**3GPP TSG-RAN WG2 Meeting #131 R2-250xxxx**

**Bengaluru, India, August 25th – 29th, 2025**

**Agenda item: 8.12.1**

**Source: Samsung**

**Title: Report of MAC open issues for MIMO**

**WID/SID: NR\_MIMO\_Ph5**

**Document for: Discussion and Decision**

# Introduction

This document includes a list of open issues according to the following email discussion:

* [Post130][219][MIMO\_Ph5] Running CR for 38.321 (Samsung)

Intended outcome: Updated and reviewed the CR for endorsement, update the open issue list if needed, can also discuss open issues to form proposals to the next meeting

Deadline: Long

Companies are invited to provide comments on open issues by **1st August 1000 UTC** to allow Rapporteur to summarize and formulate initial proposals. Based on the input, we may consider a short second-round discussion, if necessary, to be finalized by Aug. 8th.

# Discussion

## Issue 1: When the TAT of the sTAG expires, whether/how to release PUCCH/type-1 CG resource for UEI report.

In RAN2#130 meeting, UE behavior for UEI report at TAT expiry was raised and discussed. The following agreement has been made regarding the release of PUCCH/PUSCH resource, which follows the legacy release behavior at TAT expiry for pTAG. Note according to Rel-19 WID, UEI report is for sTRP, so the scope is limited to a single TAG per cell.

RAN2#130

* When the TAT of the pTAG expires, UE releases PUCCH resource for mode-A/B UEI report and clears type-1 CG for mode-B UEI report. FFS for the case when the TAT expires on the sTAG.

For sTAG expiry the legacy behavior of PUCCH release and type-1 CG clear should be followed as well.

To be more specific, according to the latest RRC parameter list (R2-2505000, also see endorsed RRC running CR R2-2504184), PUCCH and type-1 CG for UE-initiated report are configured with explicit resource ID, BWP ID, and cell indication.

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| **RAN2 Parent IE** | **Parameter name in the spec** | **Description** | **Value range** |
| CSI-ReportConfig | configuredPUSCHResourceOfModeB-r19 | This parameter is used to inform Type-1 CG PUSCH resource for second channel in mode-B | configuredGrantConfigIndex, UL bwp-Id, serving cell index |
| CSI-ReportConfig | PUCCHResource-r19 | This parameter is used to configure the periodic PUCCH resource for first PUCCH carrying UEIRI- to request dynamically scheduled PUSCH to carry UE-initated/event-driven beam report for mode-A- to notify Type-1 CG PUSCH to carry UE-initated/event-driven beam reportfor mode-B. | periodicityAndOffset, PUCCH-ResourceID, BWP-Id, pucchCell-r19 |
| CSI-ReportConfig | pucchCell-r19 | This parameter is used to indicate one from {SpCell, PUCCH-Scell} as the cell of the configured PUCCH resource for first PUCCH carrying UEIRI. | {SpCell, PUCCH-Scell}  |

Note for *pucchCell-r19*, according to RAN1 last meeting’s agreement, only an indication between SpCell and SCell is enough with no need of serving cell index. In Rapporteur’s understanding, this is based on the assumption that NW can by implementation configure unique PUCCH-resourceIDs for different cells to avoid ambiguity.

Given explicit resource ID, BWP ID, and cell indication, the PUCCH or the type-1 CG for UEI report point to the resource configured in *PUCCH-config* or *ConfiguredGrantConfig* for the indicated BWP of the indicated serving cell, so that UE knows the PUCCH/type-1 CG is associated to a specific serving cell and the corresponding TAT(s).

The current behavior for TAT expiry is as follows.

