**3GPP TSG-RAN WG2 Meeting #125R2-2401567**

**Athens, Greece, 26 February – 01 March 2024**

**Agenda Item: 7.6.4**

**Source: MediaTek Inc.**

**Title: Discussion on the remaining issues of IoT NTN MAC CR**

**Document for: Discussion and Decision**

# Introduction

This document aims to collect companies’ views for the following offline discussion to complete the MAC correction CR on IoT NTN.

* [Post125][307][NR-NTN Enh] 36.321 CR (Mediatek)

 Scope: draft a MAC CR with meeting agreements

 Intended outcome: Agreed CR

 Deadline for agreed CR (in R2-2401596): short

# 2. Contact information

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| Company | Delegate contact |
| COMPANY\_NAME | NAME (email@address.com) |
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# Discussion

## 3.1 Alt1 or Alt1-a

RAN1 has provided options on when timeAlignmentTimer is not infinity how the UL transmission extension is updated and ask RAN2 to select.

[R2-2401925](file:///C%3A%5C%5CData%5C%5C3GPP%5C%5CRAN2%5C%5CInbox%5C%5CR2-2401925.zip%22%20%5Co%20%22C%3AData3GPPRAN2InboxR2-2401925.zip) LS on improved GNSS operations in Rel-18 IoT NTN (R1-2401754; contact: Mediatek) RAN1 LS in Rel-18 IoT\_NTN\_enh-Core To:RAN2

RAN1 has discussed the end of duration X when timeAlignmentTimer is not infinity for improved GNSS operations and made the conclusion on the following:

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| AgreementSend an LS to RAN2 with the following:From RAN1 perspective, when timeAlignmentTimer is not infinity, the following alternatives were considered, and it is up to RAN2 to specify:* + Alt-1: the end of X should be at the point where new timer ULTransmissionExtentionTimer expires and ULTransmissionExtentionTimer is reset with length equal to remaining timeAlignmentTimer every time when a MAC CE (to be defined by RAN2) is received
	+ Alt-1a: the end of X should be at the point where new timer ULTransmissionExtentionTimer expires and ULTransmissionExtentionTimer is set to remaining timeAlignmentTimer at the start point of X and ULTransmissionExtentionTimer is reset with length equal to configured timeAlignmentTimer value every time when a MAC CE (to be defined by RAN2) is received
	+ Alt-2: the end of X should be at the point where timeAlignmentTimer expires and timeAlignmentTimer is reset every time when a legacy MAC TAC is received

Note 1: It is up to RAN2 to decide whether the MAC CE is the legacy TAC or a new TAC or a new MAC CE.Note 2: It is up to RAN2 to implement the above behaviour based on new timer, existing timer, or by extending GNSS validity.Note 3: For Alt-1a, from RAN1 perspective, eNB should be able to update TA without extending X |

* We no longer consider Alt2 and continue the discussion between Alt1 and Alt 1a as part [Post125][307] (if there is no consensus we will come back in the next meeting)
* **Noted**

In terms of the MAC CE Type, RAN2 has made the following agreement:

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| **Agreements:****1. Legacy TAC MAC CE shall not be used for UL transmission extension timer T390 restart. We introduce a new zero-byte MAC CE only to extend X.** |

Therefore, the rapporteur would like to collect the preference of options beside the type of MAC CE. From rapporteur’s understanding, the difference between Alt-1 and Alt-1a is the length of extension timer while restarting. Alt-1 is reset to the **remaining timeAlignmentTimer** while the Alt-1a is reset to **configured timeAlignmentTimer.**

**Q1: Beside the type of MAC CE, which option do you prefer, Alt-1 or Alt-1a?**

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| **Company** | **Alt-1 or Alt-1a** | **Comments** |
| MTK | Alt-1 |  |
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**Rapporteur Summary**

Felix, MTK View

TAT is finite

* At the start of X, T390 is started with **Remaining** TAT time
* T390 is restarted with **Configured** TAT time every time new MAC CE received
* T390 is restarted with **Remaining** TAT time every time new MAC CE received

TAT is infinite

* At the start of X, T390 is started with **Configured** value (Y)
* T390 is restarted with **Configured** value (Y) the new MAC CE received

Question

TAT is finite, NW send both legacy TAC MAC CE + New MAC CE in one TB, The UE should process legacy TAC MAC CE first.

