3GPP RAN WG2 Meeting #117-e R2-220xxxx

eMeeting February 21st – March 3rd, 2022

Agenda Item: 8.10.2.1.1

Source: InterDigital

Title: [DRAFT] Summary of [Pre117-e][NTN][103] MAC open issues

Document for: Discussion, Decision

# Introduction

This document is intended address a subset of remaining open issues as per the following email discussion:

**[Pre117-e][NTN][103] MAC open issues (InterDigital)**

* **Issues 1-3, 5-11 and 13 from R2-2201900 will be handled in offline discussion**
* Issues 4, 12 and additional details of K\_Offset MAC CE will be handled by CR rapporteur directly in the running CR
* Issues 14-18 can be handled via company contributions in AI 8.10.2.1.1
* The following aspect of Issue 3: “*RAN2 to confirm support of UE location information for purposes of TA reporting*” can be handled via company contributions in AI 8.10.2.1.1
* Other MAC issues can be handled via company contributions in AI 8.10.2.1.2 and AI 8.10.2.1.3

Please note the following deadlines:

* Deadline (for companies' feedback): **Monday 2022-02-14 23:59 UTC**

# TA reporting and RACH aspects

## UE-specific TA reporting

### Enable/disable TA reporting during RACH in connected mode

In the second phase of offline [AT116bis][101], there was near consensus (18 of 19) that in general, TA reporting during RACH in connected mode is not controlled by the enable/disable indication configured in SI but depends on whether a TA update event is triggered or not.

Considering very large majority, Rapporteur suggests this proposal be agreed, and implementation details be discussed during stage-3.

**Question 1: Do you agree with the following proposal?:**

***Proposal: TA reporting during RACH in connected mode is not controlled by the enable/disable indication configured in SI, but depends on whether a TA update event is triggered or not. Specification impact, if any, can be discussed in Stage 3.***

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| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments** |
| CATT | Agree |  |
| OPPO | See comments | We think the proposal can be applied to connected mode RACH except RACH triggered by RRC re-establishment and handover.  During re-establishment procedure, the UE will read SIB from the target cell before initiating re-establishment request message and target cell’s SIB may include the enable/disable indication. If broadcasted and enabled, it seems reasonable for the UE to follow the indication in SI to trigger TA report during RACH in the re-establishment procedure. With this, network can configure the UE-specific K\_Offset at its earliest time.  In the current handover procedure, handover command will include part of target cell’s essential system information for UE to perform handover access. In NTN, it can be assumed that some NTN specific system information would need to be provided in handover command, e.g. ephemeris, common TA, etc, for UE to do TA pre-compensation. Enable/disable indication could also be carried in handover command. Similar to initial access and re-establishment, it seems reasonable for the UE to follow that indication to trigger TA report or not during RACH. If enabled and TA report is triggered, target cell can provide the UE-specific K\_Offset at its earliest time.  Based on above, we suggest to update the proposal as follows:  ***Proposal: TA reporting during RACH in connected mode except RACH triggered RRC connection re-establishment and handover is not controlled by the enable/disable indication configured in SI, but depends on whether a TA update event is triggered or not.*** |
| Samsung | Agree with comment | We think this proposal is only specifying the TA reporting to the serving cell. If to report TA to target cell or any cell other than the serving cell, it does not make sense to use the previous report value to trigger a new TA report since the old TA value and new TA value are associated with different cells. Suggest to update the wording of the proposal, e.g. “TA reporting to the serving cell during RACH in connected mode is not controlled by the enable/disable indication configured in SI, but depends on whether a TA update event is triggered or not.” |
| Nokia | See comments | The same topic is in discussion at [Pre117-e][011] for IoT NTN. RAN2 need to further discuss RACH in re-establishment procedure where UE re-establish in a new cell and RACH in handover procedure. The same solution should be applied to both IoT NTN and NR NTN. |
| Intel |  | agree with Samsung |
| Apple | Agree | Agree with OPPO and Samsung |
| vivo | Yes | We can go with the majority’s view that TA reporting during RACH in connected mode depends on whether a TA update event is triggered or not. |
| Lenovo, Motorola Mobility | Agree with comments | OPPO’s update seems fine. |
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### TA reporting triggered and no UL-SCH resources

