**3GPP TSG-RAN WG2 Meeting #123bis** **R2-230xxxx**

**Xiamen, China, 9 – 13 October 2023**

**Agenda item: 7.20.1**

**Source: Samsung**

**Title: [Post123bis][203][MIMOevo] Remaining issues on MAC CR**

**Document for: Discussion and Decision**

# Introduction

This document records inputs and outcome for the following post-meeting discussion.

* [Post123bis][204][MIMOevo] MAC Running CR and further discussions (Samsung)

**Scope**: Update and review the MAC running CR, also discussions on the MAC open issues based on the progress in this meeting

**Intended outcome**: MAC running CR for endorsement, and discussion report with proposals

**Deadline**: Long (2 weeks for running CR, November 3rd for open issue)

This discussion aims to collect views and comments for the remaining open issues on MAC CR, and prepare agreeable proposals for RAN2#124 meeting.

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# Discussion

## TAG indication for inter-cell PDCCH order CFRA

For inter-cell PDCCH order CFRA, based on RAN1 agreements,

* one additional PRACH configuration for each additional PCI is supported for RACH triggered by PDCCH order;
* support indication of which PRACH configuration to be used in the RACH procedure in the PDCCH order;
* PDCCH order can be received from one TRP triggering CFRA PRACH towards another TRP;

In RAN2#123 meeting, we have reached the following agreement for inter-cell PDCCH order CFRA.

* For inter-cell PDCCH order CFRA to the additionalPCI,
* PDCCH order indicates which additiona lPCI’s PRACH configuration to be used (according to RAN1 agreement),

In RAN1#114bis meeting, the following agreement has been made.

Agreement

For inter-cell multi-DCI based Multi-TRP operation with two TA enhancement, 1 bit is supported for indicating active *additionalPCI* in the PDCCH order.

* The single bit in the PDCCH order indicates if the PRACH triggering is towards *servingCell* PCI or active *additionalPCI*.

Note: This has no impact on whether common or separate field with cell indication in LTM is used.

Hence, UE can determine the PRACH configuration to be applied based on the indication in PDCCH order. However, how to indicate the TAG for the TA to be applied in inter-cell PDCCH order CFRA is still not clear. Based on companies’ contributions, Rapporteur understands there are two options.

Option 1: Specify that if inter-cell PDCCH order CFRA towards the serving cell PCI is triggered, the legacy PRACH configuration is applied and the legacy tag-Id is applied for the TA in RAR; if inter-cell PDCCH order CFRA towards the active addtionalPCI is triggered, the additional PCI’s PRACH configuration is applied and the tag-Id2 is applied for the TA in RAR.

Option 2: Use the R bit in RAR to indicate TAG, same as intra-cell PDCCH order CFRA.

Note that Option 1 implies different procedures for inter-cell and inter-cell cases to determine the TAG, while the current RA procedure does not differentiate inter-cell or intra-cell PDCCH order CFRA. Option 2 can allow a unified procedure and NW flexibility.

**Q1) Which option do you agree to determine TAG for inter-cell PDCCH order CFRA?**

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| **Company** | **1 or 2** | **Comments**  |
| ZTE | Option 2 | Both can work. we slightly prefer option 2 where the unified solution for both inter-cell and intra-cell PDCCH ordered CFRA can be achieved. |
| Docomo | Option 2 | We agree that both will work. We are not motivated to have separate indications considering their MAC spec impact and complexity. |
| Sharp | Option 2 | A unified procedure is prefered |
| CATT | Option 2 | Considering the spec impacts, prefer to have unified solution. |
| LGE | Option 2 | We prefer the unified solution for both intra-cell and inter-cell case. |
| Ericsson | Option 1/2 | Agree Option 2 simplifies the Ue behaviour with a unified solution, however also Option 1 works specifically for Inter cell and we have not a strong opinion. |
| Nokia | Option 2 | Both works, we don’t see a reason not to indicate the TAG in RAR also in this case, and hence, it is simpler to have only one modelling in the specifications. |
| Qualcomm | Option 1 | For inter-cell case, there is no need to indicate the TAG ID in RAR. Because it is clear which RACH resource is used based on the selection of RACH resource configuation, and thus no indication of TAG ID is required in RAR. We fail to observe the necessititiy of having a unified solution for intra and inter case.  |
| OPPO | Option 1 | Agree with QC |
| Huawei, HiSilicon | Option 1 or 2 |  |
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## Issues on UE initiated CBRA

In RAN2#123bis, we have made the following agreement for CBRA.