## 3.2 Whether “or if the UE has initiated the Random Access procedure” is needed

[R2-2401129](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2401129%20Correction%20to%2036.321%20on%20GNSS%20validity%20duration%20reporting.docx) Correction to 36.321 on GNSS validity duration reporting Nokia, Nokia Shanghai Bell CR Rel-18 36.321 18.0.0 1581 - F IoT\_NTN\_enh-Core

1. When UE has initiated the Random Access procedure due to GNSS validity duration reporting, the UE shall include the corresponding MAC CE in an uplink transmission after RAR.

2. GNSS validity duration reporting is cancelled if the UE has included the GNSS Validity Duration report MAC CE in a transmission or if the UE has initiated the Random Access procedure.

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| *Next Modified Subclause*5.4.10 GNSS validity duration reportingFor a NB-IoT UE, a BL UE or a UE in enhanced coverage in a non-terrestrial network, an indication may be sent by upper layer to report the remaining GNSS measurement validity duration.If the GNSS validity duration reporting procedure has been triggered and not cancelled:- if the MAC entity has UL resources allocated for new transmission for this TTI, and;- if the allocated UL resources can accommodate the GNSS Validity Duration Report MAC control element plus its subheader, as a result of logical channel prioritization:- instruct the Multiplexing and Assembly procedure to generate the GNSS Validity Duration Report MAC control element as defined in clause 6.1.3.23.- else:- initiate a Random Access procedure (see clause 5.1).All triggered GNSS validity duration reports shall be cancelled when a GNSS Validity Duration Report MAC control element is included in a MAC PDU for transmission or a Random Access procedure has been initiated. |

* GNSS validity duration reporting is cancelled if the UE has included the GNSS Validity Duration report MAC CE in a transmission
* Discuss in the MAC CR review whether the second part (“or if the UE has initiated the Random Access procedure”) is also needed

Companies are invited to answer the following question:

**Q2: Do you agree that the second part (“or if the UE has initiated the Random Access procedure”) is also needed?**

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| **Company** | **Yes/No** | **Comments** |
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**Rapporteur Summary**

## 3.2a Whether cancellation of RACH due to GNSS validity duration reporting is needed

[R2-2400121](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2400121%20Cancellation%20of%20Triggered%20GNSS%20Validity%20Duration%20Reporting.docx) Remaining Issues on GNSS Validity Duration Reporting vivo discussion Rel-18 IoT\_NTN\_enh-Core

Proposal 2: If MAC entity has enough resource for GNSS validity duration report MAC CE, MAC entity shall cancel, if any, initiated RACH procedure for GNSS validity duration report.

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| *Next Modified Subclause*5.4.10 GNSS validity duration reportingFor a NB-IoT UE, a BL UE or a UE in enhanced coverage in a non-terrestrial network, an indication may be sent by upper layer to report the remaining GNSS measurement validity duration.If the GNSS validity duration reporting procedure has been triggered and not cancelled:- if the MAC entity has UL resources allocated for new transmission for this TTI, and;- if the allocated UL resources can accommodate the GNSS Validity Duration Report MAC control element plus its subheader, as a result of logical channel prioritization:- instruct the Multiplexing and Assembly procedure to generate the GNSS Validity Duration Report MAC control element as defined in clause 6.1.3.23;- cancel, if any, initiated Random Access procedure for GNSS validity duration reporting.- else:- initiate a Random Access procedure (see clause 5.1).All triggered GNSS validity duration reports shall be cancelled when a GNSS Validity Duration Report MAC control element is included in a MAC PDU for transmission or a Random Access procedure has been initiated. |

Companies are invited to answer the following question:

**Q2a: Do you agree that cancellation of RACH due to GNSS validity duration reporting is also needed?**

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| **Company** | **Yes/No** | **Comments** |
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**Rapporteur Summary**