In the final phase of offline [AT116bis][101], the following proposal was discussed and supported by 12 of 16 companies:

***Proposal: SR can be triggered if there is a TA reporting triggered and no UL-SCH resources for TA reporting. When SR is triggered but there are no available PUCCH resources, UE will trigger RACH.***

During discussion, it was noted that the drawback of SR/RACH triggering from UE is that the UE will send periodically TA report when it exceeds the threshold even when there is no data to send, which will cause much overhead especially given that all UEs within the cell will be sending this. For example, all connected UEs in an area the size of the UK (i.e. a cell size of 1000km) will end up always reporting TA (periodically). Relying on existing mechanisms will ensure that TA report is only sent when required, i.e. only when there is DL or UL data (i.e. when TA is actually needed).

Companies supportive of this proposal counter this concern by noting that the reporting interval is up to NW implementation e.g., by setting the offset threshold/UE-specific K\_Offset. Proper NW configuration, for example, configuration of a relatively large UE-specific K\_Offset, would result in less frequent TA report, thus less overhead.

**Question 2a: Should** **connected UE send TA report (if triggered) only if there is UL/DL data?**

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| **Company** | **Yes/No** | **Additional comments** |
| CATT | See the comments | Different scenarios can be considered as following:   * If there is UL-SCH resources, connected UE should send TA report (if triggered), regardless whether there is UL/DL data or not * Otherwise (if there is no UL-SCH resources),   + if there is UL/DL data, connected UE should send TA report (if triggered)   + otherwise (if there is no UL/DL data), connected UE need not send TA report (if triggered) |
| OPPO | No | TA reporting is important for NW to adjust UE-specific K-offset. If it has no chance to report, it may impact the subsequent UL/DL transmission by using the old K-offset.  Some companies may think that TA report is only necessary if there is data for the UE, since if the UE has UL data, UE would trigger BSR, and may further trigger a SR if there is no available UL-SCH resources. If the UE has no UL data but there is DL data for the UE, NW may schedule the UE with larger K1 if the UE-specific Koffset has been out-of-date or NW sends PDCCH order to trigger RACH. In our understanding, there are issues for both UL and DL. In NTN, we have UE pre-compensation of TA which is open-loop. Without timely TA report, network does not know whether and when UE-specific Koffset starts to become unusable due to Koffset below UE’s TA. In this case, even if UL data can trigger BSR and then SR, the subsequent UL grant may still be risky not to be usable if using small K2 value as K\_offset has not been updated, or NW has to always use large K2 value which is not efficient. Similarly, as K\_offset can be obsolete, NW may have to always schedule the UE with a relatively large K1 value to make ACK/NACK timing work. This would make the whole Koffset mechanism useless. Also K2 and K1 have upper limit in RAN1 spec and cannot be any arbitrarily large. It could be possible that even the maximum K2/K1 value cannot cover the gap between the current TA and the configured K\_offset, in which case RAN2 has to discuss how to handle this kind of failure.  Relying on loss of synchronization and triggering RACH has many drawbacks, e.g. RACH may suffer collisions and multiple attempts, which increases the latency for UL/DL scheduling.  To facilitate network’s implementation, to ease RAN2’s job not to handle various failure cases, and to reduce scheduling delay, we think triggering SR/RACH for TA reporting is the simplest way.  Therefore, we see no need to introduce the limitation that connected UE should send TA report (if triggered) only if there is UL/DL data. |
| Samsung | No | If there is no UL-SCH resource but UL data, BSR and then SR will be triggered as legacy. If there is no UL-SCH resource, no UL data, and SR is not triggered, then issues with ACK/NACK for DL data could happen as mentioned by OPPO that large K1/K2 may not always work. But we also think triggering SR/RACH whenever there is no UL-SCH resource and no UL data can cause much overhead. If majority think this works, we are fine to agree with the proposal. |
| Nokia | Yes | See our comments on question2b. The signalling overhead should be considered if SR should be triggered by all UE under the satellite coverage to report TA even it has no UL/DL data. |
| Intel | Yes | agree with Nokia’s concern, it’s quite likely to lead to a RACH signalling storm by simultaneous TA report triggerring. |
| Apple | No | We think it is unlikely that all UEs will trigger TA report simultaneously, so don’t think signalling storm is a real issue. |
| vivo | No | We understand the intention of Q2a is to delay the TA MAC CE reporting and avoid TA reporting impacting the legacy SR/RACH trigger. But this will cause additional delay of UL/DL transmission or scheduling issue. For example, during RACH procedure, NW may schedule grant for msg3 based on the old TA, which may cause the scheduled grant is already outdated and thus unable to be used when UE receives it. If NW schedules grant for msg3 based on the maximum TA, it will cause additional delay of data transmission. As the TA MAC CE is inherently introduced to reduce the scheduling delay, it is reasonable that UE and NW should always maintain the latest TA value. Thus, TA MAC CE should be reported as soon as possible, once TA reporting is triggered.  Regarding the frequency of TA reporting, we agree with the view pointed by Rapporteur that it can be controlled by NW implementation e.g., by setting the offset threshold/UE-specific K\_Offset. This can address the concern on over-frequent TA reporting from some companies. |
| Lenovo, Motorola Mobility | No | Agree with Rapporteur that NW implementation can handle. |
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**Question 2b: If the above proposal is agreed, can NW configuration address any possible excessive TA reporting? If “No” please describe system impact(s) which preclude this option.**

