**3GPP TSG-RAN WG2 Meeting #130 R2-250xxxx**

**St Julian, Malta, 19th – 23rd May 2025**

**Source: vivo**

**Title: Discussion summary and list of MAC open issues for mobility Enhancements**

**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.

* [POST129b][117][MOB] (Vivo)

 **Scope:**

1. Update MAC running CR based on RAN2#129bis progress
2. Essential open issue list in a separate contribution (MAC running CR can keep editor’s notes for readability).

 **Intended outcome:** Updated MAC running CR and essential MAC open issue list.

**Deadline: Long email discussion**

Companies are invited to provide comments/additional issues in the below table by 2nd May, 2025

# Discussion

* 1. Part I - Issues related to running CR

**Open issue MAC-1 (essential): Whether the beam specific offset for serving cell Obs is needed for LTM event evaluation**

In the current MAC running CR, there is an EN as below:

Editor’s NOTE: FFS whether the beam specific offset for serving cell Obs is needed. If needed, per-serving cell or per-beam or per-RS type. Similar as other events.

In RAN2#126 meeting, we agreed the beam specific offset is configured for LTM event evaluation:

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| 6. For LTM event evaluation, TTT, hysteresis for entering/leaving, and/or beam specific (FFS for cell specific) offset can be applied. FFS on the need of measurement reporting once leaving condition is met. |

In RAN2#129bis meeting, the configuration format for the beam specific offset is agreed as following:

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| 1. In L1 reporting configuration, the UE can be configured with a list of candidate IDs. For each listed candidate ID, the network can configure an offset, this offset applies to all the RSs belong the candidate ID that associated with the reporting configuration (the offset value also includes 0dB); If a candidate ID is not provided in the reporting configuration, it means the UE is not required to measure/evaluate the RSs that belonging to the candidate ID for this event, even if these are configured within the L1 resource configuration (to which the L1 reporting configuration points to).
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Current MAC running CR introduce the beam offset for candidate beam as below, while the beam offset for serving cell is FFS. According to the latest agreement, the beam offset is configured in the LTM L1 reporting configuration. The serving cell won’t generally be associated to a LTM L1 reporting configuration, so there is no such beam offset is configured for current beam.

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| Inequality LTM3-1 (Entering condition)*Mn + Obn* *– Hys > Ms + Obs + Off*Inequality LTM3-2 (Leaving condition)*Mn + Obn + Hys < Ms + Obs + Off*The variables in the formula are defined as follows:***Mn*** is the beam measurement quantity of the LTM candidate cell based on SS/PBCH block or CSI-RS, not taking into account any offsets.***Obn*** is the offset of the LTM candidate cell (i.e. [*beamIndividualOffsetN*] as defined in *LTM-CSI-ReportConfig* for this event). One offset is applied to all beam(s) associated with the LTM candidate cell.***Ms*** is the beam measurement quantity of the serving cell based on SS/PBCH block or CSI-RS, not taking into account any offsets. The beam associated with this event is the current beam, i.e corresponding to the RS configured in the indicated TCI state or the RS QCLed with the RS configured in the indicated TCI State indicated by TCI State in the serving cell [as defined in clause 5.1.5 in TS 38.214] in the serving cell.**[*FFS Obs*** is the offset of the beam of the serving cell (i.e. [*beamIndividualOffsetS*] as defined in *LTM-CSI-ReportConfig* for this event).] |

Thus, rapporteur suggests to discuss whether the beam offset should be introduced for current beam of serving cell for LTM event evaluation, e.g. for LTM2, LTM3 and LTM5.

