3GPP TSG-RAN WG2 Meeting #131  R2-2506292

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

**Agenda item: 8.9.3**

**Source: MediaTek Inc.**

**Title:** **Report of [AT131][302][R19 IoT NTN] UL enhancements – phase 2**

**Document for: Discussion and Decision**

# Introduction

This is the phase 2 report of below offline:

* [AT131][302][R19 IoT NTN] UL enhancements (Mediatek) – phase 2

[R2-2505555](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2505555.zip) Remaining MAC open issues in IoT NTN MediaTek Inc. discussion Rel-19 IoT\_NTN\_Ph3-Core R2-2504526

[R2-2505026](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2505026.zip) Reply LS on CB Msg3 EDT for IoT NTN Ph3 (R1-2504959; contact: MediaTek) RAN1 LS in Rel-19 IoT\_NTN\_Ph3 To:RAN2

# Discussion

## CB-MSG3 Configuration

* Further details on resource configuration

[R2-2505082](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2505082.zip) Remaining Issues on CB-Msg3 EDT Mechanism vivo discussion Rel-19 IoT\_NTN\_Ph3-Core

Proposal 1: RAN2 confirms that both multi-PRB allocation and sub-PRB allocation are supported for CB-Msg3.

Proposal 2: RAN2 confirms that both single-tone and multi-tone are supported for CB-Msg3, and intends to reuse the parameter npusch-MCS-r16 for CB-Msg3.

Proposal 3: RAN2 confirms only one narrowband is configured for MPDCCH monitoring, as the running CR implementation.

Proposal 4: RAN2 sends an LS to RAN1 to inform them of Proposal 1 and Proposal 2.

Proposal 9 (RRC-1.4): CB-Msg3 transmission window length and periodicity are configured in multiples of the CB-Msg3 PUSCH periodicity (e.g., value ranging from 1..32).

[R2-2505632](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2505632.zip) Remaining issues on UL capacity enhancement for IoT NTN Nokia, Nokia Shanghai Bell discussion Rel-19 IoT\_NTN\_Ph3-Core

Proposal 14: To support capacity enhancement in line with the objective of the WI, the MPDCCH narrowband configuration for CB-Msg4 monitoring shall be defined as a set, following the legacy RACH procedure.

[R2-2505258](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2505258.zip) Remaining issues for CB-msg3-EDT ZTE Corporation, Sanechips discussion Rel-19 IoT\_NTN\_Ph3-Core

Proposal 3: It’s suggested to use value 3 as the number of frequency-domain resources set for both eMTC and NB-IoT.

Proposal 4a: It’s suggested to define the length of CB-msg3 transmission window in units of (N)PUSCH resources periodicity.

Proposal 4b: It’s suggested to introduce a multiplication factor for parameter of replicas, e.g., K as the configurable parameter for the length of CB-msg3 transmission window. The final value of the length of CB-msg3 transmission window is the result of [(the number of replicas) multiplied by the factor of K], that is:

Length of CB-msg3 transmission window = [(the number of replicas) \* K] \* (N)PUSCH resources periodicity

Proposal 4c: The number of K can be configured by the NW with the maximum value of 4.

Proposal 4d: It’s suggested to also define the periodicity of CB-msg3 transmission window as a value in units of (N)PUSCH resources periodicity.

[R2-2506184](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2506184.zip) UL capacity enhancements for IoT NTN Ericsson discussion Rel-19 IoT\_NTN\_Ph3-Core

Proposal 5 The periodicity of (N)PUSCH resources for CB-Msg3 is not larger than H-SFN duration.

**Rapporteur suggestion**

To agree

Proposal 1: RAN2 confirms that both multi-PRB allocation and sub-PRB allocation are supported for CB-Msg3.

Proposal 2: RAN2 confirms that both single-tone and multi-tone are supported for CB-Msg3, and intends to reuse the parameter npusch-MCS-r16 for CB-Msg3.

Proposal 3: RAN2 sends an LS to RAN1 to inform them of Proposal 1 and Proposal 2.

To agree

Proposal 4: CB-Msg3 transmission window length and periodicity are configured in multiples of the CB-Msg3 PUSCH periodicity (e.g., value ranging from 1..32).

