3GPP RAN WG2 Meeting #131 R2-250XXXX

Bengaluru, India, Aug 25th – 29th, 2025

Agenda Item: 8.9.1

Source: MediaTek. Inc

Title: Remaining MAC open issues in IoT NTN

Document for: Discussion, Decision

# Introduction

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

* [Post130][307][R19 IoT NTN] MAC CR (Mediatek)

 Scope: discuss the running MAC CR

 Intended outcome: Endorsed CR and list of remaining open issues

**Deadline:** Long

Companies are invited to provide feedback on open issue list by: TBD

# Remaining open issues for specification 36.321

**Open issue MAC-2:** CB-RNTI calculation

**Issue description:**

RAN2 had agreement to use CB-RNTI to scramble Msg3 and monitor Msg4. The CB-RNTI is derived from the transmit resource for the transmission window. A working assumption has been agreed in the RAN2#130.

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| RAN2#129bis agreement:* For CB-msg3-EDT we adopt a Single Msg4 monitoring window and Single RNTI (the RNTI is derived on the transmit resource for the transmission window).
* Introduce a new RNTI (i.e. CB-RNTI) for CB-Msg4 monitoring and CB-Msg3 scrambling. We include this agreement in the LS to RAN1

RAN2#130 agreement:Working Assumption:* The formula for RNTI for Msg4 monitoring is:

RNTI=X + Msg3\_W\_index modulo (Y) + Y\*CE\_level + 3\*Y\*carrier\_id. * X is the starting RNTI for Msg4 reception, which can be defined by RAN2 e.g. X=2401 for eMTC or 4097 for NB-IoT,
* Msg3\_W\_index is the index of Msg3 transmission window within a periodicity of 1024 SFNs and index 0 corresponds to the Msg3 transmission window starts at the SFN defined by IE startSFN-r19,
* Y is ceil (Msg4\_WS/Msg3\_WP),
* CE\_level is the CE level, 0 <= CE\_level < 3
* carrier\_id is the index of the UL carrier of the CB-Msg3 resources, anchor carrier has index 0, 0 <= carrier\_id < 16

Can come back to check if the NW can also simply configure RNTI = XAgreements – part 2:* The value of X is 4097 for NB-IoT and 2401 for eMTC
* The value of Msg4\_WS is the maximum Msg4 window size
* The value of Msg3\_WP is the minimum Msg3 window periodicity
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**Proposed resolution:**

RAN2 confirms the CB-RNTI working assumption.

Companies are invited to indicate their preference regarding the confirmation of the CB-RNTI working assumption , and to comment on whether we should allow simply configure RNTI = X.

