------------------------------------------****7.3.1.2.1 Format 1\_0**DCI format 1\_0 is used for the scheduling of PDSCH in one DL cell. The following information is transmitted by means of the DCI format 1\_0 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:- Identifier for DCI formats - 1 bits- The value of this bit field is always set to 1, indicating a DL DCI format- Frequency domain resource assignment -  bits where  is given by Clause 7.3.1.0If the CRC of the DCI format 1\_0 is scrambled by C-RNTI and the "Frequency domain resource assignment" field are of all ones, the DCI format 1\_0 is for random access procedure initiated by a PDCCH order, with all remaining fields set as follows:- Random Access Preamble index - 6 bits according to *ra-PreambleIndex* in Clause 5.1.2 of [8, TS38.321]- UL/SUL indicator - 1 bit. If the value of the "Random Access Preamble index" is not all zeros and if the UE is configured with *supplementaryUplink* in *ServingCellConfig* in the cell, this field indicates which UL carrier in the cell to transmit the PRACH according to Table 7.3.1.1.1-1; otherwise, this field is reserved- SS/PBCH index - 6 bits. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the SS/PBCH that shall be used to determine the RACH occasion for the PRACH transmission; otherwise, this field is reserved. - PRACH Mask index - 4 bits. If the value of the "Random Access Preamble index" is not all zeros, this field indicates the RACH occasion associated with the SS/PBCH indicated by "SS/PBCH index" for the PRACH transmission, according to Clause 5.1.1 of [8, TS38.321]; otherwise, this field is reserved- Cell indicator -$ \left⌈log\_{2}\left(C+1\right)\right⌉$ bits indicating the cell for the corresponding PRACH transmission if the UE is configured with higher layer parameter *EarlyUlSyncConfig*, where *C* is the number of candidate cells configured with higher layer parameter *EarlyUlSyncConfig*; 0 bit otherwise. The bit field index 0 of the cell indicator field is mapped to the serving cell, and other bit field indexes are mapped to the candidate cells configured with higher layer parameter *EarlyUlSyncConfig* according to an ascending order of a candidate identity configured by *ltm-CandidateId*, with the bit field index 1 mapped to the candidate cell with the smallest candidate identity. - PRACH association indicator - 0 or 1 bit- 1bit if the UE is provided with *tag-Id2*~~, and the UE is not provided~~ *~~coresetPoolIndex~~* ~~or is provided~~ *~~coresetPoolIndex~~* ~~with value 0 for the first CORESETs, and is provided~~ *~~coresetPoolIndex~~* ~~with value 1 for the second CORESETs~~.- This field indicates the PCI associated with the PRACH transmission if the UE is provided *SSB-MTC-AddtionalPCI*. The bit field index 0 of this field is mapped to the PCI of the serving cell, and the bit field index 1 of this field is mapped to the additional PCI associated with active TCI states.- This field indicates the PL-RS for the PRACH transmission if the UE is not provided *SSB-MTC-AddtionalPCI*. The bit field index 0 of this field is mapped to the DL RS that the DM-RS of the PDCCH order is quasi-collocated with, and the bit field index 1 of this field is mapped to the SS/PBCH indicated by the SS/PBCH index field in this DCI format. - 0 bit otherwise. **-----------------------------------------------------End of draft CR--------------------------------------------------** | **Support**: Ericsson**Not support**: |
| 1.5 | **Proposal:** Adopt the following TP 1.5 for TS 38.213 Section 7.1.1 [5]**Reason for change:** Unnecessary resetting of first closed loop (l=0) configured for the first TRP instead of the resetting the second closed loop (l=1), when CFRA based PDCCH order triggers PRACH towards the second TRP.**Summary of change:**  Clarify the spec on whether to reset the first closed loop power control adjustment state (l=0) or reset the second closed loop power control adjustment state (l=1) based on whether the PRACH is toward the first TRP or the second TRP.**Consequence if not approved:** Current code results in unnecessary resetting of the wrong closed loop when PRACH is triggered towards the second TRP.**-----------------------------------------------------Start of TP --------------------------------------------------**If the UE transmits a PUSCH associated with the first RS resource index $q\_{d}$, the UE applies the first $P\_{O\\_UE\\_PUSCH,b,f,c}\left(j\right)$ value, the first $α\_{b,f,c}\left(j\right)$ value, and $f\_{b,f,c}\left(i,l\right)$ for determining $P\_{PUSCH,b,f,c}(i,j,q\_{d},l)$. If the UE transmits a PUSCH associated with the second RS resource index $q\_{d}$, the UE applies the second $P\_{O\\_UE\\_PUSCH,b,f,c}\left(j\right)$ value, the second $α\_{b,f,c}\left(j\right)$ value, and $f\_{b,f,c}\left(i,l\right)$ or $f\_{b,f,c}\left(i,0\right)$ if *twoPUSCH-PC-AdjustmentStates* is provided or not provided, respectively, for determining $P\_{PUSCH,b,f,c}(i,j,q\_{d},l)$.- If the UE receives a random access response message in response to a PRACH transmission or a MsgA transmission on active UL BWP $b$ of carrier $f$ of serving cell $c$ as described in clause 8- $f\_{b,f,c}\left(0,l\right)=∆P\_{rampup,b,f,c}+δ\_{msg2,b,f,c}$, - where $l=0$ if the UE is not provided with *tag-Id2* or if the UE is not provided with *twoPUSCH-PC-AdjustmentStates*; otherwise, $l=0$ if the first TAG is indicated by the random access response message and$l=1$ if the second TAG is indicated by the random access response message, and- $δ\_{msg2,b,f,c}$ is a TPC command value indicated in a random access response grant of the random access response message corresponding to a PRACH transmission according to Type-1 random access procedure, or in a random access response grant of the random access response message corresponding to a MsgA transmission according to Type-2 random access procedure with RAR message(s) for fallbackRAR, on active UL BWP $b$ of carrier $f$ of serving cell $c$, and -  and $∆P\_{rampup\\_requested,b,f,c}$ is provided by higher layers and corresponds to the total power ramp-up requested by higher layers from the first to the last random access preamble for carrier $f$ in the serving cell $c$, $M\_{RB,b,f,c}^{PUSCH}(0)$ is the bandwidth of the PUSCH resource assignment expressed in number of resource blocks for the first PUSCH transmission on active UL BWP$ b$ of carrier $f$ of serving cell $c$, and $∆\_{TF,b,f,c}\left(0\right)$ is the power adjustment of first PUSCH transmission on active UL BWP $b$ of carrier $f$ of serving cell $c$. **-----------------------------------------------------End of TP--------------------------------------------------** | **Support**: Qualcomm, **Not support**: |

