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

**Bangalore, India, 25th – 29th Aug. 2025**

**Source: vivo**

**Title: Discussion summary and list of MAC open issue for Mob Ph4**

**Agenda Item: 8.6.1**

**Document for: Discussion and Decision**

1. Introduction

This document summarizes the discussion of the following email discussion and collects the MAC open issues for mobility Enhancements.

* [POST130][111][MOB] (Vivo)

**Scope:** Update 38.321 running CR (also including this meeting’s agreements and latest other WGs’ inputs) and remaining essential MAC open issues.

**Intended outcome:** 38.321 running CR and remaining essential MAC open issues.

**Deadline:** Long email discussion.

Companies are invited to provide comments/additional issues in the below table by 31st July, 2025.

# Discussion

* 1. Part I – New issues related to running CR

**Open issue MAC-20 (essential): How to design the MAC CE to activate/deactivate the SP CSI-RS resource for LTM CSI acquisition for candiate cells based on RAN1 LS**

In RAN2#130 meeting, the LS from RAN1 on the support of SP CSI-RS resource for LTM CSI acquisition for candidate cells was discussed as below, and we have the following open issue that whether a same MAC CE is used for both RRM measurement and early CSI acquisition purpose.

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| R2-2503311 LS on the support of semi-persistent CSI-RS resource for LTM CSI acquisition for candidate cells (R1-2503079; contact: Fujitsu) RAN1 LS in Rel-19 NR\_Mob\_Ph4-Core To:RAN2, RAN3   * MAC CR rapporteur will take it into account. * Noted.   **[CB session]:**  [Vivo]: We haven’t decided whether a same MAC CE is used for both RRM measurement and early CSI acquisition purpose. Would like RAN2 to make decision to prepare MAC running CR. [Ericsson]: Before RAN2 makes decision, we would like to see more RAN1 inputs (e.g. related RRC configuration). MAC CR rapporteur can take RAN1 inputs into account in the preparation of MAC running CR (directly including discussion on this issue).   * MAC CR rapporteur can discuss this issue (whether a same MAC CE is used for both RRM measurement and early CSI acquisition purpose) with the consideration of further RAN1 inputs, in running CR preparation. |

According to the latest Rel-19\_higher\_layer\_parameters\_list\_RAN1 [1], the CSI report configuration could be summarized as follows:

The CSI report is configured in *LTM-Candidate-r18* for a certain candidate cell via the current IE *ltm-CSI-ReportConfig-r18*, in this case the UE ignores the fields *ltm-ReportConfigType* and *ltm-ReportContent* for early CSI acquisition purpose;

In order to differentiate the the CSI acquisition and RRM, the *reportQuantity-r19* with CHOICE {cri-RSRP ssb-Index-RSRP, cri-RI-PMI-CQI} is introduced in current *ltm-CSI-ReportConfig-r18.*

And according to the following RAN1 agreements on CSI-RS measurement for CSI acquisition:

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| **RAN1#120**   1. After the RRC configuration and before the reception of CSC, the UE may measure CSI based on the configured CSI-RS resource(s), which is subject to UE capability  * FFS: whether or how to select a subset of CSI-RS resources to measure * FFS: when the UE may start measuring the configured CSI-RS resources  1. UE determines the CSI report configuration based on the CSC 2. After the reception of cell switch command, the UE may measure (depending on the timeline) CSI-RS resource(s) associated with determined CSI report configuration   **RAN1#120bis**  **[FL proposal 5-3-1-v3]**  Regarding CSI acquisition, for a candidate cell,   * A single CSI report configuration is configured * Multiple CSI-RS resources for CMR can be associated with the CSI report configuration   + The number of CSI-RS resources for CMR is subject to UE capability   **Agreement**  For candidate cell CSI acquisition   * In addition to periodic CSI-RS resource, semi-persistent CSI-RS resource is supported   + Support of semi-persistent CSI-RS resource is subject to separate UE capability. * MAC CE is used to activate/deactivate the semi-persistent CSI-RS resource similarly to the legacy mechanism for a serving cell which will be specified in RAN2   Send an LS to RAN2 and RAN3 to inform this agreement |