**Companies are invited to provide your views on whether introducing the beam offset for current beam of serving cell for the LTM event evaluation:**

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| **Company** | **Yes/No** | **Comments, if any** |
| Xiaomi | No | Given that we have already implemented cell specific offset, there seems no need to further introduce beam specific offset. If we really want to have beam specific offset, we need to remove cell specific offset and only have beam specific offset, since having both cell and beam specific offsets are redundant (that is the reason RAN2 concluded “*Cell specific offset is not supported for LTM L1 event evaluation*”).[Rapp]: the intention for this question is whether we need to introduce Obs above. It is a separate issue. Please see the TP above.  |
| Baicells | No | See no technical issues for using the cell specific offset.[Rapp]: the intention for this question is whether we need to introduce Obs above. It is a separate issue. Please see the TP above. |
| MediaTek | Yes, but | “beam offset” and “offset with beam granularity” are different concept.Rapporteur seems to ask: Do we need ***Obs*** in the formula like ***Obn***?We think **Yes** because this is similar to the legacy Ax event.However, this “**beam offset for current beam**” does not means the granularity is per beam. For example, the *candidateSpecificOffset-R19* in running CR is “beam offset” for candidate beam, but it is configured per candidate cell (cell granularity).So we think Obs is needed, but configured per serving cell is enough.[Rapp]: Thanks. Please see the TP above.  |
| Ericsson |  | Agree on that the question can be interpreted different ways. To summarize, as MediaTek points out; Obs should still remain in the formula, but can be defined for each cell.[Rapp]: Thanks. Please see the TP above.  |
| CATT | No |  |
| vivo | Yes | Similar as legacy L3 event.  |
| Apple | No  | If companies would like to keep Obs in the formula, we can set the Obs=0. |
| Nokia |  | The Obs should be supported. If that is preferred, can be a single value per serving cell (but of course applied at the level of an individual beam). |

**If companies agree to introduce the beam offset for current beam of serving cell, companies are invited to provide your preference on the offset granularity, e.g. the beam offset is configured per beam/serving cell/RS type/etc.:**

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| **Company** | **Granularity** | **Comments, if any** |
| Xiaomi | Per beam |  |
| Baicells | Per beam |  |
| MediaTek | Per cell | Please see the comment above. |
| Ericsson | Comment | The offset will be applied per beam, but it should be configured per cell.[Rapp]: the intention for this question is to ask the configuration granularity. How to use it is clear based on the above TP. |
| vivo | Per cell | Agree with Ericsson: it is applied to the beam, and the configuration should be per-cell.  |
| Nokia |  | Yes, as commented to the previous question and we agree with Ericsson.  |

**If companies agree to introduce the beam offset for current beam of serving cell, companies are invited to provide your preference on which LTM event the beam offset is used for, e.g. LTM2, LTM3, LTM5:**

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| **Company** | **LTM2/LTM3/LTM5** | **Comments, if any** |
| Xiaomi | Maybe LTM3 | For L3 events, serving cell specific offsets are not used for event A2 and A5. And consequently, current MAC running CR does not have serving cell specific cell / beam offsets for LTM2 and LTM5. So for LTM2 and LTM5, we don’t see motivation to have beam offset for current beam of serving cell.For LTM3, this might be needed. Again we are also OK if we don’t define beam specific offset and rely on RRC reconfiguration (if needed) when current beam of serving cell changes. |
| Baicells | LTM3 |  |
| MediaTek | LTM2 LTM3 LTM5 | Similar to A2 A3 and A5 [Rapp]: But in legacy L3 event, only event A3 has such Ofp and Ocp. |
| Ericsson | LTM2/LTM3/LTM5 | Follow L3 principles.[Rapp]: But in legacy L3 event, only event A3 has such Ofp and Ocp. |
| vivo | LTM3 | As in legacy, only event A3 has such Ofp and Ocp |
| Nokia | LTM2, 3 and 5 | All events where serving beam is involved in the comparison. We do not think we need to copy exactly what was done for L3 events.  |

**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**

In RAN2#129 bis meeting, we have the following agreements for the truncated L1 MR MAC CE, the UE should be able to report the event-triggered beam(s) that were not included in the truncated MR MAC CE by the following grant.