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| 5.2 Maintenance of Uplink Time Alignment…The MAC entity shall:…1> when a *timeAlignmentTimer* expires:2> if the *timeAlignmentTimer* is associated with a PTAG and the SpCell is not configured with two PTAGs; or2> if the *timeAlignmentTimer* is associated with a PTAG, the SpCell is configured with two PTAGs, and the *timeAlignmentTimer* associated with the other PTAG is not running:3> flush all HARQ buffers for all Serving Cells;3> notify RRC to release PUCCH for all Serving Cells, if configured;3> notify RRC to release SRS for all Serving Cells, if configured;3> clear any configured downlink assignments and configured uplink grants;3> clear any PUSCH resource for semi-persistent CSI reporting;3> consider all running *timeAlignmentTimer*s as expired;3> maintain NTA (defined in TS 38.211 [8]) of all TAGs.2> else:3> if the *timeAlignmentTimer* is associated with a TAG for an SCell configured with only this TAG; or3> if the *timeAlignmentTimer* is associated with a TAG for an SCell, and if the SCell is configured with two TAGs and *the timeAlignmentTimer* associated with the other TAG is not running:4> flush all HARQ buffers for all such SCells;4> notify RRC to release PUCCH, if configured for all such SCells;4> notify RRC to release SRS, if configured for all such SCells;4> clear any configured downlink assignments and configured uplink grants for all such SCells;4> clear any PUSCH resource for semi-persistent CSI reporting for all such SCells;4> maintain NTA (defined in TS 38.211 [8]) of this TAG.3> else if the *timeAlignmentTimer* is associated with a TAG for a Serving Cell configured with two TAGs, and if the *timeAlignmentTimer* associated with the other TAG is running, for all such Serving Cells:4> clear any configured downlink assignment, if the activated TCI state(s) for all PUCCH resources configured for the configured downlink assignment is associated with the TAG of the expired *timeAlignmentTimer*;4> clear any configured uplink grant, if the activated TCI state(s) for the configured uplink grant is associated with the TAG of the expired *timeAlignmentTimer*;4> clear any PUSCH resource for semi-persistent CSI reporting, if the activated TCI state(s) for the PUSCH resource is associated with the TAG of the expired *timeAlignmentTimer*;4> maintain NTA (defined in TS 38.211 [8]) of this TAG. |

In the current procedure for sTAG (i.e. TAT of the single TAG for a SCell is expired), all PUCCH/configured UL grant configured for such a SCell are released by RRC or cleared in MAC. According to this, if the PUCCH of a UEI report configuration is pointed to this SCell (i.e., the PUCCH resource is associated to the expired TAT), it is released by RRC; if the type-1 CG of a UEI report configuration is pointed to this SCell (i.e., the type-1 CG is associated to the expired TAT), it is cleared as a configured UL grant. The current MAC procedure already supports this behavior.

**Q1: Do you agree the following view?**

**If the PUCCH/type-1 CG of a UEI report configuration is pointed to a SCell whose TAT of the single sTAG is expired, this PUCCH for the SCell is released by RRC and this type-1 CG for the SCell is cleared as a configured UL grant. There is no MAC specification impact.**

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## Issue 2: Does UE initiate RACH when UEI report is triggered and to be transmitted but TAT is expired?

Based on discussion during RAN2#130 meeting, different options are listed below.

**Option 1**: UE does not initiate RACH when UEI report is triggered and to be transmitted but TAT (associated to the UEI report resource) is expired.

* This option follows legacy behavior upon TAT expired (i.e., CSI report is not transmitted), and has no specification impact.
* UE can wait for PDCCH ordered RACH for UL resynchronization and RRC reconfiguration for new resource, and can rely on BFD/BFR for the worse case.
* This is a unified solution for mode-A and mode-B.

**Option 2**: UE initiates RACH when UEI report is triggered and to be transmitted but there is no PUCCH or type-1 CG as the associated TAT is expired, and UE waits for NW to reconfigure new resource for UEI report.

* The concern raised during the meeting is that the triggered UEI report may become stale and be discarded while performing RACH and waiting for new resources, so it is not necessary to initiate RACH. However, whether to maintain/discard a triggered report in certain timeline may be purely up to UE implementation or RAN1 issue, and we don’t need to discuss here.
* Some companies expressed the view that UE does not need to maintain the previously triggered UEI report if any new report is triggered, and UE always transmits the latest triggered report. Here we consider the scenario that a latest triggered report needs to be transmitted (not discarded).

**Option 3**: UE initiates RACH when UEI report is triggered and to be transmitted but there is no PUCCH or type-1 CG as the associated TAT is expired, and UE indicates the cause of RACH (e.g., in Msg3).

* By this option, UE explicitly informs NW the cause of RACH at the earliest occasion, so NW can reconfigure new resource for UEI report as early as possible (e.g., in Msg4).
* This option has more MAC specification impact.

**Option 4**: UE initiates RACH when UEI report is triggered and to be transmitted but there is no PUCCH or type-1 CG as the associated TAT is expired, and UE transmits UCI for the report in Msg3 or using the uplink grant scheduled by PDCCH addressed to C-RNTI based on which RA procedure is completed.