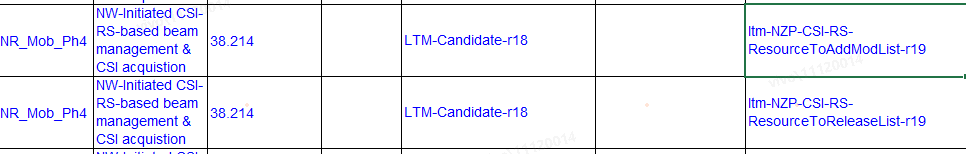
For a UE configured with LTM candidate configuration, if the UE has the capability to measure CSI before receiving CSC, it would measure CSI for the LTM candidate cell(s) which has the *ltm-CSI-ReportConfig-r18* in its *LTM-Candidate* and measure CSI based on the *ltm-CSI-ReportConfig-r18*. And after the reception of CSC, the UE may only measure CSI based the *ltm-CSI-ReportConfig-r18* in *LTM-Candidate* of target cell.

Based on the CSI report configuration as below, it is associated with the CSI-RS resource configured in *LTM-CSI-ResourceConfig*.

In the *LTM-CSI-ResourceConfig* in current RRC running CR [2], it has the CSI-RS resources which includes SP CSI-RS configured in the *LTM-NZP-CSI-RS-ResourceSet* as below:

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| LTM-CSI-ResourceConfig-r18 ::= SEQUENCE {  ltm-CSI-ResourceConfigId-r18 LTM-CSI-ResourceConfigId-r18,  ltm-SSB-ResourceSet-r18 LTM-SSB-ResourceSet-r18,  ... ,  [[  ltm-NZP-CSI-RS-ResourceSet-r19 LTM-NZP-CSI-RS-ResourceSet-r19 OPTIONAL, -- Need R  resourceType-r19 ENUMERATED {periodic, semi-persistent} OPTIONAL -- Cond CSI-RS  ]]  }  ….  LTM-NZP-CSI-RS-ResourceSet-r19 ::= SEQUENCE {  ltm-CSI-RS-ResourceList-r19 SEQUENCE (SIZE (1..maxNrofLTM-CSI-ResourcesPerSet-r19)) OF NZP-CSI-RS-ResourceId,  ltm-CandidateIdList-r19 SEQUENCE (SIZE (1..maxNrofLTM-CSI-ResourcesPerSet-r19)) OF LTM-CandidateId-r18,  ...  } |

And according to latest Rel-19\_higher\_layer\_parameters\_list\_RAN1, the CSI-RS resource for *LTM-NZP-CSI-RS-ResourceSet* is referred to the pool of *NZP-CSI-RS-Resource* of a candidate cell in *LTM-Candidate,* which could be used for NW-Initiated CIS-RS-based beam management and CSI acquisition as below:



Based on above, it could be observed that the configured CSI-RS in *LTM-NZP-CSI-RS-ResourceSet* could be used for both RRM measurement and early CSI acquisition purpose, and since there is no conclusion that the *LTM-CSI-ResourceConfig* configured for RRM measurement couldn’t be also associated to *ltm-CSI-ReportConfig* used for CSI acquisition. Besides, the same mechanism is used for Rel-15 serving cell RRM measurement and CSI acquisition on the CSI-RS resource configuration, and the same MAC CE is used for both RRM measurement and early CSI acquisition purpose in Rel-15.

Thus, rapporteur suggests:

**Rapporteur Proposal 1: Same SP CSI-RS Resource Set Activation/Deactivation MAC CE is used for both RRM measurement and early CSI acquisition purpose.**

**Companies are invited to provide your views on whether agree the above rapporteur proposal 1.**

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| **Company** | **Yes/No** | **Comments, if any** |
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**Summary:**

**x companies provided the comments:**

x

With this, x

**Proposal 1: (x/x) x.**

Besides, based on the latest Rel-19\_higher\_layer\_parameters\_list\_RAN1, the CSI-IM-Resource of a candidate cell is also introduced for IMR measurement of candidate cells as below in the latest RRC running CR:

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| LTM-CSI-ResourceConfig-r18 ::= SEQUENCE {  ltm-CSI-ResourceConfigId-r18 LTM-CSI-ResourceConfigId-r18,  ltm-SSB-ResourceSet-r18 LTM-SSB-ResourceSet-r18,  ...,  [[  ltm-NZP-CSI-RS-ResourceSet-r19 LTM-NZP-CSI-RS-ResourceSet-r19 OPTIONAL, -- Need R  ltm-CSI-IM-ResourceSet-r19 LTM-CSI-IM-ResourceSet-r19 OPTIONAL, -- Need R  resourceType-r19 ENUMERATED {periodic, semiPersistent} OPTIONAL -- Cond CSI-RS  ]]  }  LTM-SSB-ResourceSet-r18 ::= SEQUENCE {  ltm-SSB-ResourceList-r18 SEQUENCE (SIZE (1..maxNrofLTM-CSI-ResourcesPerSet-r18)) OF SSB-Index,  ltm-CandidateIdList-r18 SEQUENCE (SIZE (1..maxNrofLTM-CSI-ResourcesPerSet-r18)) OF LTM-CandidateId-r18,  ...  }  LTM-NZP-CSI-RS-ResourceSet-r19 ::= SEQUENCE {  ltm-CSI-RS-ResourceList-r19 SEQUENCE (SIZE (1..maxNrofLTM-CSI-ResourcesPerSet-r18)) OF NZP-CSI-RS-ResourceId,  ltm-CandidateIdList-r19 SEQUENCE (SIZE (1..maxNrofLTM-CSI-ResourcesPerSet-r18)) OF LTM-CandidateId-r18,  ...  } |

And the IMR is also a CSI acquisition, which has a same LTM report configuration for other CSI acquisition as below in the latest RRC running CR:

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| LTM-CSI-ReportConfig-r18 ::= SEQUENCE {  ltm-CSI-ReportConfigId-r18 LTM-CSI-ReportConfigId-r18,  ltm-ResourcesForChannelMeasurement-r18 LTM-CSI-ResourceConfigId-r18,  <--Skip-->  ltm-ReportContent-r18 LTM-ReportContent-r18,  ...,  [[  ltm-ReportContent-v19xy LTM-ReportContent-v19xy OPTIONAL, -- Need R  ltm-ResourceForInterferenceMeasurements-r19 LTM-CSI-ResourceConfigId-r18 OPTIONAL, -- Need R  ]]  } |

Based on the configuration from RAN1, the CSI-RS for IMR measurement could as be semi-persistent, and following the same mechanism in Rel-15 Activation/Deactivation of Semi-persistent CSI-RS/CSI-IM resource set MAC CE design, rapporteur suggests:

**Rapporteur Proposal 2: SP CSI-RS Resource Set Activation/Deactivation MAC CE could be also used to activate and deactivate the configured semi-persistent CSI-IM resource sets of a LTM candidate cell.**

**Companies are invited to provide your views on whether agree the above rapporteur proposal 2.**

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| **Company** | **Yes/No** | **Comments, if any** |
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**Summary:**

**x companies provided the comments:**

x

With this, x

**Proposal 1: (x/x) x.**

**Open issue MAC-21: Whether indicate the selected RS index to the lower layer for RACH-less CLTM.**

In RAN2#130 meeting, whether UE needs to determine the target TCI state upon the RACH-less conditional LTM execution and indicate it to lower layer was discussed as below:

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| R2-2503411 Discussion on Conditional Intra-CU LTM CATT discussion Rel-19 NR\_Mob\_Ph4-Core  Proposal 9: Send LS to RAN1 to confirm whether UE needs to determine the target TCI state upon the RACH-less conditional LTM execution and indicate it to lower layer.   * Can be treated as part of running CR discussion. |

In the current running CR, during CLTM execution, the RS is selected for RACH-less CLTM as described in 5.y.3. Rapporteur understands the selected RS should be informed to the lower layer to determine the QCL assumption for DL channel/RS reception after CLTM. Thus, the corresponding part was captured in 5.8.2 as below, similar as the legacy LTM procedure:

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| 1> if a SSB corresponding to the configured UL grant has the same SSB index as the selected SSB, as specified in clause 5.y.3:  2> indicate the SSB index to the lower layer;  2> consider this configured uplink grant as valid.  1> if a CSI-RS associated with SSB corresponding to the configured UL grant has the same CSI-RS index as the selected CSI-RS, as specified in clause 5.y.3:  2> indicate the CSI-RS index to the lower layer;  2> consider this configured uplink grant as valid. |

**Companies are invited to provide your views on whether agree the above text in running CR.**

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| **Company** | **Yes/No** | **Comments, if any** |
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**Summary:**

**x companies provided the comments:**

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With this, x

**Proposal 1: (x/x) x.**

**Open issue MAC-22: whether multiple MR should be triggered and wether only one or multiple L1 measurement report MAC CE should be generated in case multiple beams associated with an LTM report configuration satisfies triggering condition for TTT.**

Before RAN2#130 meeting, LG commented that it is not crystal clear for the case multiple beams associated with an LTM report configuration satisfies triggering condition for TTT at adjacent times: whether multiple MR should be triggered and wether only one or multiple L1 measurement report MAC CE should be generated. Details could be found in section MAC-LG1 in [R2-2504639]. Rapporteur thinks it is necessary to align the understanding with all companies to ensure everyone is on the same page.