To agree

Proposal 5: The periodicity of (N)PUSCH resources for CB-Msg3 is not larger than H-SFN duration.

To discuss

REF 1 – From RRC Running CR

CB-MSG3-MPDCCH-Config-r19 ::= SEQUENCE {

 mpdcch-Narrowband-r19 INTEGER (1..maxAvailNarrowBands-r13),

 mpdcch-PRB-PairsConfig-r19 SEQUENCE{

 numberPRB-Pairs-r19 ENUMERATED {n2, n4, n6, spare1},

 resourceBlockAssignment-r19 BIT STRING (SIZE(4))

 },

 mpdcch-NumRepetition-r19 ENUMERATED {r1, r2, r4, r8, r16, r32, r64, r128, r256},

 mpdcch-StartSF-CSS-r19 ENUMERATED {v1, v1dot5, v2, v2dot5, v4, v5, v8, v10},

 mpdcch-Offset-CSS-r19 ENUMERATED {zero, oneEighth, oneQuarter,

 threeEighth, oneHalf, fiveEighth,

 threeQuarter, sevenEighth}

}

CB-Msg3-PUSCH-Config-r19 ::= SEQUENCE {

 numRUs-r19 BIT STRING (SIZE(2)),

 prb-AllocationInfoSet-r19 SEQUENCE (SIZE(1..48)) OF BIT STRING (SIZE(10)),

 mcs-r19 BIT STRING (SIZE(4)),

 numRepetitions-r19 BIT STRING (SIZE(3)),

 p0-UE-PUSCH-r19 INTEGER (-8..7),

 alpha-r19 Alpha-r12

}

CB-Msg3-Config-NB-r19 ::= SEQUENCE {

 cb-Msg3-TBS-NB-r19 ENUMERATED {b328, b408, b504, b584, b680, b808, b936,

 b1000},

 cb-Msg3-NumOfReplicas-NB-r19 INTEGER (1..4),

 cb-Msg3-TimeResource-NB-r19 SEQUENCE {

 npusch-Periodicity-r19 ENUMERATED {ms40, ms80, ms160, ms240,

 ms320, ms640, ms1280, ms2560},

 npusch-StartSFN-r19 INTEGER (0..1023),

 npusch-StartSubframe-r19 INTEGER (0..9)

 },

 cb-Msg3-PhysicalConfig-r19 ::= SEQUENCE {

 npusch-NumRUsIndex-r19 INTEGER (0..7),

 npusch-NumRepetitionsIndex-r19 INTEGER (0..7),

 npusch-SubCarrierSetList-r19 SEQUENCE (SIZE(1..48)) OF NPUSCH-SubCarrierSet-r19,

 npusch-MCS-r19 CHOICE {

 singleTone INTEGER (0..10),

 multiTone INTEGER (0..13)

 },

 ack-NumRepetitions-NB-r19 ACK-NACK-NumRepetitions-NB-r13 OPTIONAL, --Need OP

 p0-UE-NPUSCH-r19 INTEGER (-8..7),

 alpha-NB-r19 ENUMERATED {al0, al04, al05, al06,

 al07, al08, al09, al1},

 npdcch-CarrierIndex-r19 INTEGER (1..maxNonAnchorCarriers-NB-r14)

 OPTIONAL, -- Need OP

 npdcch-NumRepetitions-r19 ENUMERATED {r1, r2, r4, r8, r16, r32, r64, r128,

 r256, r512, r1024, r2048,

 spare4, spare3, spare2, spare1},

 npdcch-StartSF-CSS-r19 ENUMERATED {v1dot5, v2, v4, v8, v16, v32, v48, v64},

 npdcch-Offset-CSS-r19 ENUMERATED {zero, oneEighth, oneFourth, threeEighth}

 },

 cb-Msg3-TxWindow-NB-r19 SEQUENCE {

 windowSize-NB-r19 ENUMERATED {4, 8, 12, 16, 24, 32, 48, 64},

 windowPeriodicity-NB-r19 ENUMERATED {4, 8, 12, 16, 24, 32, 48, 64}

 } OPTIONAL, --Need OP

 cb-Msg3-ResponseWindow-NB-r19 ENUMERATED {pp1, pp2, pp3, pp4, pp8, pp16, pp32,

 pp64},

 cb-Msg3-MaxAttemptNum-NB-r19 ENUMERATED {n2, n3, n4, n5, n6, n7, n8, n10} OPTIONAL, --Need OP

 ...