* This option intends to use the earliest DG to reduce the interruption of UEI report at the best effort.
* This behavior implicitly informs NW the cause of RACH so NW can reconfigure new resource as early as possible.
* This option also has RAN1 impact.

**Q2: Which option(s) do you support? Please indicate with support, acceptable, not acceptable, etc.**

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For mode-A UEI report, TAT can be expired after PUCCH and before mode-A PUSCH for a triggered report. Some think the case can be handled by NW implementation to initiate PDCCH ordered RACH. Some think a unified solution from Q2 can be applied to this case.

**Q3: If you support Option 2/3/4 in Q2, which option you support for the case that TAT is expired after PUCCH and before mode-A PUSCH for a triggered report?**

**Option A: handle by NW and no new UE behavior.**

**Option B: apply same solution as Option 2/3/4.**

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## Issue 3: UEI report in DRX

In the current DRX procedure as highlighted below, UE does not report periodic CSI on PUCCH or semi-persistent CSI on PUSCH/PUCCH outside DRX active time, but reports aperiodic CSI on PUSCH outside DRX active time. In addition, if CSI masking is setup (i.e., *csi-Mask* is configured as true), UE does not report CSI on PUCCH and if *drx-onDurationTimer* is not running.

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| 5.7 Discontinuous Reception (DRX)…When DRX is configured, the MAC entity shall: …1> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3; and1> if the current symbol n occurs within *drx-onDurationTimer* duration; and1> if *drx-onDurationTimer* associated with the current DRX cycle is not started as specified in this clause:2> if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause; and2> if *allowCSI-SRS-Tx-MulticastDRX-Active* is not configured, or if *cfr-ConfigMulticast* is not configured for any of the active BWP(s) of the Serving Cell(s), or if all multicast DRXes would not be in Active Time considering multicast assignments/DRX Command MAC CE for MBS multicast received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in Clause 5.7b and all multicast sessions are configured with multicast DRX:3> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7];3> not report semi-persistent CSI configured on PUSCH;3> not report semi-persistent CSI on PUCCH;3> if *ps-TransmitPeriodicL1-RSRP* is not configured with value *true*:4> not report periodic CSI that is L1-RSRP on PUCCH.3> if *ps-TransmitOtherPeriodicCSI* is not configured with value *true*:4> not report periodic CSI that is not L1-RSRP on PUCCH.1> else:2> in current symbol n, if a DRX group would not be in Active Time considering grants/assignments scheduled on Serving Cell(s) in this DRX group and DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause; and2> if *allowCSI-SRS-Tx-MulticastDRX-Active* is not configured, or if *cfr-ConfigMulticast* is not configured for any of the active BWP(s) of the Serving Cell(s), or, in current symbol n, if all multicast DRXes corresponding to the DRX group would not be in Active Time considering multicast assignments/DRX Command MAC CE for MBS multicast received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in Clause 5.7b and all multicast sessions corresponding to the DRX group are configured with multicast DRX:3> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7] in this DRX group;3> not report CSI on PUCCH and semi-persistent CSI configured on PUSCH in this DRX group.2> if CSI masking (*csi-Mask*) is setup by upper layers:3> in current symbol n, if *drx-onDurationTimer* of a DRX group would not be running considering grants/assignments scheduled on Serving Cell(s) in this DRX group and DRX Command MAC CE/Long DRX Command MAC CE received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause; and3> if *allowCSI-SRS-Tx-MulticastDRX-Active* is not configured, or if *cfr-ConfigMulticast* is not configured for any of the active BWP(s) of the Serving Cell(s), or, in current symbol n, if *drx-onDurationTimerPTM(s)* of all multicast DRXes corresponding to the DRX group would not be running considering DRX Command MAC CE for MBS multicast received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in Clause 5.7b and all multicast sessions corresponding to the DRX group are configured with multicast DRX:4> not report CSI on PUCCH in this DRX group.…Regardless of whether the MAC entity is monitoring PDCCH or not on the Serving Cells in a DRX group, the MAC entity transmits HARQ feedback, aperiodic CSI on PUSCH, and aperiodic SRS defined in TS 38.214 [7] on the Serving Cells in the DRX group when such is expected. |

For UE-initiated report, each report consists of two steps, the first step on PUCCH and the second step on PUSCH. In Rapporteur’s view, we can strive to apply the same rule for both steps of each report to simplify design. From another aspect, the two steps should be considered together since without the report in PUSCH the PUCCH notification is meaningless, and without PUCCH notification the report in PUSCH cannot be received properly.