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| **Company** | **Yes/No** | **Additional comments** |
| CATT |  | If UE reports the TA according to different scenario show in Question 2a, maybe there is no excessive TA report issue. |
| Nokia | No | For the proposal, it may cause all the connected UEs under the satellite coverage of a cell may need to update its TA simultaneously due to the movement of the satellite even when UE has no DL or UL data in buffer, which may cause signalling storms.  If there is some kind of prohibition timer introduced to avoid frequent reporting, it means the TA update cannot happen in time which cannot address the TA outdate issue for PUCCH feedback. Furthermore, if NW configures a relatively large UE-specific K\_offset (and large TA reporting threshold), it cannot solve the issue but only mitigate the issue. There are still many UEs which maintain the TA reports but it is useless since UE has no data to send/receive. However, the large TA reporting threshold will also reduce the gain of reporting UE-specific TA (to reduce scheduling delay via proper K\_offset + K2 configuration) which is not the intention of TA reporting. |
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### UE location information for TA reporting purposes

During offline [AT116bis][101], UE location information for TA reporting purposes was discussed over several rounds. Based on final round outcome, company opinion was split:

* **8** do not support UE location information for TA reporting purpose in connected mode;
* **6** do support; and
* 1 suggests to postpone.

However, several aspects of UE location information for TA reporting purpose have more consensus. Considering limited time remaining Rapporteur suggests the topics below be addressed in this email discussion with the condition “*If UE reporting location information for TA reporting purpose in connected mode is supported*” which shall be addressed via contribution to RAN2#117e (as captured in the Appendix via Open issue 19).

#### **Topic 1:** Whether both UE location and/or UE specific TA information are needed in parallel for the purposes of TA reporting

In final round of offline [AT116bis][101], the following proposal was discussed and supported by 6 of 8 responding companies:

***Proposal: UE can be configured to report only the UE location or the UE specific TA information IF*** ***reporting UE location information for TA reporting purpose in connected mode can be agreed.***

Companies which do not agree have raised the following technical issue:

**Technical issue 1)** Limit to NW configuration

Two companies note that this proposal would limit NW configuration possibilities for the network, and that if both TA report and UE location can be reported, let the network decide if it shall configure one of them or both or none (allowing optimization based on resource situation, services, subscriptions etc.).