}

REF 2 – From R1 reply LS

“There is no consensus in RAN1 on the need to define the set of narrowbands as a set”

Discussion Note

“

*The network will respond to all the UEs with CB-Msg4 on a single MPDCCH narrowband. This is consistent with legacy EDT and PUR mechanisms. To avoid impacts to RAN1, RAN2 should confirm that there is only one narrowband configured for UE MPDCCH monitorin*g.

*“*

Proposal 5: RAN2 confirms only one narrowband is configured for MPDCCH monitoring, as the running CR implementation.

*“*

*the MPDCCH monitoring for CB-Msg4 is more like the Msg2/Msg4 monitoring in the legacy RACH procedure than to that in PUR. In the PUR case, network allocates dedicated resources to individual UEs, making it sufficient for a UE to be assigned with only one MPDCCH narrowband at one configuration. In contrast, for CB-Msg3, the SIB-indicated resources are shared among multiple UEs, enabling simultaneous system access by many UEs—similar to the legacy RACH procedure.*

*“*

Proposal 5: To support capacity enhancement in line with the objective of the WI, the MPDCCH narrowband configuration for CB-Msg4 monitoring shall be defined as a set, following the legacy RACH procedure.

Proposal 5a: It’s suggested to use value **3** as the number of frequency-domain resources set for both eMTC and NB-IoT.

Summary

**Proposal 1:**

## CQI Report

* whether to support CQI reporting in anchor carrier and/or non-anchor in CB-Msg3-EDT procedure. If yes, RAN2 to discuss how does the UE prepare DL channel quality measurement result in CB-Msg3 without Msg1/Msg2.

[R2-2505917](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2505917%20On%20open%20issues%20for%20CB-Msg3-EDT.docx) On open issues for CB-Msg3-EDT Samsung discussion Rel-19 IoT\_NTN\_Ph3-Core

Proposal 5: RAN2 to confirm CQI reporting (in RRCEarlyData and DCQR and AS RAI MAC CE) in CB-Msg3 for CB-Msg3-EDT (for CP/UP eMTC and NB-IoT) is supported for anchor carrier.

- MTK thinks this CQI reporting is not very useful in this procedure and we can avoid supporting this. Nokia agrees

- QC thinks this could be supported at least for anchor carrier

- Xiaomi wonders if also for the anchor carrier we need to check with RAN1

- vivo thinks we need to also ask RAN4

- HW is reluctant to introduce this if it impacts other WGs

- Samsung thinks that in any case we need to spec changes to say that CQI reporting is not include in this case

* We clarify that CQI reporting is not included in CB-Msg3 for CB-Msg3-EDT for non-anchor carrier
* CB Friday to decide on the anchor carrier case

**Rapporteur suggestion**

It is suggested to check with your R4 colleagues and comeback tomorrow.

Below are the corresponding RAN4 SPEC

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 36.133 6.6.2.6 MSG3-based channel quality report for UE Category NB1The requirements in this clause shall apply for UE supporting DL channel quality reporting for UE Category NB1 as defined in TS 36.331 [2] section 5.3.3.3, 5.3.3.3a, and 5.3.7.4. The DL channel quality provides the serving eNB with information about the minimum NPDCCH repetition level to satisfy the hypothetical NPDCCH block error rate of 1% with the parameters specified in Table 6.6.2.6-1.Table 6.6.2.6-1: NPDCCH transmission parameters for downlink quality reporting.

|  |  |
| --- | --- |
| Parameters | Values |
| DCI format | Format N1 |
| Number of information bits (excluding CRC) | 23bits |
| System bandwidth | 200kHz |
| Aggregation level | 2 |
| DRX | OFF |