In this caes, rapporteur understands in this case, multiple MR will be triggered and only one L1 measurement report MAC CE will be generated, i.e. option 2 in LG’s contribution, which is captured in the current running CR as below:

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| In 5.x.3: //there may be multiple triggering beam, each one will initiate the measurement report in 5.x.4  2> if the entry condition for the event associated with *ltm-CSI-ReportConfigId* is fulfilled for one or more applicable beams, i.e. reference signalling associated with *SSB-Index* or *NZP-CSI-RS-ResourceID* in the *LTM-CSI-ResourceConfig* associated with the *LTM-CSI-ReportConfig*, which is not in the *BEAM\_TRIGGERED\_LIST*,for the measurement from lower layer during *timeToTrigger* defined for this event:  ….  3> initiate the measurement reporting procedure, as specified in 5.x.4.  2> else if the leaving condition for the event associated with *ltm-CSI-ReportConfigId* is fulfilled for one or more applicable beams included in the *MR\_LIST* for the measurement from lower layer during *timeToTrigger* defined for this event:  ….  4> initiate the measurement reporting procedure, as specified in 5.x.4;  In 5.x.4: // when there is UL grant, MR MAC CE will be generated. At this time there may be more than one measurement report has been triggered as in 5.x.3.  1> if at least one L1 measurement report has been triggered as specified in 5.x.3 and not cancelled:  2> if UL-SCH resources are available for a new transmission in the serving cell and these UL-SCH resources can accommodate the L1 measurement report MAC CE plus its subheader as a result of logical channel prioritization:  3> instruct the Multiplexing and Assembly procedure to generate the L1 measurement report MAC CE associated with the *ltm-CSI-ReportConfigId* as befined in clause 6.1.3.x according to the measurement report information in the *MR\_LIST*;  … |

**Companies are invited to provide your views on 1) whether agree with rapporteur’s understanding, and 2) if yes, whether the current text in the running CR is clear enough.**

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| **Company** | **Yes/No on 1)** | **Yes/No on 2)** | **Comments, if any** |
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**Summary:**

**x companies provided the comments:**

x

With this, x

**Proposal 1: (x/x) x.**

**Open issue MAC-23: whether support CG resource associated with CSI-RS.**

In RAN2#130 meeeting, it was agreed that:

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| * In case CG resource is only associated with SSB, if the beam meeting the execution condition is CSI-RS, the UE determines whether a CG resource is valid based on the SSB associated with the CSI-RS. |

But it is still open whether support CG resource associated with CSI-RS. The corresponding Editor’s Note is captured in the current running CR as below:

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| Editor’s NOTE: Currently, CG resource is only associated with SSBs. FFS whether support CG resource associated with CSI-RS. |

**Companies are invited to provide your views on whether support CG resource associated with CSI-RS.**

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| **Company** | **Yes/No** | **Comments, if any** |
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**Summary:**

**x companies provided the comments:**

x

With this, x

**Proposal 1: (x/x) x.**

* 1. Part II – Other open issue list

**Rapporteur provides the list of open issues as below, and the corresponding suggestions on how to address them. Some of them could be further discussed based on contributions or resoved based on further progress. Companies are invited to provide comments on whether it is open issue and whether the suggestions from reapporteur is accuracy enough.**

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| **Company** | **Comments, if any** |
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### Closed open issues