To counter this argument, It is noted by other companies that there is no need to report both the UE specific pre-compensation and the UE location information to NW in parallel since they are derived from the same inputs.

**Question 3: Companies are invited to comment on the above technical issue or provide additional comments regarding the above proposal.**

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| **Company** | **Additional comments** |
| CATT | We think it is not efficient to discuss this issue without any agreement on ***reporting UE location information for TA reporting purpose,***and we also think there is no need support UE location information for TA reporing purpose, it is not a essential issue. |
| OPPO | Share the same view as CATT.  We think using UE specific TA pre-compensation for TA reporting purpose is sufficient in Rel-17. We need to make sure NTN can work in this release and should not introduce too many optimizations which are simply duplicated functions and not essential to have. So we prefer not to support UE location information for purpose of TA reporting. |
| Samsung | We can leave this issue for now. We are fine not to support UE location report for TA purpose. |
| Nokia | RAN2 agreed in 116bis meeting that, if NTN-specific user consent will be available in Rel-17, the UE location can be requested by NW for any reason which of course including for TA reporting purpose. We can see the proposal above is clearly stated with the pre-condition that “*IF reporting UE location information for TA reporting purpose in connected mode can be agreed*.” which is aligned with below RAN2 agreement. With the pre-condition, the details on how to support UE location reporting should be discussed in Rel-17.   |  | | --- | | 3. If SA3 will confirm that NTN-specific user consent will the available in Rel-17, **the network could at least ask the UE to report its UE location for any reason at any time.** FFS if we define an event-triggered reporting of UE location for TA reporting purposes. |   For the proposal, we agree with rapporteur that there is no need to report both the UE specific pre-compensation and the UE location information to NW in parallel since they are derived from the same inputs. |
| Intel | agree with Nokia. This question is actually re-worded as the FFS part in agreement above. |
| Apple | Agree with CATT, OPPO, and Samsung. We do not think UE location report for TA purposes need to be supported. In any case, configuring both TA report and UE location report at the same time is not justified. |
| vivo | Our view is that the UE specific TA information for TA reporting purpose is enough. There is no need to introduce additional UE location information for the same purpose (even if the location reporting can be agreed finally). Thus, the above technical issue does not exist. |
| Lenovo, Motorola Mobility | Agree with vivo that UE specific TA information for TA reporting purpose is enough. |
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#### **Topic 2:** Definition of event trigger for location reporting (e.g. if it re-uses the same event trigger or different trigger)

In final round of offline [AT116bis][101] there was consensus that if reporting UE location information for TA reporting purpose in connected mode can be agreed, it shall reuse the TA-based trigger event. Rapporteur suggests that the same proposal be agreed.

**Question 4: Do you agree with the following proposal?:**

***Proposal: Reuse the TA-based trigger event if reporting*** ***UE location information for TA reporting purpose in connected mode can be agreed.***

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| **Company** | **Agree/Disagree** | **Additional comments** |
| CATT | Agree | It is suffecient to reuse the TA-based trigger, event if UE location information for TA reporting purpose in connected mode can be agreed. |
| OPPO | Agree, but | See our comment to Q3. |
| Samsung | Agree |  |
| Nokia | Agree | The UE movement distance (UE location change) doesn’t mean the TA change since the trajectory of UE movement is unknown. The TA change threshold should be used in both mechanisms, whether the UE’s TA or UE location information is used to perform that update shouldn’t matter. |
| Intel | Agree |  |
| Apple | Agree |  |
| vivo | Disagree | Same reason with Q3. |
| Lenovo, Motorola Mobility | Agree |  |
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#### **Topic 3:** connected mode UE failing to acquire an accurate UE location to be used in the calculation of the full TA.