## 3.3 HARQ feedback overridden to enable by DCI

HARQ enhancements

[R2-2401001](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2401001%20-%20Discussion%20on%20HARQ%20enhancement%20for%20IoT%20NTN.doc) Discussion on HARQ enhancement for IoT NTN OPPO discussion Rel-18 IoT\_NTN\_enh-Core

Proposal 3 For multiple TB scheduling for a NB-IoT UE, if the HARQ processes are configured as HARQ feedback disabled by RRC and further reversed to HARQ feedback enabled by DCI, UE behaviour on DRX follows the case when HARQ feedback is enabled.

* Check during the MAC CR review if anything else is needed on top of what already agreed

Regarding **proposal 3**, for a HARQ process configured as HARQ feedback disabled by RRC and further reversed to HARQ feedback enabled by DCI, RAN1 had agreement for single TB:

RAN1 agreement for single TB:

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| **Agreement in RAN1#114bis:**For single TB scheduled by DCI, * Working assumption 2 For Option 1 + Option 3 DCI based overridden mechanism, for a HARQ process configured as HARQ feedback disabled by per-HARQ process bitmap signaling and further reversed to HARQ feedback enabled by DCI, the NBIoT UE does not wait for an RTT+3ms (i.e., till subframe *n+Kmac+3* in TS36.213 section 16.6) before monitoring NPDCCH for the same HARQ process (or monitoring any NPDCCH for the case of single HARQ process configuration).
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In RAN1 36.213, it has specified that:

R1-2308693 36.213 CR 1436:

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| If a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig*-     and if the UE has a NPUSCH transmission ending in subframe *n*,-    the UE is not required to receive transmissions in the Type B half-duplex guard periods as specified in [3]for FDD ; and-    the UE is not expected to receive an NPDCCH with DCI format N0/N1 for the same HARQ process ID as the NPUSCH transmission in any subframe starting from subframe n+1 to subframe n+3, or in a NTN serving cell, in any downlink subframe that overlaps with uplink subframe *n*+1 to subframe *n*+*K*mac+3 except if the UE is configured with higher layer parameter *uplinkHARQ-mode* set to ‘*HARQModeB*’ for the same HARQ process ID, or if the NPUSCH transmission carries ACK/NACK response, as determined in clause 16.4.2, for the same HARQ process ID, and the UE is configured with higher layer parameter *downlinkHARQ-FeedbackDisabled-Bitmap-NB* indicating disabled HARQ-ACK information for the same HARQ process ID and configured with higher layer parameter *downlinkHARQ-FeedbackDisabled-DCI-NB;*else if the UE is not using higher layer parameter *edt-Parameters* or if the UE is using higher layer parameter *edt-Parameters* and  -     if the NB-IoT UE has a NPUSCH transmission ending in subframe *n*,-   the UE is not required to receive transmissions in the Type B half-duplex guard periods as specified in [3] for FDD; and -    the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+3*,or in a NTN serving cell, in any downlink subframe that overlaps with uplink subframe *n*+*1* to subframe *n*+*K*mac+*3* except if the UE is configured with higher layer parameter *uplinkHARQ-mode* set to ‘*HARQModeB*’, or if the NPUSCH transmission carries ACK/NACK response as determined in clause 16.4.2 and the UE is configured with higher layer parameter *downlinkHARQ-FeedbackDisabled-Bitmap-NB* indicating disabled HARQ-ACK information and configured with higher layer parameter *downlinkHARQ-FeedbackDisabled-DCI-NB*.  |

Here is the rapporteur’s understanding of RAN1 spec: NB-IoT UE starts to monitor PDCCH after NPUSCH transmission (HARQ ACK) + 1ms(i.e., Type B half-duplex guard periods).

Rapporteur ‘s understanding of RAN1 spec:



RAN2 had made the following agreement. Per rapporteur’s understanding, this RAN2 agreement is based on the RAN1 agreement for single TB case, and RAN1 had made different agreement for Multiple TB scheduling case. Therefore, this RAN2 agreement should also be limited to single TB case.

