3GPP RAN WG2 Meeting #130 R2-25xxxxx

Malta, Malta May 19th – 23rd, 2023

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:

* [Post129bis][311][R19 IoT NTN] MAC CR (Mediatek)

Scope: discuss the running MAC CR and create list of open issues

Intended outcome: Endorsed CR and list of open issues

Deadline: long **(May 2nd 10:00 UTC**)

Companies are invited to provide feedback on open issue list by: May 2nd 10:00 UTC

# Remaining open issues for specification 36.321

## CB-Msg3

**Open issue MAC-1:**if the maximum TBS is same or different for different CE levels.

**Issue description:**

RAN2 had agreement that the UE triggers CB-Msg3 only if the size of pending UL data is less than the configured maximum TBS. But if the maximum TBS is same or different for different CE levels has not been discussed.

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| RAN2#128 agreement:   * The UE triggers CB-Msg3 only if the size of pending UL data is less than the configured maximum TBS (FFS if the maximum TBS is same or different for different CE levels) |

If the TBS is per CE level, UE may need to cancel CB-Msg3-EDT if the size of pending UL data is more than the TBS when moving to the next CE level.

It has been captured as editor’s note.

**Proposed resolution:**

Since the UL resource is provided per CE level, the maximum TBS should also be considered as per CE level.

**Proposal 1: The maximum TBS could be different for different CE levels.**

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| **Company** | **Agree to proposal?** | **Other comments** |
| Apple | No strong view. | Since mentioned by rapporteur, we think a relevant discussion point is whether UE can fallback from a lower CE level to higher CE level. |
| vivo | Yes | Different CE levels correspond to varying channel conditions. It is a spontaneous logic that the maximum TBS will differ accordingly. |
| OPPO | See comment | We understand the maximum TBS is configured per CE level, whether to configure the same value is up to the NW |
| Huawei, HiSilicon | Agree, but | We don’t see the need to support fallback across the different CE levels which will make the procedure very complex and may lead to larger latency. Falling back to the legacy EDT is sufficient.  Regarding the CE level change after UE begins to perform CB-Msg3-EDT, there is no need to cancel it. The TBS should be only used to decide whether to initiate the procedure and doesn’t need to affect the ongoing procedure. |
| Ericsson | Disagree | To make everything simple, lets have only one TBS (no maximum needed!). The per CE level resource allocation enable better coverage for the lower CE level for example by more repetitions. |
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**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. However, the detail of calculation of CB-RNTI is still FFS.

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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 |

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| Apple | OK. We will bring a contribution. Likely the starting time domain info can be used for RNTI derivation. We can then determine whether to involve all H-SFN, SFN, slot, symbol info (also relevant with resource config). |
| vivo | Agree with the rapporteur. |
| Huawei, HiSilicon | We prefer to reuse the legacy formula, unless there is any issue identified. For DSA, we can specify which occasion to use for RNTI calculation within the transmission window. |
| Ericsson | We will anyway need to discuss sooo much else, this is not a really important part of the feature. Simplest is to just allocate one CB-RNTI for msg3 and msg4 say for example FFF8. |
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**Open issue MAC-3:** how the mapping of PUSCH resources and CE levels are done for NB-IoT.

**Issue description:**

In legacy NB-IoT Random access, the mapping of PRACH resources to enhanced coverage levels are done in increasing *numRepetitionsPerPreambleAttempt* order. For CB-Msg3-EDT, there is also repetition numbers in NPUSCH configuration. Whether the same method should be adopted?

It has been captured as editor’s note.

**Proposed resolution:**

Follow the legacy.

**Proposal 2: For NB-IoT, the mapping of NPUSCH resource to enhanced coverage levels are done in increasing *npusch-NumRepetitionsIndex* order**.