* The baseline is confirmed as agreement: One R bit in RAR is used to indicate TAG ID, i.e. which TAG’s TA is updated. FFS if the association between the TAGs and value of the R bit (0 or 1) need to be configured by RRC.

Regarding the FFS, the mapping between TAG ID and 1st/2nd TAG indication in RAR may be needed to make TAG indication in RAR in CBRA workable.

From NW perspective, it can fix the mapping between TAG and TRP, e.g., 1st TAG mapped to TRP1 and 2nd TAG mapped to TRP2. For a UE performing initial access (4-step CBRA), it has not been configured with 2 TAGs, so it regards the R bit in RAR (although NW indicates a TAG in RAR) and applies the first TA to the legacy tag-Id, i.e., tag 0. Then NW may configure 2 TAGs and configures the association between TAGs and 1st/2nd TAG indication by RRC. If the UE sent PRACH in initial access by selecting a SSB from TRP2, NW can configure for this UE tag-Id (i.e., tag 0) is mapped to the 2nd TAG and tag-Id2 is mapped to the 1st TAG, then trigger PDCCH ordered CFRA for 1st TAG (i.e. tag-Id2) and indicate the second TA is applied to 1st TAG in RAR.

For a UE in connected mode with 2 TAGs configured, when it performs 4-step CBRA, it reads the TAG indication in RAR. And the NW can indicate the TAG in RAR without identifying the UE, but based on the SSB selected by UE for PRACH transmission, i.e., if PRACH is received with SSB from TRP1, NW indicates the 1st TAG in RAR; otherwise NW indicates 2nd TAG in RAR.

By this means, NW can configure UE-specific association between the TAG ID and the 1st/2nd TAG indication in RAR, and indicate TAG in RAR for 4-step CBRA.

**Q2: Do you agree that the association between the TAGs and value of the R bit (0 or 1) need to be configured by RRC?**

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| **Company** | **Yes/No** | **Comments**  |
| ZTE | Yes | It can address the issue caused by the UE identity unknown by NW in the first two steps of the CBRA procedure.In this sense, NW always needs to present the value of the R bit in RAR as long as the NW support mDCI mTRP with 2TA, and regardless of the UE who initiates the CBRA. |
| Docomo | Yes | Looks a good solution for consistent consiguration of association between TRP# and TAG# among UEs in the same cell. |
| Sharp | Yes |  |
| CATT | Yes | Agree RRC to configure the association upon configuring the 2TA to UE. As for the concern from ZTE, we have similar understanding, NW may always need to indicate the TAG index, but whether to use/ignore the TAG index totally depend on UE (i.e., whether the 2TA is configured or not).  |
| LGE | Comment | Question is unclear on how to associated TAG ID and the value of R bit. If the intention is that tag-Id is associated with R = 0 and tag-Id2 is associated with R = 1, we agree with this. |
| Ericsson | Yes | Agree w ZTE |
| Nokia | Yes |  |
| Qualcomm | Yes | Seems to be a solution. |
| OPPO | Yes | We also agree that in this way NW always need indicate TAG index since it can’t differentiate UE’s capability and RRC states simply based on received preamble. For legacy UE in connected state or UEs in IDLE state, mismatch could happen between network and UE because UE always take TAG ID =0 while network may not. In this case we assume network will correct its TAG ID once it receives message 3. |
| Huawei, HiSilicon | Yes |  |
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Since the 2 TA operation is only supported in connected mode, for CBRA in connected mode, the R bit is used for TAG indication in MAC RAR and fallbackRAR included in Msg2 if 2 TAGs are configured.

However, it is not clear whether TAG indication using the R bit is needed in successRAR or not. As the successRAR is included in MsgB in initial access only (i.e., before 2 TA is applied), TAG indication in successRAR may not be necessary.