**Corresponding RAN2 agreement:**

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| **Agreement in RAN2#123bis:**For a HARQ process configured as HARQ feedback disabled by RRC and further reversed to HARQ feedback enabled by DCI, UE behaviour on DRX follows the case when HARQ feedback is disabled. |

RAN2 spec:

However, this agreement is not captured in MAC.

P5 in MTK’s R2- 2400428

* For a HARQ process configured as HARQ feedback disabled by RRC and further reversed to HARQ feedback enabled by DCI, UE behaviour on DRX follows the case when HARQ feedback is disabled.

**Proposal 5: Capture the above agreement in MAC specification clause 5.7.**

Rapporetur also finds that there is a misalignment in monitoring PDCCH between the RAN2 agreement and the RAN1 specification.

Rapporteur’s understanding of RAN2 agreement:



In conclusion, there are three issues relate to above RAN2 agreement:

1. This agreement should be limited to single TB case.
2. This agreement is not captured in the MAC CR.
3. There is a misalignment in monitoring NPDCCH between the RAN2 agreement and RAN1 spec that may need to address.

Companies are invited to answer the following question:

**Q3: Do you agree with the above three issues?**

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| **Company** | **Yes/No** | **Comments** |
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**Rapporteur Summary**

If the answer to Q3 is yes, companies are invited to comment on the revise of the RAN2 agreement:

**Q4: Do you agree the above RAN2 agreement can be revised to**

For single TB scheduling case: for a HARQ process configured as HARQ feedback disabled by RRC and further reversed to HARQ feedback enabled by DCI, NB-IoT UE start/restarts drx-inactivity timer after the HARQ feedback + 1ms.

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**Rapporteur Summary**

RAN1 had made agreement for Multiple TBs scheduling case:

RAN1 agreement Multiple TBs

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| **Agreement in RAN1#115:**When multile TBs are scheduled by a single DCI: For Option 1 + Option 3 DCI based overridden mechanism, when DCI indicates HARQ feedback enabled, then the NB-IoT UE always wait for an RTT+3ms (i.e., till subframe n+Kmac+3 in TS36.213 section 16.6) before monitoring NPDCCH. |

RAN1 spec:

The following TP has been agreed in RAN1#116.

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| AgreementThe TP 1-1b in section 3 of R1-2401497 is endorsed for TS36.213 clause 16.6.TP1-1b

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| **Reason for change:** | Clarify that when multiple TBs are scheduled by a single DCI and DCI indicates HARQ feedback enabled, then the NB-IoT UE always wait for an RTT+3ms (i.e., till subframe n+Kmac+3) before monitoring NPDCCH in clause 16.6. |
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| **Summary of change:** | Added condition that NB-IoT UE always wait for an RTT+3ms (i.e., till subframe n+Kmac+3) before monitoring NPDCCH when multiple TBs are scheduled by a single DCI and DCI indicates HARQ feedback enabled. |
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| **Consequences if not approved:** | NB-IoT UE will need to monitor NPDCCH during RTT+3ms (i.e., till subframe n+Kmac+3) when multiple TBs are scheduled by a single DCI and DCI indicates HARQ feedback enabled. |