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| **Company** | **Confirm WA?** | **Comments** |
| Qualcomm | Yes, see comment | We should avoid same RNTI for different transmission windows. In that sense, cell specific RNTI is not desirable. |
| vivo | Yes |  |
| CATT | Yes with comments | We are ok to confirm the WA. We also support to allow simply configure RNTI = X. For example, if there is no overlap between the two adjacent Msg4 monitoring window, then RNTI=X can be used.But we are also OK to follow the majority view. |
| Apple | Yes | As we commented online, though right now one single RNTI is used for one Msg3 window, we prefer not pursuing one RNTI within cell level, to not make the false alarm issue more severe.  |
| ZTE | Yes, see comments. | Firstly, the fundamental purpose of introducing RNTI is to differentiate UEs that perform uplink transmission on different resource locations. So with similar false alarm concern mentioned by Qualcomm and other companies, we strongly against cell specific RNTI, e.g., to simply configure RNTI = X.Secondly, we think the discussion in last meeting on the justifications for introducing Msg3\_W\_index and modulo (Y) operation was not thorough. So we further discuss as below:* #1: The current definition for Msg3\_W\_index is descriptive in nature. However, we think that by leveraging the factor [floor(SFN\_id/4)] in one of legacy RA-RNTI formula can achieve a similar result, and better as it’s based on a clear mathematical calculation. Here 4 corresponds to the minimum PRACH resource periodicity, so similarly, for CB-RNTI, the factor can be [floor(start SFN\_id of Tx window/minimum Tx window length)]. The only difference is that descriptive Msg3\_W\_index seems to be derived from the actual configuration (i.e., Msg3\_W\_index seems to be equivalent to [floor(start SFN\_id of Tx window /configured Tx window length). Meanwhile, in [floor(start SFN\_id of Tx window / minimum Tx window length)], since the minimum Tx window length is used, the calculated Tx window index value may be larger than the actual index. Nevertheless, this does not affect the desired outcome where UEs selecting different Tx windows can have distinct Tx window index values. In other word, the factor [floor(start SFN\_id of Tx window / minimum Tx window length)] is more general that can adapt to different configurations.
* #2: Per our understanding, the “modulo (Y) and Y is ceil (maximum Msg4 window size/minimum Msg3 window periodicity)” operation is designed to further compress the Tx window index values selected by the UEs. Specifically, if two UEs select different Tx windows (for example, UE1 selects Tx window index 0 and UE2 selects Tx window index 2), and their Msg4 reception windows will not overlap (e.g., when Msg4 window size shorter than Msg3 window periodicity, or when Msg4 window size is longer than Msg3 window periodicity but shorter than or equal to two times of Msg3 window periodicity), it’s allowed to use the modulo (Y) operation to compress their indices into the same value. For example, if ceil (maximum Msg4 window size / minimum Msg3 window periodicity) = 2, UEs selecting Tx window index 0 and index 2 can both be adjusted to be with Tx window index 0. Even if other parameters (e.g., CE-level, carrier-id) are identical, the isolation of their Msg4 reception windows ensures they will not falsely detect each other's CB-RNTI.
	+ Here we also can consider to use configured Msg4 window size and configured Msg3 window periodicity respectively, but with legacy experience, to use maximum Msg4 window size and minimum Msg3 window periodicity can make formula more general to adapt to different configurations. This reason is simiar as the reason for our suggestion in above #1, e.g., to use [floor(start SFN\_id of Tx window / minimum Tx window length)] instead of descriptive Msg3\_W\_index.

In a summary, we can confirm CB-RNTI working assumption with a change that to use [floor(start SFN\_id of Tx window / minimum Tx window length)] instead of descriptive Msg3\_W\_index. |
| Nokia | Yes | For the proposal to simply configure cell-level CB-RNTI=X for all the CB-Msg3 transmission windows and all the CB-Msg4 monitoring windows, the main concern with this approach is that, if the CB-Msg4 windows are overlapped, with the single CB-RNTI for Msg4 monitoring, the UE may be required to decode a large number of irrelevant CB-Msg4 with response to other CB-Msg3 transmission windows. This could lead to unnecessary power consumption due to false decoding. Agree with QC, Apple and ZTE that it is not needed.We also agree the WA can be confirmed. On ZTE’s comments to further clarify the Msg3\_W\_index as well as either the “configured” or “maximum/minimum” value should be used for calculation, it can be further discussed in next meeting. |
| NEC | Yes | For the detailed formula, we also support Y to be a fixed value (based on max and/or min) for different configurations, simplifying the network implementation.  |

Summary

**Open issue MAC-6:** The power ramping parameters and how the power ramping is done.

**Issue description:**

RAN2 assumes power ramping should be supported for CB-Msg3-EDT. And in LS R2-2503175, RAN2 has asked RAN1 for confirmation and in case which parameters should apply.

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| RAN2#129bis agreement:* RAN2 assumes power ramping should be supported for CB-msg3-EDT (for both eMTC and NB-IoT) should be supported and will ask RAN1 for confirmation and in case which parameters should apply.
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In the RAN1 reply LS R2-2504962 after RAN2#130, RAN1 indicates that it has not evaluated the potential performance of power ramping for CB-msg3-EDT, and it is likely that there will not be sufficient time to evaluate this topic within the R19 timeframe. Instead, for open loop power control, RAN1 suggests the following UL power control parameters can be reused for CB-msg3-EDT: p0-UE-NPUSCH-r16 and alpha-r16 for NB-IoT NTN.