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| **Index** | **Issue description** | **Status** |
| MAC-1 | **Open issue MAC-1 (essential): Whether the beam specific offset for serving cell Obs is needed for LTM event evaluation** | **Closed** |
| MAC-2 | **Open issue MAC-2 (essential): How to ensure UE be able to report the event-triggered beam(s) that were not included in the truncated MR MAC CE by the following grant** |  |
| MAC-3 | **Open issue MAC-3 (essential): The initial status for Semi-persistent CSI-RS resoruce set for candidate cell** | **Closed** |
| MAC-4 | **Open issue MAC-4 (essential): Whethe keep L1-SINR quantity for L1 event triggered MR as FFS.** | **Closed** |
| MAC-5 | **The content of L1 MR MAC CE triggered by LTM2**  Editor’s NOTE: FFS For MR triggered by LTM2, whether only include the current beam information in the MR MAC CE or the MR can include measurements for LTM candidates. | **Closed** |
| MAC-6 | **Truncated L1 MR MAC CE details. E.g.**  **Except the triggered beam, whether any beam should be prioritised to be included in the truncated L1 MR MAC CE?**  **In case the UL grant could include at least 2 beams in truncated L1 MR MAC CE, which beam should be included as the first beam in the truncated L1 MR MAC CE?**  **Based on following agreement:**  For differential L1-RSRP reporting, the best quality beam among the beams included in L1 MR MAC CE is taken as the reference beam as the first one. The differential L1-RSRP value is derived based on the absolute L1-RSRP of the reference beam. FFS for truncated MAC CE. | **Closed** |
| MAC-7 | **Whether one UL TB could include more than one truncated MAC CE or only one?**  For the case more than 1 triggering events are pending, if UL grant is sufficient for one regular L1 MR MAC CE or for two truncated L1 MR MAC CEs but insufficient for two regular L1 MR MAC CEs, the UE behaviour should be discussed. | **Closed** |
| MAC-9 | **In case UE considers RACH-less CLTM is ongoing, i.e., UE has valid TA for CLTM target cell, how UE selectes the valid CG resource for L3 based CLTM?**  Editor’s NOTE: FFS in case UE considers RACH-less CLTM is ongoing, i.e., UE has valid TA for CLTM target cell, how UE selectes the valid CG resource for L3 based CLTM. | **Closed** |
| MAC-10 | **Beam selection for L3 based RACH-less CLTM determination**  Editor’s NOTE: FFS how to determine the selected beam in case the CLTM is triggered by L3 event. | **Closed** |
| MAC-11 | **In case UE considers RACH-less CLTM is ongoing, i.e., UE has valid TA for LTM target cell, while UE couldn’t obtain valid CG resource, whether UE will fall back to RACH-based LTM? Or we need to change the condition to determine the RACH-less CLTM?** | **Closed** |
| MAC-12 | **How UE selece the CG resource if the selected beam is CSI-RS or if the indicated TCI stae is associated with CSI-RS?**  Editor’s NOTE: This part will be further updated based on RAN1 progress on CSI-RS. E.g. whether there is agreement on CSI-RS associated with CG for LTM and CLTM. | **Update to MAC-23** |
| MAC-13 | **FFS the coexistence between CLTM and (e)RedCap, CovEnh?**  Editor’s NOTE: Whether/How CLTM could co-exist with (e)RedCap is FFS, i.e. whether follow Rel-18 intra-CU LTM as below.  Editor’s NOTE: Whether/How CLTM could co-exist with CovEnh is FFS, i.e. whether follow Rel-18 intra-CU LTM as below. | **Closed** |
| MAC-15 | **Whether the triggered MR should be cancelled in the below case: if all the triggered beam(s), i.e. Type#00 and Type#01, have been reported, no matter whether truncated MR MAC CE or regular MR MAC CE is used before, the trigger MR should be cancelled.**  [Rapp]: Raised by Apple during the discussion. | **Closed** |
| MAC-16 | **Whether the triggered MR should be cancelled in the below two cases:**   * Case 1: When a beam (or multiple beam) meents the entry condition for TTT (Type#00), a MR will be triggered. Before getting the UL grant, if this beam (or all these beams) meets the leaving condition, then, whether this MR is still triggered or should be cancelled? * Case 2: When a beam (or multiple beam) in the reporting list meents the leaving condition for TTT (Type#01), a MR will be triggered. Before getting the UL grant, if this beam (or all these beams) meets the entry condition again, then, whether this MR is still triggered or should be cancelled?   [Rapp]: Raised by Apple during the discussion. | **Closed** |
| MAC-17 | **FFS how to handle the case if the dedicated SR configuration for L1 measurement report MAC CE transmission is not configured, when MR is triggered**  Editor’s NOTE: FFS how to handle the case if the dedicated SR configuration for L1 measurement report MAC CE transmission is not configured, when MR is triggered, e.g. trigger RACH directly*.*  [Rapp]: Based on comments from ZTE and Samsung. | **Closed** |
| MAC-18 | **FFS whether CFRA resource can be associated with CSI-RS**  Editor’s NOTE: FFS whether CFRA resource can be associated with CSI-RS*.*  [Rapp]: Based on comments from ZTE and Samsung. | **Closed** |
| MAC-19 | **FFS whether NCC is optional present in Enhanced LTM Cell Switch Command MAC CE. FFS for which cases should this Enhanced LTM Cell Switch Command MAC CE is used, e.g. whether only for inter-CU case with security key update.**  Editor’s NOTE: FFS whether NCC is optional present in Enhanced LTM Cell Switch Command MAC CE. FFS for which cases should this Enhanced LTM Cell Switch Command MAC CE is used, e.g. whether only for inter-CU case with security key update.  [Rapp]: Based on comments from ZTE and Samsung. | **Closed** |