TS36.213<Unchanged parts are omitted>16.6  Narrowband physical downlink control channel related proceduresThroughout this clause, if a NB-IoT UE is configured with higher layer parameter *k-Mac*, *K*mac = *k-Mac* otherwise, *K*mac = 0.<Unchanged parts are omitted>If a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig*-    and if the UE has a NPUSCH transmission ending in subframe *n*,-    the UE is not required to receive transmissions in the Type B half-duplex guard periods as specified in [3]for FDD ; and-    the UE is not expected to receive an NPDCCH with DCI format N0/N1 for the same HARQ process ID as the NPUSCH transmission in any subframe starting from subframe n+1 to subframe n+3, or in a NTN serving cell, in any downlink subframe that overlaps with uplink subframe *n*+1 to subframe *n*+*K*mac+3 except if the UE is configured with higher layer parameter *uplinkHARQ-mode* set to ‘*HARQModeB*’ for the same HARQ process ID, or if the NPUSCH transmission carries ACK/NACK response, as determined in clause 16.4.2, for the same HARQ process ID associated with a transport block scheduled in a NPDCCH scheduling a single transport block, and the UE is configured with higher layer parameter *downlinkHARQ-FeedbackDisabled-Bitmap-NB* indicating disabled HARQ-ACK information for the same HARQ process ID and configured with higher layer parameter *downlinkHARQ-FeedbackDisabled-DCI-NB;*else if the UE is not using higher layer parameter *edt-Parameters* or if the UE is using higher layer parameter *edt-Parameters* and  -    if the NB-IoT UE has a NPUSCH transmission ending in subframe *n*, -    the UE is not required to receive transmissions in the Type B half-duplex guard periods as specified in [3] for FDD; and -    the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+3* or in a NTN serving cell, in any downlink subframe that overlaps with uplink subframe *n*+*1* to subframe *n*+*K*mac+3 except if the UE is configured with higher layer parameter *uplinkHARQ-mode* set to ‘*HARQModeB*’, or if the NPUSCH transmission carries ACK/NACK response as determined in clause 16.4.2 and the UE is configured with higher layer parameter *downlinkHARQ-FeedbackDisabled-Bitmap-NB* indicating disabled HARQ-ACK information and configured with higher layer parameter *downlinkHARQ-FeedbackDisabled-DCI-NB*. <Unchanged parts are omitted> |

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Rapporteur’s understanding of RAN1 agreement:



RAN2 Proposal:

P3 in Oppo R2-2401001

Proposal 3 For multiple TB scheduling for a NB-IoT UE, if the HARQ processes are configured as HARQ feedback disabled by RRC and further reversed to HARQ feedback enabled by DCI, UE behaviour on DRX follows the case when HARQ feedback is enabled.

Rapporteur’s understanding of RAN2 proposal



Companies are invited to answer the following question:

**Q5: Do you agree that, “for multiple TB scheduling for a NB-IoT UE, if the HARQ processes are configured as HARQ feedback disabled by RRC and further reversed to HARQ feedback enabled by DCI, UE behaviour on DRX follows the case when HARQ feedback is enabled” ?**

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| **Company** | **Yes/No** | **Comments** |
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**Rapporteur Summary**

## 3.4 HARQ RTT Timer for HARQ process with HARQ feedback enabled

HARQ enhancements

[R2-2401001](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2401001%20-%20Discussion%20on%20HARQ%20enhancement%20for%20IoT%20NTN.doc) Discussion on HARQ enhancement for IoT NTN OPPO discussion Rel-18 IoT\_NTN\_enh-Core

Proposal 4 For multiple TB scheduling with mixed HARQ feedback enabled/disabled configuration for NB-IoT, if HARQ-ACK bundling is not configured, HARQ RTT Timer for HARQ process with HARQ feedback enabled is k+3+N plus RTToffset + deltaPDCCH.

* Continue the discussion during the MAC CR review

**HARQ RTT Timer length for HARQ process with enabled HARQ feedback in multiple TB scheduling for NB-IoT**

In RAN2#124 meeting, the following agreement was made regarding HARQ RTT Timer length for HARQ process with enabled HARQ feedback in multiple TB scheduling.

**Agreements in RAN2#124**:

1. For multiple TB scheduling with mixed HARQ feedback enabled/disabled configuration, if HARQ-ACK bundling is not configured, HARQ RTT Timer for HARQ process with HARQ feedback enabled is calculated based on the number of scheduled TBs with HARQ feedback enabled.

For NB-IoT, the above agreement has been captured in the MAC running CR as below.