**Proposed resolution:**

Power ramping is not used for CB-Msg3 transmission. The transmission power of CB-Msg3s in the selected CE level remains the same between the replicas and attempts.

Companies are invited to provide comments on the proposed resolution.

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| **Company** | **Agreed or not** | **Comments** |
| Qualcomm | Yes |  |
| vivo | Agree | Given that the RAN1 specifications have been frozen and there remains no consensus within RAN1 regarding power ramping, we propose that RAN2 should refrain from proceeding with this (initiative/measure), in order to avoid impacting RAN1's functionality. |
| CATT | Agree |  |
| Apple | OK | At the moment, seems RAN2 cannot force to introduce power ramping. It is acceptable to us with no power ramping. |
| ZTE | Can be agree if no further RAN1 input |  |
| Nokia | No | In legacy, to improve the RACH successful rate, UE can not only have power ramping in multiple preamble attempts but also increase its CE level with more repetitions. For CB-Msg3, RAN2 agreed that the UE shall not increase its CE level (to have more repetitions) even the number of failed attempts reached a threshold in current CE level. If the CB-Msg3 power ramping is not supported as well, the UE may finally fail after multiple CB-Msg3 attempts which is a waste of UE’s power and NW resource. In our understanding, power ramping between CB-Msg3 windows is beneficial for the UE that remains in a certain CE level. We agree power ramping is not needed within a CB-Msg3 window (i.e. no power ramping per relica).We think it is also an open issue whether the power level applied for CB-Msg3 is reused in case the UE falls back to 4-step RACH. |
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Summary

**Open issue MAC-9:** Whether NW/UE processing time is needed when determine the Msg4 monitoring starts.

**Issue description:**

In RAN2#129, it has been agreed that the Msg4 monitoring starts at the end of CB-Msg3-EDT transmission window plus UE-eNB RTT. FFS NW/UE processing time is needed or not. In RAN2#130, this open issue was not discussed and remains FFS.

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| RAN2#129bis agreement:* The Msg4 monitoring starts at the end of CB-Msg3-EDT transmission window plus UE-eNB RTT (FFS NW/UE processing time is needed or not)

RAN2#130 agreement:* We do not specify another way of starting Msg4 monitoring window, i.e. it is confirmed that the Msg4 monitoring window always starts at the end of CB-Msg3-EDT transmission window plus UE-eNB RTT (FFS NW/UE processing time is needed or not)
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**Proposed resolution:**

Based on the observations of companies’ contributions and discussions, the following options are summarized.

**Option 1**: The processing time is not needed. (i.e. 0ms)

**Option 2**: A 3 ms processing time is used.

**Option 3**: A 4 ms processing time is used.

**Option 4**: Aother processing time.

Companies are invited to choose between the options.

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| **Company** | **Prefer option** | **Comments** |
| Qualcomm | See comments | No unless any restriction applied from RAN1. |
| vivo | Option 1 | We fail to see the necessity in introducing new processing time. |
| CATT | Option 1 |  |
| Apple | Option 1 | We are fine with no processing time. |
| ZTE | Option 2 | We think it’s safer to have processing time with similar reason in legacy, especially considering that the last replica may be sent almost close to the end of Tx window. We can arbitrarily select a smaller value, e.g., 3ms. |
| Nokia | Option 1 | We have no strong view but would like to go Option1 for simplicity.In TS36.321, the start time of the Msg3 response window were defined in both the legacy RACH and PUR procedure, in which 4 ms were considered in PUR while it is not added in RACH contention resolution procedure. Furthermore, the processing time may not be needed in order to start the transmission of CB-Msg4 earlier since the network can process the Msg3 transmission and prepare for Msg4 transmission well in advance for those UEs who transmit the Msg3 at the early part of CB-Msg3 transmission window. |
| NEC | Option 2 or Option 4 | We can choose a small value or ask RAN1 for a particular value. |

Summary

**Open issue MAC-15:** FFS on the details of the failure behaviour.

**Issue description:**

Whether the UE can initiate the legacy 4-step RA when the CB-Msg3 procedure fails was discussed in the RAN2#129bis. Most companies agreed. But when the CB-Msg3 procedure failes, which upper layer should be notified is still unknown. This issue was identified as an open MAC issue, but it was not discussed at RAN2#130.