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| 1. Intention is that the UE should be able to report the event-triggered beam(s) that were not included in the truncated MR MAC CE by the following grant. Detailed wording can be further discussed as part of the running CR.
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In the current MAC running CR, this agreement was catprued as below, i.e. the triggered L1 MR is cancelled only if the normal MR MAC CE is transmitted, while it is not cancelled if the truncated MAC CE is transmitted.

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| 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;….3> cancel the the triggered L1 measurement report;2> else if the UL-SCH resources are available for a new transmission in the serving cell and these UL-SCH resources can accommodate the Truncated 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 Truncated L1 measurement report MAC CE;…. |

Rapportuer understands that this could ensure that UE is able to report the event-triggered beam(s) that were not included in the truncated MR MAC CE by the following grant. If the network provides enough grant later, the UE will transmit the whole L1 MR MAC CE, which would include the event-triggered beam(s) that were not included in the truncated MR MAC CE, and maybe also include the parts which have been reported to network via the truncated L1 MR MAC CE before. If the grant provided by network is still not enough later, the UE will continue to transmit the truncated L1 MR MAC CE, which would include the event-triggered beam(s) that were not included in the truncated MR MAC CE before by UE implementation.

Alternatively, if companies prefer to specify this explicitly in the specification, we need to design the model like:

* UE maintains a list for the triggering beam(s); once the measurement quantity of a beam satisfies the trigger event, it will be stored in this list;
* UE maintains a list for the reporting beam(s); once the UE transmits the event triggered L1 MR MAC CE (not truncated MAC CE), the beam(s) in the triggering list will be moved to the reporting list;

If the UE transmits the event triggered truncated L1 MR MAC CE, the beam(s) in the triggering list will be still maintained in the triggering list.

Rapporteur understands the current MAC running CR is enough, or at most we could add some note the clarify the UE behaviour on how to report event-triggered beam(s) after a truncated MR MAC CE before.

**Companies are invited to provide your view on whether the current MAC running CR is enough (may be a note could be added) or not for the above agreement.**

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| **Company** | **Comments** |
| Xiaomi | Current MAC running CR might not be clear enough on UE behavior. For example, after sending truncated MAC CE, if the subsequent UL grant is not big enough, current running CR requires that “report ID field and at least one triggered beam with corresponding measured quantity are included.” Maybe some clarification is needed (e.g. in a note) that UE only report beams not included in previous truncated MAC CE.  |
| Baicells | At 129bis we achieved the following agreement:* When UL grant is enough to accommodate only limited number of beams in MR MAC CE, the triggered beam should be included in the truncated MR MAC CE.