**Q3: Do you agree that the TAG indication is not needed in the successRAR?**

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| **Company** | **Yes/No** | **Comments**  |
| ZTE | No | The UE who performs the RRC resumption procedure may need TAG indication in the successRAR if the UE was configured with two TAG for PCell before stepping into RRC\_InactiveState and the RRC configuration related two TAG is still applied according to the *RRCResume*. |
| Docomo | Yes | Agree that the scenario which ZTE mentions is a valid case, but I guess TAG# (i.e. first TAG or second TAG) can be indicated then via absolute TAC MAC CE in MsgB, based on following agreement.

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| RAN2#123bis* **One R bit in Absolute TAC MAC CE is used to indicate TAG ID, i.e. which TAG’s TA is updated.**
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| Sharp | NO with comments | The scenario mentioned by ZTE could be a valid case. However, it has not been discussed if the two TAG configuration could be stored in INACTIVE state and restored when initiating RRC resume procedure. |
| CATT | No | Same understanding as ZTE.  |
| LGE | comment | We have same concern with ZTE. Including TAG Id in successRAR depends on whether to store two TAGs configuration in RRC\_INACTIVE. RAN2 has not discussed whether two TAGs configuration is stored in RRC\_INACTIVE and is restored at RRCResume. We think this should be discussed first. |
| Ericsson | comment | Agree with others that the answer to this question depends on if the UE stores the TAG association in RRC INACTIVE. |
| Nokia | Comment | Inactive case needs to be discussed. |
| Qualcomm | comment | Further discussion on the indative case. |
| OPPO | Comment | The discussion on INACTIVE state should be also applied for 4-step RACH due to same reason. |
| Huawei, HiSilicon |  | Agree that further discussion is needed for the inactive case |
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As we have the previous agreement that do not support per-TRP UE initiated RACH, UE initiated RACH should be performed towards the SpCell using the legacy serving cell RACH configuration, as the legacy operation. Therefore, the RACH configuration for the additionalPCI shall only be used for inter-cell PDCCH ordered CFRA, i.e., not used for UE initiated RACH.

**Q4: Do you agree that the RACH configuration for the additionalPCI shall only be used for inter-cell PDCCH ordered CFRA, i.e., not used for UE initiated RACH?**

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| **Company** | **Yes/No** | **Comments**  |
| ZTE | Yes | As legacy, the RACH-ConfigCommon of the serving cell would be applied for UE initiated CBRA for TA acquisition. |
| Docomo | Yes |  |
| Sharp | Yes |  |
| CATT | Yes | It is RAN1 agreement, the RACH configuration for the additionalPCI shall only be used for inter-cell PDCCH order CFRA.  |
| LGE | Yes | This is clear according to the description of *additionalCFRA-ToAddModList-r18* in R1-2308672 (Consolidated higher layer parameters list). |
| Ericsson | Yes |  |
| Nokia | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes |  |
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## TAT expiry when exceeding MTTD

Maximum transmission timing difference (MTTD) is defined for DC between PCell and PSCell, and for CA between different carriers. In TS 38.321 clause 5.2, the relevant restriction on TAT expiry is specified as follows.

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| When the MAC entity stops uplink transmissions for an SCell due to the fact that the maximum uplink transmission timing difference between TAGs of the MAC entity or the maximum uplink transmission timing difference between TAGs of any MAC entity of the UE is exceeded, the MAC entity considers the *timeAlignmentTimer* associated with the SCell as expired. |

This means if the MTTD between TAGs is exceeded, the TAT of the corresponding SCell is considered expired, the TAT of PTAG is not considered as expired.

For multi-DCI multi-TRP operation, RAN4 has defined new MTTD values between multiple TRPs that are applicable to both intra-cell and inter-cell cases (R4-2217278). Correspondingly, we need to discuss when/which TAG(s) is considered as expired if MTTD between TRPs is exceeded. The MTTD could be exceeded between TRPs from the same cell or between TRPs from different cells/MAC entities. The following cases are possible.