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| For NB-IoT, when single TB is scheduled by PDCCH or when multiple TBs are scheduled for the interleaved case when HARQ-ACK bundling is configured the HARQ RTT Timer is set to k+3+N subframes plus RTToffset + deltaPDCCH, where k is the interval between the last subframe of the downlink transmission and the first subframe of the associated HARQ feedback transmission and N is the transmission duration in subframes of the associated HARQ feedback, and deltaPDCCH is the interval starting from the subframe following the last subframe of the associated HARQ feedback transmission plus 3 subframes plus RTToffset to the first subframe of the next PDCCH occasion.For NB-IoT, when multiple TBs are scheduled by PDCCH for the non-interleaved case or for the interleaved case when HARQ-ACK bundling is not configured, the HARQ RTT Timer is set to k+m\*N+1 subframes plus RTToffset + deltaPDCCH where k is the interval between the last subframe of the downlink transmission and the first subframe of the first HARQ feedback transmission and N is the transmission duration in subframes of the associated HARQ feedback and m is the number of scheduled TBs as indicated in PDCCH whose associated HARQ process is configured with HARQ feedback enabled, and deltaPDCCH is the interval starting from the subframe following the last subframe of the last HARQ feedback transmission plus 1 subframe plus RTToffset to the first subframe of the next PDCCH occasion. |

Note that in legacy, for multiple TB scheduling and if HARQ-ACK bundling is configured, HARQ RTT Timer is k+3+N subframes plus deltaPDCCH, where the 3 subframe includes UE-eNB RTT and eNB processing/scheduling delay. For multiple TB scheduling and if HARQ-ACK bundling is not configured, HARQ RTT Timer is k+2\*N+1 subframes plus deltaPDCCH, where the 1 subframe is the UE processing time, and for this case the 3 subframes for UE-eNB RTT and eNB processing/scheduling delay is not counted since eNB may get ready to schedule the HARQ process used by the first TB when it receives the first HARQ-ACK information, in other words, the UE-eNB RTT and eNB processing/scheduling delay can be coved by the transmission duration of the second HARQ-ACK. In Rel-17 IoT NTN, HARQ RTT Timer is extended by simply adding a RTToffset. In our understanding, for the case of multiple TB scheduling and HARQ-ACK bundling is not configured, if one process is configured with disabled HARQ feedback and the other HARQ process is configured with enabled HARQ feedback, UE would transmit one HARQ feedback, this is more like the case of multiple TB scheduling when HARQ-ACK bundling is configured, so we think in this case the HARQ RTT Timer for the HARQ process with enabled HARQ feedback should be k+3+N plus RTToffset + deltaPDCCH rather than k+N+1 plus RTToffset + deltaPDCCH.

Companies are invited to answer the following question:

**Q6: Do you agree that for multiple TB scheduling with mixed HARQ feedback enabled/disabled configuration for NB-IoT, if HARQ-ACK bundling is not configured, HARQ RTT Timer for HARQ process with HARQ feedback enabled is k+3+N plus RTToffset + deltaPDCCH?**

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| **Company** | **Yes/No** | **Comments** |
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**Rapporteur Summary**

# 4. Summary and Proposals

This section summarizes the main proposals:

# 5. References

1. [R2-2401925](file:///C%3A%5CData%5C3GPP%5CRAN2%5CInbox%5CR2-2401925.zip) LS on improved GNSS operations in Rel-18 IoT NTN (R1-2401754; contact: Mediatek) RAN1 LS in Rel-18 IoT\_NTN\_enh-Core To:RAN2
2. [R2-2401129](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2401129%20Correction%20to%2036.321%20on%20GNSS%20validity%20duration%20reporting.docx) Correction to 36.321 on GNSS validity duration reporting Nokia, Nokia Shanghai Bell CR Rel-18 36.321 18.0.0 1581 - F IoT\_NTN\_enh-Core
3. [R2-2401001](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2401001%20-%20Discussion%20on%20HARQ%20enhancement%20for%20IoT%20NTN.doc) Discussion on HARQ enhancement for IoT NTN OPPO discussion Rel-18 IoT\_NTN\_enh-Core
4. [R2-2400428](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2400428%20MAC%20correction%20on%20Rel-18%20IoT%20NTN.docx) Discussion on MAC corrections on Rel-18 IoT-NTN MediaTek Inc. discussion