**Proposed resolution:**

When the *CB-Msg3ResponseTimer* expires and the maximum number of re-attempts has been reached, MAC notifies the RRC layer. It is up to UE implementation to initial legacy connection establishment, EDT, or PUR.

Do companies agree with the proposed resolution? Other options are also welcome.

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| **Company** | **Agreed or not** | **Comments** |
| Qualcomm | Agree |  |
| vivo | Agree |  |
| CATT | Agree |  |
| Apple | Agree |  |
| ZTE | See comments | We can propose it as a working assumption at this stage. We may need to firstly discuss another issue that whether and how to specify the priority for UE processing if all the legacy EDT, CB-Msg3-EDT and PUR are configured. After that discussion, we can double check this issue to see whether we need to further specify UE behaviour. |
| Nokia | See comments | We think it is reasonable that MAC notifies the RRC layer when maximum number of the CB-Mg3 transmission failure reached. However, if the UE fallback to legacy 4-step RACH, EDT or PUR, the CB-Msg3 buffer should be kept in MAC and transmitted in the fallback procedure to avoid UL data lost. The latter part is not up to UE implementation and there may have some MAC spec impact (e.g., the Msg3 buffer should not be flushed in 5.1.1 Random Access Procedure initialization). |
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Summary

**Open issue MAC-17:** Whether to allow multiple TBSs as in EDT.

**Issue description:**

In legacy EDT, the small TBS subset is supported to reduce the redundant padding on Msg3, thereby saving some power and time. Some companies have suggested to support the same mechanism for CB-Msg3-EDT.

**Proposed resolution:**

Companies are invited to provide comments to resolve the issue.

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| **Company** | **Comments** |
| Qualcomm | Yes as it is indeed EDT but without msg1 and Msg2. |
| vivo | Input from RAN1 is needed for this. It is safer to not do this in the late stage.  |
| CATT | Yes, we are OK to follow the legacy behavior. |
| Apple | Small TBS subset is a RAN1 heavy design thus we need to consult with RAN1 on it. If RAN1 does not need to do any major work, we think it should be OK. |
| ZTE | We prefer a simple solution in this late stage, e.g., not to support multiple TBS |
| Nokia | Yes, we agree to follow the legacy EDT principle to support small TBS selection for CB-Msg3 to avoid unnecessary padding in the message.We are fine to either * Option1: NW can configure multiple CB-Msg3 TBS for a CE level
* Option2: UE is allowed to select TBS smaller than the configured CB-Msg3 TBS for the corresponding CE level (as legacy parameter *edt-SmallTBS-Enabled*)

Furthermore, RAN2 has agreed to support CB-msg3-EDT for MT cases, and therefore the Paging triggered CB-Msg3 message may only include the RRC message but no user data. In this case, support of a small TBS for CB-Msg3 is necessary.  |
| NEC | Yes as legacy |

Summary

**Open issue MAC-18:** How to model the CB-Msg3 response window (i.e. MSG4 monitoring window) ? Should it be a timer as in legacy RA response window, and what should be the value range.

**Issue description:**

During the MAC running CR discussion, the question of how to model the CB-Msg3 response window was raised. Most companies preferred to model it as a timer. An MAC open issue was identified, but it was not discussed at the RAN2#130. This issue is only about how to capture the agreement, so it should not be a major concern. Since most companies preferred the timer approch, the rapporteur has adopted this assumption in the MAC running CR.

**Proposed resolution:**

The CB-Msg3 response window(i.e., Msg4 monitoring window) is modeled as a timer (e.g., *CB-Msg3ResponseTimer*)

Do companies agree with the proposed resolution?