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| **Company** | **Agree to proposal?** | **Other comments** |
| Apple | See comments | I may not get the proposal well. Is this about introducing an index, which refers to TS36.213? Why not directly introduce the repetition number in TS36.331?  Perhaps the question should be using *numRepetitionsPerPreambleAttempt?* |
| vivo | Yes | The npusch-NumRepetitionsIndex is specifically designed for NPUSCH. It makes perfect sense to reuse this parameter for CB-Msg3 EDT. |
| OPPO | Yes, but | Should it be a RRC issue? |
| Huawei, HiSilicon | Yes | To avoid overlapping, this is not listed in RRC open issue list. |
| Ericsson |  | Agreements in Hefei:   * CB-msg3 EDT cell specific PUSCH resources for Msg3 transmission are provided per CE level (FFS whether we have a CE level specific configuration for DSA) * RAN2 assumes that CB-msg3 EDT cell specific PUSCH resources are associated with number of repetitions, RSRP selection threshold to determine the CE level and largest TBS for Msg3 transmission, but this has to be confirmed by RAN1. FFS if there is an RSRP threshold that determines whether CB-msg3 EDT cannot be used (the UE will have to use 4-step RA)   Thus repetition is supposed to be configured per CE level, no need to deviate from configured levels??? |
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**Open issue MAC-4:** which IE in SIB22-NB contains the CB-Msg3-EDT configuration.

**Issue description:**

RAN2 has agreed to introduce new IE for shared resource configuration of CB-Msg3 in SIB22-NB for non-anchor carrier. But which IE in SIB22-NB contains that information? It needs to be specified in CB-Msg3-EDT initialization.

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| RAN2#129bis agreement:   * For NB-IoT, introduce a new IE (e.g. CB-Msg3-ConfigSIB-NB-r19) for shared resources configuration of CB-Msg3 in SIB2-NB and SIB22-NB for non-anchor carrier. |

The legacy random access resources for non-anchor carrier are in the ul-configList of SIB22-NB.

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| SystemInformationBlockType22-NB-r14 ::= SEQUENCE {  dl-ConfigList-r14 DL-ConfigCommonList-NB-r14 OPTIONAL, -- Need OR  ul-ConfigList-r14 UL-ConfigCommonList-NB-r14 OPTIONAL, -- Need OR  pagingWeightAnchor-r14 PagingWeight-NB-r14 OPTIONAL, -- Cond pcch-config  nprach-ProbabilityAnchorList-r14 NPRACH-ProbabilityAnchorList-NB-r14 OPTIONAL, -- Cond nprach-config  lateNonCriticalExtension OCTET STRING OPTIONAL,  ...,  [[ mixedOperationModeConfig-r15 SEQUENCE {  dl-ConfigListMixed-r15 DL-ConfigCommonList-NB-r14 OPTIONAL, -- Cond dl-ConfigList  ul-ConfigListMixed-r15 UL-ConfigCommonList-NB-r14 OPTIONAL, -- Cond ul-ConfigList  pagingDistribution-r15 ENUMERATED {true} OPTIONAL, -- Need OR  nprach-Distribution-r15 ENUMERATED {true} OPTIONAL -- Need OR  } OPTIONAL, -- Need OR  ul-ConfigList-r15 UL-ConfigCommonListTDD-NB-r15 OPTIONAL -- Cond TDD  ]],  [[ coverageBasedPagingConfig-r17 CoverageBasedPagingConfig-NB-r17 OPTIONAL -- Need OR  ]]  }  UL-ConfigCommonList-NB-r14 ::= SEQUENCE (SIZE (1.. maxNonAnchorCarriers-NB-r14)) OF  UL-ConfigCommon-NB-r14  UL-ConfigCommon-NB-r14 ::= SEQUENCE {  ul-CarrierFreq-r14 CarrierFreq-NB-r13,  nprach-ParametersList-r14 NPRACH-ParametersList-NB-r14 OPTIONAL, -- Need OR  ...,  [[ nprach-ParametersListEDT-r15 NPRACH-ParametersList-NB-r14 OPTIONAL -- Cond EDT  ]],  [[ rsrp-ThresholdsPrachInfoList-r16 RSRP-ThresholdsNPRACH-InfoList-NB-r13 OPTIONAL -- Need OR  ]]  } |

It has been captured as editor’s note.

**Proposed resolution:**

Follow the legacy.

**Proposal 3: For NB-IoT, the configurations of CB-Msg3-EDT for non-anchor carriers are in the *ul-ConfigList* of SIB22-NB.**

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| **Company** | **Agree to proposal?** | **Other comments** |
| Apple | Agree |  |
| vivo | Agree | Agree with the rapporteur. |
| OPPO | Agree, but | We noticed it is already in the MAC running CR, which is bit odd |
| Huawei, HiSilicon | Agree | Will update RRC CR later if there is no different view. |
| Ericsson | Agree |  |
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**Open issue MAC-5:** when multiple carriers provide PUSCH resources for the same enhanced coverage level, how the NB-IoT UE select the carriers.