Case 1: the MTTD between two STAGs is exceeded

Case 2: the MTTD between a PTAG and a STAG is exceeded

Case 3: the MTTD between two PTAGs is exceeded

For case 1, we can apply the principle in legacy operation that TAT of SCell is considered to be expired, so the TATs of both STAGs are considered as expired.

For case 2, similarly, the TAT of the STAG is considered as expired.

For case 3, we can follow the legacy principle that the TAT of PTAG is not considered as expired.

**Q5: Do you agree that if the MTTD between two STAGs or between a STAG and a PTAG is exceeded, the TAT of each concerned STAG is considered as expired?**

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| **Company** | **Yes/No** | **Comments**  |
| ZTE | Yes | As legacy |
| Docomo | Yes |  |
| Sharp | Yes |  |
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| LGE | Yes |  |
| Ericsson | Yes | Follow legacy principle |
| Nokia | Yes |  |
| Qulcomm | Yes |  |
| CATT2 |  | To clarify, for case 1, we think in legacy, only one TAT of one STAG is expired. As for R18 behaviours, we agree to just follow legacy principle.  |
| OPPO | Yes |  |
| Huawei, HiSilicon |  | The legacy text says "When the MAC entity stops uplink transmissions for an SCell", it does not say for which SCell the UE may stop.For example, if TA for TAG1 is 5, TA for TAG2 is 10, TA for TAG3 is 20 and MTTD is 12, the different between TA of TAG1 and TAG3 exceeds the MTTD, so both can't be used, but the UE is supposed to be capable to transmit on all serving cells belonging to TAG1 and TAG2, or to all serving cells belonging to TAG2 and TAG3, then it does not look like the UE is allowed to stop UL transmission on all serving cells belonging to TAG1 and to TAG3.So it is up to UE implementation to stop transmission on serving cells belonging to TAG1 or to TAG3, but the UE is not supposed to stop on both.(This text is a copy paste of LTE and the Rel-11 LTE CR coversheet contradicts with the content of the CR, but what matter is the text in the specification, not "the intention" or the coversheet). |
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**Q6: Do you agree that if the MTTD between PTAGs is exceeded, do not consider TAT of any PTAG as expired?**

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| **Company** | **Yes/No** | **Comments**  |
| ZTE | No? | In this case, it may be allocated into two sub-cases:Subcase 1: MDDT between PTAGs in one MAC entitySubcase 2:MDDT between PTAGs across different MAC entitiesFor subcase 2, it is legacy that the TAT of any PTAGs is not considered as expired.For subcase 1, it is a brand new scenario, there is no legacy behavior can be referred to. We suggest to send an LS to RAN4 to ask what is the expected UE behavior if MDDT between PTAGs in one MAC entity is reached. |
| Docomo | No | We support observation about subcases by ZTE. For subcase 2, we tend to think that two PTAGs with exceeded MTTD in between should not co-exist in one MAC entity, i.e., one of PTAGs should be regarded as expired, but it is fine to confirm with RAN4. |
| Sharp | - | No strong view, we could go with majority. |
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| Rapporteur |  | RAN4 have made the following agreement regarding the requirement of MTTD between MTRPs (R4-2217278). Besides the following MTTD requirements, RAN4 cannot tell us what’s the UE behavior when MTTD is exceeded. RAN2 needs to decides the corresponding UE behavior.**Issue 1-2: MRTD/MTTD requirement for multi-DCI multi-TRP operation in FR1****Agreements:*** For both intra-cell and inter-cell multi-TRP, the MRTD between multiple TRPs can be assumed within a CP length as baseline. MTTD can be CP+M1 µs for FR1. Where M1 is FFS.
	+ FFS whether transient period between 2 UL signals associated with 2 different TAs needs to be considered
* For a UE capable of supporting RTD>CP (as an optional UE capability), MRTD/MTTD value is 33/34.6 µs.