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| **Company** | **Agreed or not** | **Other comments** |
| Qualcomm | Yes |  |
| vivo | Yes | Either window modeling or timer modeling is okay to us. |
| CATT | Yes |  |
| Apple | Yes |  |
| ZTE | Yes |  |
| Nokia | Agree | Fine to follow legacy, similar as Contention Resolution Timer. |
| NEC | Yes | Either is OK. |

Summary

**Open issue MAC-19**: The CB-Msg4 is decoded after CB-Msg3 response timer expired.

When the *CB-Msg3ResponseTimer* expires, UE will stop monitoring PDCCH. If the PDCCH is successfully decoded before *CB-Msg3ResponseTimer* expires, but the corresponding PDSCH is successfully decoded after the *CB-Msg3ResponseTimer* has expired, the UE behavior has not been discussed and is therefore unknow.

The same scenario for legacy RA is defined in 36.321 as follows:

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| - if *mac-ContentionResolutionTimer* expires:- for BL UEs or UEs in CE or NB-IoT UEs:- if notification of a reception of a PDCCH transmission has been received from lower layers before *mac-ContentionResolutionTimer* expired; and- if the MAC PDU received until the subframe that contains the last repetition of the corresponding PDSCH transmission is successfully decoded; and- if the MAC PDU contains a UE Contention Resolution Identity MAC control element; and- if the UE Contention Resolution Identity included in the MAC control element matches the 48 first bits of the CCCH SDU transmitted in Msg3:- consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;- set the C-RNTI to the value of the Temporary C-RNTI;- discard the Temporary C-RNTI;- consider this Random Access procedure successfully completed. |

It essentially states a PDSCH decoded afte the *mac-ContentionResolutionTimer* has been expired will be treated the same as the one successfully decoded before the timerhas been expired.

**Proposed resolution:**

We follow the legacy approach. If the PDCCH is successfully decoded before *CB-Msg3ResponseTimer* expires, but the corresponding PDSCH is successfully decoded after the timer has expired, the MAC PDU is treated the same as the one successfully decoded before the timerexpires.

Do companies agree with the proposed resolution?

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| **Company** | **Agreed or not** | **Other comments** |
| Qualcomm | Agree | Yes its better to follow legacy approach, if the PDCCH has been received, we should let UE to decode the PDU. |
| vivo | Agree |  |
| CATT | Agree | We are OK to follow the legacy approach. |
| Apple | Agree |  |
| ZTE | Agree |  |
| Nokia | Agree |  |
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Summary

# Other identified open issues

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)** |
| Qualcomm | [1] Do we support backoff indicator without waiting to expire the Msg4 response window. In case network does not have any response to send, it may want UE to execute backoff immediately.[2] We have 2 bits for different MAC PDU formats. Three are used for backoff indicator, success response and data. The remnaing one should be used for UL grant to be used for fallback to contention free transmission(e.g., fall back to EDT or to smaller TBS for only RRC request without UL data) or re-transmission.[3] Can group RNTI and Msg4 enhancements be applicable to normal EDT or 4 step RACH?[4] How does UE prepare DL channel quality measurement result in CB-Msg3 without Msg1/Msg2.- if the UE is an NB-IoT UE and *cqi-Reporting* is configured by upper layers:- the MAC entity shall update the MAC PDU in the Msg3 buffer in accordance with the DL channel quality measurement result. |
| Nokia | Although RAN2 agreed that the CB-Msg3 re-attempt may apply backoff as indicated in CB-Msg4, repeated re-attempts using the CB-Msg3 resource in the same CE level may continue to fail if the CB-Msg3 resource is overloaded. Based on figure2-a from R2-2405202, DSA will worse the system performance if the system load is high. Therfore, we propose discussing whether to support the network-indicated fallback to legacy RACH, EDT, or PUR—such as by introducing a single bit or a new subhead type in CB-Msg4 to indicate NW-initiated fallback.Figure2-a from R2-2405202. |
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# Conclusions

[Proposals for easy agreement]

[Proposals for discussion]