In final round of offline [AT116bis][101], the following proposal was discussed and supported by 14 of 16 companies:

***Proposal: RAN2 do not address the issue on connected mode UE failing to acquire an accurate UE location to be used in the calculation of the full TA.***

The main concern from companies which do not agree (and also recognized by some companies who do) is that if UE cannot fix GNSS, then its TA would not be valid and it should not perform any UL transmission. Rapporteur suggests RAN2 can capture the above concern, however considering the very large majority support do not address this issue in RAN2 specification.

**Question 5: Do you agree with the following proposal?:**

***Proposal: RAN2 understanding: UE failing to acquire an accurate UE location to be used in the calculation of the full TA should not perform any UL transmission until GNSS is fixed. No RAN2 specification impact.***

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| **Company** | **Agree/Disagree** | **Additional comments** |
| CATT | Agree |  |
| OPPO | Agree, but | We think this issue may be only valid for IoT NTN where IoT devices could not acquire the GNSS fix during RRC connected mode and not so relevant for NR NTN. |
| Samsung | Agree |  |
| Nokia | Agree | We understand it is UE’s implementation to decide whether the UE location is accurate enough for full TA estimation. Maybe we can describe it more specifically:  ***Proposal: RAN2 understanding: UE failing to acquire ~~an~~ sufficiently accurate UE location to be used in the calculation of the full TA should not perform any UL transmission until GNSS is within accuracy limits ~~fixed~~. No RAN2 specification impact.*** |
| Intel | agree |  |
| Apple | Agree |  |
| vivo | Agree | We agree that no RAN2 impact is needed. |
| Lenovo, Motorola Mobility | Agree |  |
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## Details of new MAC CEs

### Details of UE-specific K\_Offset and TA reporting MAC CEs

Rel-17 NTN has introduced two new MAC CEs, captured in the current version of the MAC CR [2] as follows:

#### 6.1.3.XX UE-Specific TA MAC CE

The UE-Specific TA MAC CE is identified by MAC subheader with LCID as specified in Table 6.2.1-2. It has a fixed size and consists of two octets defined as follows (Figure 6.1.3.X-X):

- UE-specific TA: This field contains the UE estimate of the full UE-specific TA (i.e., T\_TA as defined in the UE’s TA formula). The length of the field is 16 bits

#### 6.1.3.XX Differential UE-Specific K\_Offset MAC CE

The Differential UE-Specific K\_Offset MAC CE is identified by a MAC subheader with eLCID as specified in Table 6.2.1-2b. It has a fixed size and consists of a single octet defined as follows (Figure 6.1.3.X-X):

- Differential UE-Specific K\_Offset: This field contains the differential UE-specific K\_Offset, The length of the field is 8 bits.

RAN2 to confirm details of new MAC CEs, including the structure and name of both MAC CEs.

**Question 6a: Do you agree UE-specific MAC CE consists of only one field with length 16 bits, which contains the UE estimate of full UE-specific TA (i.e., T\_TA as defined in the UE’s TA formula)?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| CATT | Agree |  |
| OPPO | Agree |  |
| Samsung | Agree but | Max full TA cannot exceed 14 bits (consider GEO max RTT 541ms for different numerologies), 2 bits can be reserved. Also fine to go with majority. |
| Nokia | Agree |  |
| Intel | Agree |  |
| Apple | Agree |  |
| vivo | Disagree | “R” field is needed in the UE-specific TA MAC CE.  As the maximum TA value could be 541.46ms and the granularity of the reported TA is slot, the 10 bits are enough for TA reporting with 15khz SCS. Currently, RAN1 only agreed that 15 kHz is used as the reference subcarrier spacing value for the unit of TA reported in FR1. However, considering the forward compatibility, 120khz SCS can also be considered in the design of TA MAC CE. We suggest that 14 bits are used for reporting full TA, the remaining 2 bits are R fields. |
| Lenovo, Motorola Mobility | Agree |  |
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**Question 6b: Do you agree Differential UE-Specific K\_Offset MAC CE consists of only one field with length 8 bits, which contains the Differential UE-Specific K\_Offset?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| CATT | Agree |  |
| OPPO | Agree |  |
| Samsung | Agree |  |
| Nokia | Agree |  |
| Intel | Agree |  |
| Apple | Agree |  |
| vivo | Yes |  |
| Lenovo, Motorola Mobility | Agree |  |
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**Question 6c: Do you agree with the following names: 1) UE-specific TA MAC CE; and 2) Differential UE-Specific K\_Offset MAC CE?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| CATT | Agree |  |
| OPPO | Agree |  |
| Samsung | Agree |  |
| Nokia | Agree |  |
| Intel | Agree |  |
| Apple | Agree |  |
| vivo | Yes |  |
| Lenovo, Motorola Mobility | Agree |  |
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## RA windows and timers