Does this agreement mean only the triggered beam can be included in MAC CE ?[Rapp]: Not exactly. During online discussion, the intention for this agreements is: if truncated MAC CE is transmitted, the triggered beam(s) should be included with high priority… |
| MediaTek | This should be a corner case and the behavior is complex.We prefer to simple add a note saying that for that case (grant still not enough), the selection of the beam is up to UE implementation.  |
| Ericsson | The current behaviour in the CR seems good enough in general. Prefer to have some note inline with what rapporteur, Xiaomi and MediaTek has proposed, clarifying the behaviour if not all remaining beams can be fitted within the following grant. In general this seems like a corner case and simplicity of spec should be prioritized. |
| CATT | Agree with companies above that the current behavior is enough. But it is fine to clarify in a note. |
| vivo | We agree the current text is enough. We are also fine to add a note to capture the corresponding behaviour.  |
| Apple | Current MAC CR is not clear enough on UE behavior, at least in the following two exmaples:Example#1: if one beam meet the entry condition (for TTT) and add in the BEAM\_TRIGGERED\_LIST, and before UE got the UL grant to transmit it the beam meets the leaving condition (for TTT), and UE will remove it from the BEAM\_TRIGGERED\_LIST. For this case, as the beam information has not been reported, UE doesnot need to trigger MR based on leaving condition. [Rapp2]: After further discussed with Apple, the following case needs to be disussed: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? As the previous triggered beam has not been reported to the network, it seems there is no need to further report the leaving.Rapporteur understands a similar case should be discussed together: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?**With this, a new open issue MAC-15 is added below to collect companies’ view.** Example#2: When the 1st UL grant can includes the MR MAC CE which can carry all the triggered beams, but there is no room to carry the other beams which are not satisfied the condition. For this case, according to current description, we call it as truncated MR MAC CE. But in this case, UE donot need to trigger the 2nd MR MAC CE as all triggered beams have been already reported in the 1st UL trant. Then, UE should cancel the triggered L1 MR. [Rapp]: in this example, (case 1) if the number of triggered beams is less than the maximum number of reported beam in MAC CE configured by NW, then, truncated MR MAC CE will be used. (case 2) If the number is larger or equal to the maximum number of reported beam in MAC CE configured by NW, regular MR MAC CE will be used. Based on the current MAC, 2nd MR MAC CE will be triggered if truncated MR MAC CE is used (case 1). Otherwise (case 2), the triggered report will be cancelled based on above TP, and there is no 2nd MR MAC CE. [Rapp2]: After further discussed with Apple, Apple understands the current MAC with note is not enough, and the agreements means that if all triggered beam(s) (Type#00 and Type#01) have been reported, no matter whether truncated MR MAC CE or regular MR MAC CE is used, the trigger MR should be cancelled. i.e. the above model should be explicitly captured in MAC. **With this, a new open issue MAC-16 is added below to collect companies’ view.**  |
| Nokia | Agree with Apple. We do not think this is necessarily a corner case, so we should have a clear MAC procedure for addressing this LTM MAC CE, especially as we have agreed the procedure is not completed upon transmitting the truncated MAC CE. |

**Open issue MAC-15 (essential): 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.**

Regarding the above agreements:

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| 1. Intention is that the UE should be able to report the event-triggered beam(s) that were not included in the truncated MR MAC CE by the following grant. Detailed wording can be further discussed as part of the running CR.
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Some companies may understand that: if all triggered beam(s) (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 (no matter whether there is any beam in the list, i.e. Type#10).

Rapporteur understands this may be corner case based on above companies’ view, but it is better to check with companies as it has not been discussed before.

**Companies are invited to provide your view on 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.**

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| **Company** | **Cancelled/Not cancelled** | **Comments, if any** |
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**Open issue MAC-16 (essential): 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?

Rapporteur understands this may be corner case, but it is better to check with companies as it has not been discussed before.

**Companies are invited to provide your view on whether the triggered MR should be cancelled in the above two cases.**

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| **Company** | **Cancelled/Not cancelled** | **Comments, if any** |
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**Open issue MAC-3 (essential): The initial status for Semi-persistent CSI-RS resoruce set for candidate cell**

In the current MAC running CR, there is an EN as below:

Editor’s NOTE: FFS whether the Semi-persistent CSI-RS resource set for candidate cell is initially deactivation upon (re-)configuration by upper layers.

In RAN2#129bis meeting, we have the agreements:

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| 1. Introduce new MAC CE to activate/deactivate the semi-persistent CSI-RS resource.
2. The new MAC CE includes: A/D indication, Target configuration id or {SP CSI-RS resource set id and/or candidate id}, TCI state id.
 |

However there is no conclusion on whether the Semi-persostemt CSI-RS resource set for candidate cell is initial deactivated or not upon (re)configuraiton by upper, rapporteur thinks it is straightforward that it is initial deactivated and will be activated upon receiving the new MAC CE.