**Issue 1-3: MRTD/MTTD requirement for multi-DCI multi-TRP operation in FR2****Agreements:*** For both intra-cell and inter-cell multi-TRP, the MRTD between multiple TRPs can be assumed within a CP length as baseline. MTTD can be CP + M2 µs for FR2. Where M2 is FFS.
	+ FFS whether transient period between 2 UL signals associated with 2 different TAs needs to be considered
* For a UE capable of supporting RTD>CP (as an optional UE capability), MRTD/MTTD value is 8/8.5 µs.

[CATT]: agree with rapporteur, no need to check with RAN4. |
| LGE | No | For Subcase 1, we have same view with ZTE. The UE behaviouir upon exceeding MTTD should be checked first. We want to ask RAN4 by sending LS. Regarding Subcase 2, we also think that TAT of both PTAG is not expired. |
| Ericsson | - | Support asking RAN4, can wait with RAN2 conclusions. |
| Nokia | - | This requires input by other groups indeed. |
| Qualcomm |  | Send LS to RAN4 |
| CATT2 |  | RAN4 only defines the requirement of MTTD, the UE behaviour upon MTTD is exceed is RAN2 business, so we do not think RAN2 should send LS to ask RAN4 on the UE behaviour.As for the UE handling in case the MTTD between two PTAGs within same MAC entity is exceeded, since the 2 PTAGs are with the same priority, we think we can just follow the handling of case 1, i.e., only one PTAG is expired.  |
| OPPO |  | LS to RAN4 is fine |
| Huawei, HiSilicon |  | Agree with CATT. RAN2 could ask RAN4 about what the UE shall support, but how to handle this case is up to RAN2.We see the above agreements quoted by the rapporteur but they don't mention the SpCell explictly, this is the only thing that we might ask RAN4 about.We see the following possibilities:- the UE stops all UL transmissions on the and considers TATs of both PTAGs not running- the UE stops UL transmissions associated with one of the two TAGs (up to UE implementation, or the network configures which) and considers the associated TAT not runningRAN2 can discuss this directly, no need to ask RAN4. |
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## RA upon SCG activation

For SCG activation, currently RA is needed if TAT of pTAG is not running as specified in 5.29.

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| The network may activate and deactivate the configured SCG.The MAC entity shall for the configured SCG:1> if upper layers indicate that SCG is activated:2> if *BFI\_COUNTER* >= *beamFailureInstanceMaxCount* for the PSCell or the *timeAlignmentTimer* associated with PTAG is not running:3> indicate to upper layers that a Random Access Procedure (as specified in clause 5.1.1) is needed for SCG activation. |

As we have agreed the PSCell has two PTAGs if 2 TAGs are configured, the issue is whether RA is needed only if TATs of both PTAGs are not running, i.e., as long as the TAT of a PTAG of PSCell is running, RA is not needed.

**Q7: Do you agree that if two PTAGs are configured for the PSCell, indicate to uppler layers that RA is needed for SCG activation if TATs of both PTAGs are not running?**

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| **Company** | **Yes/No** | **Comments**  |
| ZTE | Yes | As legacy. |
| Docomo | Yes |  |
| Sharp | Yes |  |
| CATT | At least no for now | Before discussing this, we need to discuss whether to support the coexistence of these two features. As we know in R17 DCCA discussion, the coexistence of deactivated SCG and mTRP is not supported.  |
| LGE | Yes |  |
| Ericsson | Yes, comment | It would be good to retain the legacy behaviour here. In that sense TAT for both PTAGs need to be considered.  |
| Nokia | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Huawei, HiSilicon | Not for now | We agree with CATT that the coexistence of mTRP and deactivated SCG is currently not supported. If we want to do what is proposed, we need some enhancements to deactivated SCG (but we are ok to do it). |
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## HARQ feedback handling when TAT(s) expires

In TS 38.321 clause 5.3.1 and 5.3.2.2, HARQ feedback is not generated if the TAT is expired or not running. In case of 2 TAGs for a serving cell, we have to discuss how to handle HARQ feedback when any TAT(s) is expired or not running. Since for 2 TA operation, each TCI state is associated with a TAG and we have agreed that UE shall not send any UL transmission using TCI state(s) associated to the TAG with TAT expired, we can follow this principle for HARQ ACK. That is, HARQ ACK is not generated if the TCI state to be used for HARQ feedback transmission is associated to the TAG with the expired TAT.