**Table 1**

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| **Company** | **Comments** |
| Huawei, Hisilicon | Issue 1.1: support. The TP follow the similar wording of PRACH retransmission indicator which has the similar issue (how to interpret PRACH retransmission indicator and cell indicator when they are both present) and thus minimize spec impact.Issue 1.2: the same issue as 1.1. Suggest discussing with 1.1 together as three candidate solutions.For Alt1:* The condition ‘if the cell indicated by Cell indicator field is the serving cell’ is only applied for the case ‘The bit field index 0’. It is misleading and looks like: no matter the cell indicator indicates a serving cell or a candidate cell, the bit field index 1 is always mapped to the additional PCI associated with active TCI states. While, in fact, when the cell indicator indicates a candidate cell, the RACH is for LTM. In this case, PRACH association indicator = 1 has no meaning and should be ignored by UE.

We understand that we have a conclusion to preclude this case, i.e., cell indicator = non-zero and PRACH association indicator = 1. But this conclusion is not captured. Without capturing this conclusion, and only with the wording in Alt 1, the spec is ambiguous.* The condition is not complete. Another condition ‘the cell indicator field is absent’ is missing which should be applied to both ‘PRACH association indicator = 0’ and ‘PRACH association indicator = 1’.

For Alt2:* PRACH association indicator field is only used to indicate one from the serving cell PCI and the configured additional PCI of the serving cell. It cannot be used to indicate a PCI for the candidate cell which is configured for LTM. Note that candidate cell and additional PCI are different in the spec.
* The condition ‘If the cell indicator field is absent or the cell indicator field is present and indicates index 0’ should also be applied for the case of intra-cell mTRP case (i.e., the second sub-bullet of PRACH association indicator field). There is no agreement that LTM can be configured with inter-cell mTRP, but not with intra-cell mTRP.

Issue 1.3: We understand the intention is to remove some redundant description between 212 and 331 spec. But, even with the redundant part, the spec is clear enough. To my understanding, the spec has many such kind of redundant descriptions which seems ok.Issue 1.5: Support. We think the issue makes sense: i.e., for msg 3, TPC corresponding to which CLPC is applied? Since there is no TCI-state indication for msg3, using close loop index in TCI-state is not feasible. In this case, using the TAG corresponding to msg3 to determine the CLPC seems a reasonable solution. |
| **Qualcomm** | Issue 1.2: The issue is the same as Issue 1.1 as Huawei mentioned. The wording of the TP for issue 1.1 seems simpler and clearer.Issue 1.3: Tend to agree with Huawei that removing a somewhat redundant text is not an essential maintenance issue.Issue 1.5: Support. We actually proposed two options in our Tdoc. The first one (Option 1, which is captured above) is same as our TP in previous meetings. The second one (Option 2 – please see R1-2405139) tries to address one concern from a couple of companies on fixed association. Our preference is still option 1 due to its simplicity, but we think either Option 1 or Option 2 would be needed to fix the issue.  |
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# References

1. R1-2405333, Corrections on PRACH association indicator in PDCCH order in 38.212, Huawei, HiSilicon, Google, Ericsson
2. R1-2404717, Draft CR on PRACH association indicator field in PDCCH order in TS 38.212, ZTE
3. R1-2404823, Draft CR for Rel-18 two-TA enhancement, OPPO
4. R1-2405268, Draft CR for 38.212 on the condition for the PRACH association indicator field, Ericsson
5. R1-2405139, Maintenance on NR MIMO Evolution for Downlink and Uplink, Qualcomm Incorporated