For channel quality reporting in the anchor carrier, the reported NPDCCH repetition level shall be derived from the channel quality measured in the period T1 or T2 in the carrier where the random access response is transmitted, where- T1 is the period before NPRACH transmission used for NRSRP measurement for enhanced coverage level estimation- T2 is the period from the beginning of the random access response to the beginning of PUSCH format 1 for DL channel quality reporting.For channel quality reporting in the non-anchor carrier, the reported NPDCCH repetition level shall be derived from the channel quality measured in the period T2 in the carrier where UE monitors Random Access Response where T2 is defined above.The NPDCCH repetition level for CQI-NPDCCH-NB and CQI-NPDCCH-Short-NB is chosen from the supported NPDCCH repetition levels [3]. The report mapping is defined in 9.1.22.15.The UE shall satisfy the downlink channel quality measurement accuracy requirements as specified in 9.1.22.16. |

According to 36.133 section 6.6.2.6, the channel quality reporting in the anchor carrier can be derived either in the period before NPRACH transmission(T1) or during the RAR period (T2). For the non-anchor carrier, it can only be derived during the RAR period (T2).

If RAN4 feedback is okay, we can consider below proposal from R2-2505555 (MAC open issue discussion paper)

Proposal 10: CQI reporting in anchor carrier is supported in CB-Msg3-EDT, but CQI reporting in non-anchor is not.

Proposal 11: Send a LS to RAN4 to request support for CQI reporting in anchor carrier in CB-Msg3-EDT.

Summary

## CB-Msg3-EDT Completion

* On CB-Msg3-EDT completion

[R2-2505369](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2505396.zip) Leftover issues on CB-Msg3-EDT Google discussion Rel-19 IoT\_NTN\_Ph3-Core

Proposal 1 Upon receiving a matching Contention Resolution Identity and a C-RNTI in a CB-Msg4, the UE does not consider the CB-Msg3-EDT procedure has ended and continues monitoring PDCCH for receiving an RRC message responding to the RRCEarlyDataRequest.

- Ericsson thinks this is how it is currently described in the running CR

* Upon receiving a matching Contention Resolution Identity and a C-RNTI in a CB-Msg4 without an RRC message, the UE considers UL transmission as successful but the UE does not consider the CB-Msg3-EDT procedure has ended and continues monitoring PDCCH.

Proposal 2 Upon receiving a CB-Msg4 including a matching Contention Resolution Identity without including an RRC message or a C-RNTI, the UE terminates the CB-Msg3-EDT procedure and keeps in RRC\_IDLE.

* Upon receiving a CB-Msg4 including a matching Contention Resolution Identity without including both an RRC message and a C-RNTI, the UE behaves as if it received an empty EarlyDataComplete message, terminates the CB-Msg3-EDT procedure and keeps in RRC\_IDLE.

Proposal 3 The UE indicates to the network, whether it is able to terminate a CB-Msg3-EDT procedure upon receiving a CB-Msg4 containing no RRC message, as one of its capabilities.

Proposal 4 The UE can indicate in CB-Msg3, whether DL data following the UL data in CB-Msg3 is expected or not.

- ZTE wonders if this is needed

- IDC highlights that we specified the same behavior in PUR

- QC thinks there are NAS mechanisms for this

* Based on NW indication, it shall be possible for the UE to indicate during CB-Msg3-EDT procedure whether DL data following the UL data in CB-Msg3 is expected or not. FFS whether existing fields can be reused or new ones introduced
* CB Friday

**Rapporteur suggestion**

It is suggested to check whether and how we can use below MAC CE for the RAI purpose in CB-MSG3-EDT procedure and comeback tomorrow.

----- From 36.321 -------

#### 6.1.3.19 Downlink Channel Quality Report and AS RAI MAC Control Element

DCQR and AS RAI MAC control element is identified by a MAC PDU subheader with LCID as specified in Table 6.2.1-2. A MAC PDU shall contain at most one DCQR and AS RAI MAC control element.