The mode-A UE-initiated report is similar to aperiodic CSI report on PUSCH, for example, in terms of CSI trigger state indicated in DCI, DG-based report resource, aperiodic triggering. Thus, we can consider applying the same principle as for aperiodic CSI report, meaning mode-A UE-initiated report can be transmitted regardless of DRX active time.

**Q4: Do you agree the following view?**

**Regardless of whether the MAC entity is monitoring PDCCH or not on the Serving Cells in a DRX group, the MAC entity transmits mode-A UE-initiated CSI report on PUCCH and PUSCH on the Serving Cells in the DRX group when such is expected.**

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On the other hand, mode-B UE-initiated report can be considered similar to semi-persistent CSI report in terms of the pre-configured report resource, while also being aperiodic in terms of the triggering. In this sense, mode-B UE-initiated report in DRX can follow the principle of either SP CSI report or AP CSI report.

**Q5: Which option do you support?**

**Option 1: UE transmits PUCCH/PUSCH for mode-B UE-initiated CSI report regardless of DRX Active Time (i.e., same as mode-A in Q4).**

**Option 2: UE does transmit PUCCH/PUSCH for mode-B if either PUCCH or PUSCH (first valid type-1 CG occasion) is outside DRX Active Time.**

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## Issue 4: UEI report in cell DTX/DRX

In the current procedure for cell DTX, UE monitors PDCCH on the serving cell during the cell DTX Active Period. For UEI report, the issue is after transmitting the first step PUCCH of mode-A report whether UE monitors PDCCH outside cell DTX Active Period.

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| 5.34.2 Cell Discontinuous Transmission…1> if cell DTX operation is deactivated for this Serving Cell; or1> if the Serving Cell is in the cell DTX Active Period:2> monitor PDCCH on this Serving Cell, as specified in TS 38.213 [6] and other clauses of this specification.1> if any *drx-RetransmissionTimerDL*, *drx-RetransmissionTimerUL* or *drx-RetransmissionTimerSL* (as described in clause 5.7) is running on any Serving Cell in the DRX group of this Serving Cell; or1> if *ra-ContentionResolutionTimer* (as described in clause 5.1.5) or *msgB-ResponseWindow* (as described in clause 5.1.4a) is running; or1> if a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4 or 5.22.1.5); or1> if a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in clauses 5.1.4 and 5.1.4a):2> monitor PDCCH on the Serving Cells in the DRX group of this Serving Cell, as specified in TS 38.213 [6] and other clauses of this specification.1> if *ra-ResponseWindow* (as described in clause 5.1.4) is running and this Serving Cell is the SpCell:2> monitor PDCCH on this Serving Cell (as described in clause 5.1.4).… |

In one option, UEI report can be considered as an exception case that NW can accommodate outside the cell DRX Active Period and schedule the report by DCI in PDCCH, so UE monitors PDCCH after transmitting PUCCH for UEI report regardless of cell DTX Active Period.

From the other aspect, UEI report may not be important during cell DTX inactive time, the schedule of mode-A PUSCH is up to NW decision and NW can schedule during cell DTX Active Period or deactivate cell DTX to schedule UEI report.

**Q6: Which option do you agree?**

**Option 1: Regardless of cell DTX Active Period, UE monitors PDCCH if PDCCH scheduling mode-A PUSCH has not been received after transmitting PUCCH for mode-A UEI report.**

**Option 2: no impact to cell DTX**

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In the current behaviour for cell DRX, outside the cell DRX Active Period UE does not transmit SR, does not report periodic CSI on PUCCH or semi-persistent CSI on PUCCH/PUSCH. For UEI report, the rule for UEI report PUCCH/PUSCH has to be discussed.

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| 5.34.3 Cell Discontinuous Reception…1> if cell DRX is activated and the Serving Cell is not in the cell DRX Active Period:2> not instruct the physical layer to signal a SR on a PUCCH resource for SR;2> not increment the *SR\_COUNTER* for a SR;2> not start the *sr-ProhibitTimer* for a SR;2> not deliver any configured uplink grant and the associated HARQ information to the HARQ entity;2> not instruct a HARQ process associated with a configured uplink grant to trigger a new transmission or a retransmission;2> not report CSI on PUCCH and semi-persistent CSI configured on PUSCH;2> if an emergency service is initiated by upper layers and this Serving Cell is the SpCell:3> initiate a Random Access procedure (as specified in clause 5.1.1).NOTE 2: How the MAC layer in the UE is aware of an ongoing emergency service is up to UE implementation.2> if upper layers provide Access Identity 1 or Access Identity 2 and this Serving Cell is the SpCell:3> initiate a Random Access procedure (as specified in clause 5.1.1). |

The possible options for UEI report are listed as follows. Note the PUSCH for mode-A UEI report is scheduled by NW and UE shall transmit if scheduled by NW regardless of cell DRX, so there should be no spec. impact.