**Q8: Do you agree that HARQ ACK is not generated if the TCI state to be used for HARQ feedback transmission is associated to a TAG with TAT expired?**

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| **Company** | **Yes/No** | **Comments**  |
| ZTE | Yes |  |
| Docomo | Yes |  |
| Sharp | Yes |  |
| CATT | Yes |  |
| LGE | Yes |  |
| Ericsson  | Yes |  |
| Nokia | Yes |  |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Huawei, HiSilicon |  | There is no RAN1 agreement that, for every HARQ feeback transmission, the UE must use only one TCI state.If there is more than one "TCI state to be used for HARQ feedback transmission" and one is associated with a TAG whose TAG is not expired, there is no reason not to generate HARQ feedback.This proposed agreement is based on some assumption that may not be correct. |
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## Other issues

**Q9: Please indicate and justify other critical issues, if any.**

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| **Company** | **Comment** |
| Sharp | As we discussed in R2-2310193 Issue-1: Regarding to P1, random access problem could be indicated to upper layer and result RLF declaration.However, considering two TA config, early RLF declaration could be avoid in a case that the RA via the other TRP could be normal.So it is proposed to discuss the Random Access problem indication in two TAs case to avoid unnecessary interruption of the link connectionRapporteur: In legacy, SpCell may have two TRPs each having the same TA. Random access can be initiated while TAT is running. This Random access may fail due to failure of transmission/reception on one of the TRPs. UE still declare RLF. The legacy behaviour can be followed.Sharp01: I agree legacy behaviour could be followed and nothing will be broken. Just considering the benefit to avoid unnecessary RLF declaration, maybe it is worth to be discussed if time is allowed.Issue-2: regarding to P2, during a RA procedure, when RA response is received successfully, the *preambleReceivedTargetPower* is provided to PHY and used todetermine the PUSCH transmission power as described in 7.1.1 in TS38.213.Considering in two TAs case, RA procedure could be performed per TRP. Consequently, the resulted *preambleReceivedTargetPower* is also per TRP.So it should be indicated to PHY the associated TAG ID with the indicated preambleReceivedTargetPower for a Serving Cell configured with two TAGs.Rapporteur: Similarly, in legacy multi-TRP operation, preambleReceivedTargetPower is provided to PHY without differentiating TRPs. The 2 TA operation only enables UE to distinguish TAs between two TRPs, but causes no impact to other aspects of multi-TRP operation.Sharp01: in legacy multi-TRP operation, the same TA is assumed for different TRPs. So the difference of preambleReceivedTargetPower to different TRPs in legacy could be neglected based on the assumption and need to differentiate them. However, in R-18, different TAs are supported, it is not clear if it is still reasonable. Issue-3, According to the running CR,” the PUCCH, if configured only with TCI state(s) that is associated with the TAG of the expired timeAlignmentTimer” could be released. In other words, the PUCCH which is configured with both the first and the second TCI states will not be released if the other associated TA timer is running, and still could be used for SR.Currently only valid PUCCH will be indicated to PHY for SR transmission. And PHY could decide TCI state if applicable.However, how does the PHY know the TCI state(s) that is associated with the TAG of the expired timeAlignmentTimer?Rapporteur: According to the RRC parameter applyIndicatedTCIState-r18 for PUCCH, for M-DCI based MTRP operation, the candidate values can be {the first, the second}, and the first and the second indicated joint/UL TCI states correspond to the indicated joint/UL TCI states specific to coresetPoolIndex value 0 and value 1, respectively. PUCCH will not be configured with both first and second TCI states for mDCI mTRP operation.Sharp01: I think {the first, the second, both} are all supported for PUCCH, Please correct me if I miss something. |
| OPPO | In contribution R2-2309666, in section 2.2 we raise the issue how to interpret the new MAC CE to updated unified TCI state. and the proposal is :**Proposal 7: UE’s behaviour on how to apply received MAC CE is captured in RAN1’s spec. And RAN1 and RAN2 should be aligned on the UE’s behaviour.** |
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# Conclusions and Proposals

**TBD**