### Inter-CU LTM

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| **Index** | **Issue description** | **Rapporteur suggestion** |
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### Event triggered L1 measurement

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| **Index** | **Issue description** | **Rapporteur suggestion** |
| MAC-8 | **FFS the coexistence between event triggered report and mTRP, e.g.**  how UE determine the current beam or candidate beam in this case? | **Issue Type:** Not essential  **How to address it:** can be discussed based on companies’ contribution |
| MAC-24 | **It is still working assumption on the details for truncated L1 MR MAC CE**  Editor’s NOTE: It is working assumption: *If network configures to include the current serving beam in MR, the UE always includes the current serving beam in the truncated MR MAC CE. In this case, minimum size of truncated MR MAC CE is {at least one triggered beam + the current serving beam}. If grant is not enough for that, the UE does not assemble a truncated MR MAC CE*. | **Issue Type:** Essential  **How to address it:** based on companies’ contribution |
| MAC-25 | **Handling of the activated SP CSI-RS for target cell after LTM cell switch**  Editor’s NOTE: After reconfiguration with sync that is triggered by LTM, it is FFS how to handle the configured Semi-persistent CSI-RS/CSI-IM resource sets for target cell.  **Based on the following agreement:**  *UE deactivates SP CSI-RS resource of candidate cells (other than the target cell) after cell switch. FFS on the target cell* | **Issue Type:** Essential  **How to address it:** based on companies’ contribution |
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### Conditional intra-CU LTM

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| **Index** | **Issue description** | **Rapporteur suggestion** |
| MAC-14 | **FFS for the case when CLTM candidate TAT timer is running, an (Enhanced) LTM Cell switch Command MAC CE is received**  Editor’s NOTE: FFS for the case when CLTM candidate TAT timer is running, an (Enhanced) LTM Cell switch Command MAC CE is received.  [Rapp]: New added based on Anil’s comments. | **Issue Type:** Not essential but important  **How to address it:** based on companies’ contribution |
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### RACH-less intra-/inter-CU LTM and Conditional intra-CU LTM with two TAGs

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| **Index** | **Issue description** | **Rapporteur suggestion** |
| MAC-26 | **How to consider the TAG ID when determining whether to set the *REAMBLE\_POWER\_RAMPING\_COUNTER* to 1 for an (C)LTM candidate cell which is configured with two TAGs in RACH-less (C)LTM\_**  Editor’s NOTE: In RACH-less (C)LTM, for an (C)LTM candidate cell which is configured with two TAGs, TAG ID is not considered when determining whether to set the *REAMBLE\_POWER\_RAMPING\_COUNTER* to 1. Rapporteur realized the same issue exists for Rel-18 LTM, which was missing. | **Issue Type:** Essential  **How to address it:** based on companies’ contribution |

**Proposal x: RAN2 to consider the above open issues related to MAC for mobility enhancement: MAC-x.**

### Others, please specify

Companies are invited to describe any other identified open issues not currently included within this document.

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| **Company** | **Other identified open issues? (please describe) or other comments** |
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# Conclusion

In this contribution, we discuss some open issues related to MAC running CR for mobility enhancements and collect the open issues for mobility enhancements in MAC. Based on the discussion, the following proposals have been achieved:

**Open issue MAC-x**

**Proposal 1:**

**Other open issues:**

**Proposal x: RAN2 to consider the above open issues related to MAC for mobility enhancement: MAC-x.**

# References

1. R2-25xxxx, Running MAC CR for Mob Ph4, vivo