**Companies are invited to provide comments on** **whether agree: the Semi-persistent CSI-RS resource set for candidate cell MAC CE is initially deactiated upon (re-)configuration by upper layer or not .**

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| **Company** | **Yes/No** | **Comments, if any** |
| Xiaomi | Yes | We think the resource set should be initially deactivated, similar to other MAC CEs (e.g. Semi-persistent CSI-RS/CSI-IM resource set). |
| Baicells | Yes |  |
| MediaTek | Yes |  |
| Ericsson | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Apple | Yes |  |
| Nokia | Yes |  |

**Open issue MAC-4 (essential): Whethe keep L1-SINR quantity for L1 event triggered MR as FFS..**

In the current MAC running CR, there is an EN as below:

Editor’s NOTE: Beam quantity of SINR is up to RAN1 discussion and decision. Similar for events definition. By now, the conclusion in RAN1 is: *there is no consensus in RAN1 on the support L1-SINR measurement based on CSI-RS for candidate cells.* But there is no concludion on L1-SINR for SSB.

In the corresponding description for the L1 event triggered MR procedure, multiple places are FFS due to this undetermined point.

However, rapporteur understands that RAN1 won’t discuss this issue anymore for CSI-RS, and there is no beam quantity SINR for SSB. Thus, there is no need to keep this open issue in RAN2.

**Companies are invited to provide comments on whether agree RAN2 assumes there is no L1-SINR quantity for L1 event triggered MR.**

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| **Company** | **Yes/No** | **Comments, if any** |
| Xiaomi | Yes | We agree that L1-SINR is not used for L1 event triggered MR. |
| Baicells | Yes |  |
| MediaTek | Yes | We should follow RAN1’s outcome. |
| Ericsson | Yes | Agree that RAN1 will not include it. |
| CATT | Yes |  |
| vivo | Yes |  |
| Apple | Yes |  |
| Nokia | Yes | As far as we know, RAN1 has no plan to discuss L1-SINR in Rel-19. |

* 1. Part I – 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** |
| Ericsson | For the NCC value in the enhanced LTM Cell switch command: Since the NCC value consists of 3 bits it has 8 code points, which are all used for different NCCs. Thus, there is no way for the UE to understand if the NCC value is included or not, and an extra bit has to be included in the LTM CS Commandd to signal the use of NCC to the UE.[Rapp] According the below agreement, both NW and UE could behave like this based on the R19 set ID:*NCC is included in the LTM cell switch command MAC CE if the R19 set ID is different between the target cell and source cell. Conversely, if the R19 set ID is same for both cells, the NCC will not be included.* |
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### Inter-CU LTM

N/A

### Event triggered L1 measurement

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| **Index** | **Issue description** | **Rapporteur suggestion** |
| 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.  | **Issue Type:** Essential**How to address it:** based on companies’ contribution |
| 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.
 | **Issue Type:** Not essential**How to address it:** can be discussed based on companies’ contribution |
| 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. | **Issue Type:** Not essential**How to address it:** can be discussed based on companies’ contribution |
| 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 |

### Conditional intra-CU LTM

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| **Index** | **Issue description** | **Rapporteur suggestion** |
| 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.  | **Issue Type:** Essential **How to address it:** based on companies’ contribution |
| 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.  | **Issue Type:** Essential **How to address it:** based on companies’ contribution |
| 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?** | **Issue Type:** Not essential but important**How to address it:** based on companies’ contribution |
| MAC-12 | **How UE selece the CG resource if the selected beam is CSI-RS?**Editor’s NOTE: This part will be further updated based on RAN1 progress on CSI-RS. E.g. there is no agreeent on CSI-RS associated with CG.  | **Issue Type:** Not essential but important**How to address it:** based on RAN1 inputs |
| 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.  | **Issue Type:** Not essential but important**How to address it:** based on companies’ contribution |
| 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 |

### 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 collect the open issues for mobility enhancements in MAC as below:

***Inter-CU LTM***

***Event triggered L1 measurement***

***Conditional intra-CU LTM***

# References

1. R2-25xxx, MAC running CR for Mob ph4, vivo.