It has a fixed size and consists of a single octet defined as follows (Figure 6.1.3.19-1):

- R: Reserved bit, set to "0";

- AS RAI: The field corresponds to Access Stratum Release Assistance Indication as shown in Table 6.1.3.19-1. The length of the field is 2 bits;

- Quality Report: For a NB-IoT UE, if *npdsch-16QAM-Config* is not configured, the report mapping is defined in Table 9.1.22.15-1 in TS 36.133 [9] and if *npdsch-16QAM-Config* is configured the report mapping is defined in Table 9.1.22.17-1 in TS 36.133 [9]. For a BL UE or UE in CE, the field corresponds to DL channel quality report as defined in TS 36.133 [9]. The length of the field is 4 bits.



Figure 6.1.3.19-1: DCQR and AS RAI MAC control element

Table 6.1.3.19-1: Values for AS RAI

|  |  |
| --- | --- |
| Codepoint/Index | Value |
| 00 | No RAI information |
| 01 | No subsequent DL and UL data transmission is expected |
| 10 | A single subsequent DL transmission is expected |
| 11 | Reserved |

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Summary

## Others

* Some other proposals

[R2-2505917](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2505917.zip) On open issues for CB-Msg3-EDT Samsung discussion Rel-19 IoT\_NTN\_Ph3-Core

Proposal 2: RAN2 to discuss options on TA report for CB-Msg3 EDT.

1. TA report is not included for CB-Msg3-EDT – RAN2 clarifies the RRC procedures.

2. TA report is included in the CB-Msg3-EDT according to the RRC procedures – RAN2 clarifies the ta-Report field description

3. New configuration to configure TA report for CB-Msg3-EDT

[R2-2506184](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5C2508_R2_131%5CDocs%5CR2-2506184.zip) UL capacity enhancements for IoT NTN Ericsson discussion Rel-19 IoT\_NTN\_Ph3-Core

Proposal 2 The UE shall use the cell specific Koffset for the CB-Msg3-EDT procedure, regardless of if it has a UE specific Koffset or not.

Proposal 3 The MAC entity shall discard any Differential Koffset at the start of a CB-Msg3-EDT procedure.

**Rapporteur suggestion**

To Agree

“

*The CB-Msg3-EDT functionality is supposed to work for UEs in IDLE or IDLE/suspended mode and eNB cannot know what UE that is accessing, therefore all UEs must use the cell specific Koffset for Msg3 transmission on contention based resources. However, if the UE has a UE specific Koffset it would be possible to use a UE specific Koffset after Msg3 – but that would be an unnecessary complication.*

”

Proposal 6: The UE shall use the cell specific Koffset for the CB-Msg3-EDT procedure, regardless of if it has a UE specific Koffset or not.

To Discuss

REF – From R2-2505917

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In the RRC e-mail discussion, one issue on reporting the TA report (TAR MAC CE) was discussed.

The field description indicates the following:

|  |
| --- |
| ***ta-Report***When this field is included in *SystemInformationBlockType2*, it indicates reporting of timing advance is enabled during Random Access due to RRC connection establishment, RRC connection resume or RRC connection reestablishment. When this field is included in *MobilityControlInfo*, it indicates TA reporting is enabled during Random Access due to handover, see TS 36.321 [6], clause 5.4.9. |

However, according to the RRC procedures, the TA report is always included as long as *ta-Report* is configured, as seen in 36.331. Important to note that 5.3.3.2, which triggers the TA report, is initiated for all RRC establishment, RRC resume, EDT etc.

----------------- 36.331 V18.6.0 -----------------

*5.3.3.2 Initiation*

*1> if UE supports timing advance reporting and ta-Report is included in SystemInformationBlockType2:*

*2> instruct the associated MAC entity to trigger Timing Advance reporting;*

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Proposal 7: RAN2 to discuss options on TA report for CB-Msg3 EDT.

* Option 1 - TA report is not included for CB-Msg3-EDT – RAN2 clarifies the RRC procedures.
* Option 2 - TA report is included in the CB-Msg3-EDT according to the RRC procedures – RAN2 clarifies the ta-Report field description
* Option 3 - New configuration to configure TA report for CB-Msg3-EDT

Summary

**Proposal x:**

# Conclusion

# References

[1]