**Q6: Which option(s) do you agree?**

**Option A-0: the PUSCH for mode-A UEI report is scheduled by NW and UE shall transmit if scheduled by NW regardless of cell DRX, no MAC spec. impact.**

**Option A-1: UE does not transmit mode-A UEI report PUCCH outside cell DRX Active Period.**

**Option A-2: UE transmits mode-A UEI report PUCCH regardless cell DRX Active Period.**

**Option B-1: UE does not transmit PUCCH/PUSCH for mode-B UEI report if either the PUCCH or PUSCH (first valid type-1 CG occasion) for a report is outside cell DRX Active Period.**

**Option B-2: UE transmits PUCCH/PUSCH for mode-B UEI report regardless cell DRX Active Period.**

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## Issue 5: sDCI mTRP 2TA in LTM cell switch

Regarding sDCI mTRP 2TA, the following agreements have been reached.

RAN2#129bis

**For 2TA in asymmetric DL sTRP/UL mTRP scenario with pathloss offset configured Rel-18 2TA operation is applied with the following RRC changes:**

**• remove the restriction that RRC field tag2 is configured only if coresetPoolIndex is configured with more than one value;**

**• a single n-TimingAdvanceoffset is configured, i.e., n-TimingAdvanceOffset2 is not configured for 2TA in asymmetric DL sTRP/UL mTRP scenario.**

RAN2#130

* 2TA operation is supported for Rel-19 single-DCI mTRP without the restriction that coresetPoolIndex needs to be configured with more than one value, and single-DCI mTRP 2TA is applied to both the scenarios that PL offset is configured and PL offset is not configured.
* Regarding Rel-19 sDCI mTRP 2TA operation for the scenario PL offset is not configured (UE is configured with SSB-MTC-additionalPCI), RAN2 assumes both n-TimingAdvanceoffset and n-TimingAdvanceOffset2 are configured unless RAN1 has different agreement.
* Introduce a new RRC parameter per BWP that explicitly enables the Rel-19 sDCI-mTRP 2TA, and clarify in FD of tag2 to include all cases where tag2 is configured that “it is optionally configured in a serving cell for mDCI mTRP 2TA if coresetPoolIndex for a BWP is configured with more than one value, and for sDCI mTRP 2TA if [the new parameter] is configured.”

Rel-19 sDCI mTRP 2TA is supported for both cases that PL offset is configured and PL offset is not configured. The existing configuration *tag2*, which was introduced for Rel-18 mDCI mTRP 2TA, is reused for Rel-19 sDCI mTRP 2TA with field description updated. MAC behaviour on 2TA is not impacted, i.e., same behaviour is applied to support Rel-19 sDCI mTRP 2TA.

We aim to discuss whether/how to support Rel-19 sDCI mTRP 2TA by identifying the MAC impact on legacy behaviour. We only consider legacy Rel-18 LTM cell switch, which does not support PL offset for LTM candidate TCI states. This limits the case to sDCI mTRP 2TA with no PL offset. In Rapporteur’s view, there is no MAC impact identified to support Rel-19 sDCI mTRP 2TA (with no PL offset) for Rel-18 LTM cell switch, meaning legacy LTM cell switch procedure can be applied with no change.

**Q1: Do you agree the following view?**

**sDCI mTRP 2TA (in case of no PL offset) is supported for legacy Rel-18 LTM cell switch with no MAC specification impact.**

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# Other issues

Companies are invited to describe any other issues which have potential MAC impacts.

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| **Company** | **Other issues (please describe the issue and the potential MAC impacts)** |
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# Conclusions

The following proposals have been provided based on feedback to the above document:

# References

1. R2-2504672 Report from session on Rel-18 MIMO, Rel-19 MIMO, LPWUS, SBFD, NR Others RAN2 Vice Chairman (CATT)
2. R2-2504732 Report of offline discussion [AT130][202][MIMO\_Ph5] Samsung