**Issue description:**

There will be a list of PUSCH resources per CE level in SIB22-NB for each non-anchor carrier. How the NB-IoT UE select the carriers to perform CB-Msg3-EDT? In legacy, for random access, NB-IoT UE selects carriers based on the probabilities of each carrier.

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| 36.321 5.1.1  - when multiple carriers provide PRACH resources for the same enhanced coverage level, the UE will randomly select one of them using the following selection probabilities:  - the selection probability of the anchor carrier PRACH resource for the given enhanced coverage level, *nprach-ProbabilityAnchor*, is given by the corresponding entry in *nprach-ProbabilityAnchorList*  - the selection probability is equal for all non-anchor carrier PRACH resources and the probability of selecting one PRACH resource on a given non-anchor carrier is (1- *nprach-ProbabilityAnchor*)/(number of non-anchor NPRACH resources) |

It has been captured as editor’s note.

**Proposed resolution:**

Follow the legacy.

**Proposal 4: When CB-Msg3 is initiated, the NB-IoT UE selects the carrier based on the probabilities of each carrier. A new probability parameter for anchor carrier is introduced in SIB22-NB. The remaining probability is evenly split among the non-anchor carriers.**

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| **Company** | **Agree to proposal?** | **Other comments** |
| Apple | Agree |  |
| vivo | Agree | Agree with the rapporteur. The proposed solution is effective in contention control. |
| OPPO | agree |  |
| Huawei, HiSilicon | Maybe not | A simpler way is to leave it to UE implementation. Any strong motivation for this? |
| Ericsson | Disagree | To make it simple, just add the carrier number in the resource allocation per CE level. No need to allocate more than one full carrier, and if the need comes, we can add that later. |
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**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. |

It has been captured as editor’s note.

**Proposed resolution:**

RAN2 wait for RAN1 progress.

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| **Company** | **Other comments** |
| Apple | OK with waiting for RAN1 progress. |
| vivo | Agree with the rapporteur. |
| OPPO | Ok to wait for RAN1 |
| Huawei, HiSilicon | For all that require RAN1 confirmation, we need to wait. |
| Ericsson | OK |
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**Open issue MAC-7:** whether the HARQ operation is applicable to transmit CB-Msg3.

**Issue description:**

In legacy Random Access, the HARQ operation is appliable to transmit the Msg3. The HARQ process 0 will be used. The HARQ process will obtain the MAC PDU to transmit from Msg3 buffer when the UL grant is available. A retransmission of Msg3 can be triggered by a NACK.

How and whether the HARQ operation is applicable to transmit CB-Msg3 has not been discussed.

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| vivo | Agree with the rapporteur. The RV for CB-Msg3 EDT should be discussed as well. |
| Ericsson | There is no “NACK” for msg3, thus obviously we cannot add “retransmission of msg3” as there may be many many UEs that send in a msg3 window, and all will then retransmit causing new collisions. |
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**Open issue MAC-8:** whether to revise the agreement that, due to only CE mode A is supported for eMTC NTN, only 1 separate RSRP thresholds and 2 CE levels can be supported.

**Issue description:**

In RAN2#129, it has been agreed that for eMTC NTN, up to three separate RSRP thresholds can be supported for achieving at most 4 CE levels.

Later in RAN2#129bis, we agree to only support CE mode A for eMTC.

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| RAN2#129 agreement:   * For CB-msg3 transmission, for eMTC NTN, up to three separate RSRP thresholds (on top of the minimum RSRP threshold and possibly different from the thresholds for PRACH) can be supported for achieving at most 4 CE levels   RAN2#129bis agreement:   * We don’t introduce support for eMTC CE mode B case (it will not be possible to signal resources to be used for this case) |

However, according to 36.306, a CE mode A UE only support CE level 0 and CE level 1. Therefore, we may need to revise previous agreement of number of CE levels and number of RSRP threshold.

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| **36.306 i40**  4.3.29 CE parameters  4.3.29.1 *ce-ModeA-r13*  This field defines whether the UE supports operation in coverage enhancement mode A, as specified in TS 36.211 [17], TS 36.213 [22] and TS 36.331 [5], and PRACH CE levels 0 and 1 at Random Access, as specified in TS 36.321 [4]. It is mandatory for UEs of DL category M1, UL category M1, DL category M2 and UL category M2  4.3.29.2 *ce-ModeB-r13*  This field defines whether the UE supports operation in coverage enhancement mode B, as specified in TS 36.211 [17], TS 36.213 [22] and TS 36.331 [5], and PRACH CE levels 2 and 3 at Random Access, as specified in TS 36.321 [4]. A UE indicating support of *ce-ModeB-r13* shall also indicate support of *ce-ModeA-r13*. |

It has been captured as editor’s note.

**Proposed resolution:**

**Proposal 5: Revise the agreement that, due to only CE mode A is supported for eMTC NTN, only 1 separate RSRP thresholds and 2 CE levels can be supported.**

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| **Company** | **Agree to proposal?** | **Other comments** |
| Apple | Agree | We are OK to only support 2 CE levels. |
| vivo | Agree | Agree with the rapporteur. |
| OPPO | Agree |  |
| Huawei, HiSilicon | Agree |  |
| Ericsson | Agree |  |
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## CB-Msg3 Response window

**Open issue MAC-9:** NW/UE processing time is needed or not.

**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.

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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) |

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| vivo | Agree with the rapporteur. |
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**Open issue MAC-10:** FFS it will also be possible for the NW to configure that the Msg4 monitoring window starts in the subframe containing the last (N)PUSCH repetition of the first replica plus UE-eNB RTT.

**Issue description:**

In RAN2#129, it was discussed that whether it will also be possible for the NW to configure that the Msg4 monitoring window starts in the subframe containing the last (N)PUSCH repetition of the first replica plus UE-eNB RTT. Under some configuration of CB-Msg3 resource, this option can reduce the latency of reception of CB-Msg3 response.

Also, to possibly resolve the FFS it needs to be clarified what happens if the Msg4 monitoring window is overlapping with replica, i.e. whether the UE prioritize the replica transmission or monitoring.

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| RAN2#129bis agreement:   * FFS it will also be possible for the NW to configure that the Msg4 monitoring window starts in the subframe containing the last (N)PUSCH repetition of the first replica plus UE-eNB RTT (FFS NW/UE processing time). To possibly resolve the FFS it needs to be clarified what happens if the Msg4 monitoring window is overlapping with replica, i.e. whether the UE prioritize the replica transmission or monitoring |

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| vivo | Agree with the rapporteur. |
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## CB-Msg3 Response

**Open issue MAC-11:** Whether L2 ACK is supported.

**Issue description:**

In RAN2#129, it was discussed that whether a CB-Msg4 without RRC message is allowed as the complete response to the CB-Msg3 in CP solution. This discussion was postponed to the next meeting.

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| Apple | We think Contention Resolution ID can be used to terminate the procedure. |
| vivo | Agree with the rapporteur. But we hold a view that the CB-Msg3 EDT should follow the EDT procedure that no L2 ACK is introduced for simplicity. |
| OPPO | Yes it can be used, but only contention resolution ID is not sufficient |
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**Open issue MAC-12:** FFS how the multiplexing is organized.

**Issue description:**

In RAN2#129bis, we confirmed the working assumption that one CB-Msg4 can target multiple UEs simultaneously. And how the multiplexing is organized is FFS.

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| RAN2#129bis agreement:   * RAN2 confirms the working assumption that one CB-Msg4 can target multiple UEs simultaneously. FFS how the multiplexing is organized. |

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| Apple | Prefer rapporteur to provide a structure first. |
| vivo | Agree with the rapporteur. New MAC PDU format should be considered. |
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**Open issue MAC-13:** FFS the Msg4 structure including Contention Resolution Identities, C-RNTIs, Backoff parameters, TA information in the CB-Msg4.

**Issue description:**

We had agreement to include the Contention Resolution Identities, C-RNTIs, Backoff parameters, TA information in the CB-Msg4. How this information is included in the Msg4 (e.g., the format) and the structure of Msg4 is unknown.

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| RAN2#128 agreement:   * Assuming that there will be scenarios where it’s possible to receive a CB-msg4 before the UE transmits some replicas, a UE stops transmitting the remaining replicas if it has received a CB-msg4 containing a matching Contention Resolution Identity (FFS if there is no RRC message together with the CB-msg4)   RAN2#129bis agreement:   * The C-RNTI is included in CB-Msg4 if the UE is expected to receive additional RRC messages or data from the network after CB-Msg4 (FFS how to include the C-RNTI) * The timing alignment information (FFS reusing TAC MAC-CE) can be included in the CB-Msg4 * Backoff information could be included in CB-Msg4. |

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| Apple | Prefer MAC CR rapporteur to provide a structure first. |
| vivo | Agree with the rapporteur. |
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**Open issue MAC-14:** FFS for the detail of HARQ operation on Msg4.

**Issue description:**

We had agreement that HARQ feedback is adopted to acknowledge Msg4. Since one CB-Msg4 can target multiple UEs simultaneously, there could be multiple HARQ feedbacks for one CB-Msg4. How the PUSCH resources are provided to support multiple HARQ feedbacks is unknown. Whether the ACK or NACK should be used also needs further discussion.

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| RAN2#129bis agreement:   * HARQ feedback is adopted to acknowledge Msg4. FFS for the detail (e.g., how the HARQ feedback is used for each response in Msg4 when there is multiplexing in Msg4.). |

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| Apple | Prefer rapporteur to provide a structure first. |
| vivo | Agree with the rapporteur. |
| Ericsson | Simplest is to reuse the HARQ allocation in a regular DCI scheduling. |
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## Error handling

**Open issue MAC-15:** Whether the UE can initiate the legacy 4-step RA when the CB-Msg3 procedure fails.

**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 postponed to the next meeting.

It has been captured as editor’s note.

**Proposed resolution:**

Companies are invited to provide contributions to the following meeting to resolve the issue.

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| **Company** | **Other comments** |
| Apple | Will bring a contribution. |
| vivo | Agree with the rapporteur. Switching from CB-Msg3 EDT to 4-step RACH should be supported. |
| Ericsson | In MAC, we do not say which higher layers is informed, instead “indicate to upper layers” is sufficient. |
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**Open issue MAC-16:** whether UE will be in the next CE level when max re-attempt number has been reached.

**Issue description:**

In RAN2#129bis, it has been agreed that UE can re-attempt in the same CE level due to contention resolution failure until the max re-attempt number has been reached. However, whether UE will be in the next CE level when max re-attempt number has been reached is not clear.

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| RAN2#129bis agreement:   * Parameter for maximum re-attempt number per CE level is introduced and UE can re-attempt in the same CE level due to contention resolution failure until the max re-attempt number has been reached. |

Note that in legacy RACH, the UE will move to next CE level if maximum number of attempt is reached.

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| 36.321 5.1.4  - if the UE is an NB-IoT UE, a BL UE or a UE in enhanced coverage:  - increment PREAMBLE\_TRANSMISSION\_COUNTER\_CE by 1;  - if PREAMBLE\_TRANSMISSION\_COUNTER\_CE = *maxNumPreambleAttemptCE* for the corresponding enhanced coverage level+ 1:  - reset PREAMBLE\_TRANSMISSION\_COUNTER\_CE;  - consider to be in the next enhanced coverage level, if it is supported by the Serving Cell and the UE, otherwise stay in the current enhanced coverage level; |

It has been captured as editor’s note.

**Proposed resolution:**

Follow the legacy.

**Proposal 6: UE will be in the next CE level when max** **re-attempt number for current CE level has been reached.**

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| **Company** | **Agree to proposal?** | **Other comments** |
| Apple | Yes | We support this proposal. |
| vivo | Yes | Agree with the rapporteur. |
| OPPO | Yes |  |
| Huawei, HiSilicon | No | Same as comment to **Proposal 1:**  We don’t see the need to support fallback across the different CE levels which will make the procedure very complex and may lead to larger latency. Falling back to the legacy EDT is sufficient. |
| Ericsson | Agree |  |
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# 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)** |
| vivo | 1. Whether DSA pointer is supported in Rel-19? 2. Whether BI can be supported? |
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# Conclusions

*<To be filled after companies have provided feedback to the proposed resolutions for simple issues only. Please include the number of supporting companies (e.g., 18/20]) in brackets within the proposal>*

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

[Proposals for easy agreement]

*<List all proposals with consensus and/or may be easily agreed based on Rapporteur’s opinion>*

[Proposals for discussion]

*<List all proposals which will likely require further online/offline discussion to resolve>*