### Extension of *ra-ReponseWindow* and *msgB-ResponseWindow*

In current version of NTN MAC CR Section 5.1.1 [2], there are the following Editor’s Notes regarding *ra-ResponseWindow* and *msgB-ReponseWindow* extension:

Editor’s note: *Agreement:* If the start of *ra-ResponseWindow* is accurately compensated by UE-gNB RTT, *ra-ResponseWindow* is not extended in LEO/GEO. RAN2 to confirm *ra-ResponseWindow* is not extended for NTN.

Editor’s note: *Agreement:* If the start of *msgB-ResponseWindow* is accurately compensated by UE-gNB RTT, *msgB-ResponseWindow* is not extended in LEO/GEO. RAN2 to confirm *msgB-ResponseWindow* is not extended for NTN.

Considering RAN1 has not identified any need for extension, RAN2 may confirm that *ra-ResponseWindow* and *msgB-ReponseWindow* extension is not necessary.

**Question 7: Do you agree *ra-ResponseWindow* and *msgB-ReponseWindow* are not extended in NTN?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| CATT | Agree |  |
| OPPO | Agree |  |
| Samsung | Agree |  |
| Nokia | Agree |  |
| Intel | Agree |  |
| Apple | Agree |  |
| vivo | Agree |  |
| Lenovo, Motorola Mobility | Agree |  |
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### Remaining details of *ra-ContentionResolutionTimer*

During offline [AT116bis][101], *ra-ContentionResolutionTimer* behaviour was discussed over multiple rounds. Final round outcome resulted in the following proposal, which was acceptable to 10/13 companies:

***Proposal: UE stops ra-ContentionResolutionTimer upon receiving PDCCH indicating Msg3 retransmission and then starts ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT.***

The primary concern of disagreeing companies is the limitation placed on MSG3 blind retransmission, noting if the above proposal is adopted the UE is not required to monitor PDCCH and may miss the blind retransmission of MSG3 between the moment when UE stops *ra-ContentionResolutionTimer* and the moment the UE (re)starts *ra-ContentionResolutionTimer*. This may impact cell coverage, which is a key issue given the large cell sizes of non-terrestrial networks.

Rapporteur notes that a large majority support the above proposal, and there is not consensus MSG3 blind retransmission is needed. It is suggested that the above proposal be adopted for Rel-17, and impact to coverage and possible enhancement to support MSG3 blind retransmission be considered in the Rel-18 NTN coverage enhancement study item.

**Question 8: Do you agree with the following compromise proposal?:**

***Proposal: UE stops ra-ContentionResolutionTimer upon receiving PDCCH indicating Msg3 retransmission and then starts ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT. I******mpact to coverage and possible enhancements (e.g. to support MSG3 blind retransmission) can be considered in the Rel-18 NTN coverage enhancement SI.***

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| **Company** | **Agree/Disagree** | **Additional comments** |
| CATT | Agree |  |
| OPPO | Agree |  |
| Samsung | Agree |  |
| Nokia | Disagree | Support blind Msg3 retransmission is a legacy function which is implemented in NW in both LTE and NR from the original release. It is now one typical strategy for Msg3 coverage enhancement in NW implementation.  As mentioned by Rapporteur, there is Rel-18 objective to study how to perform NTN coverage enhancement. It makes no sense to disable a legacy mechanism for coverage enhancement in Rel-17 then recover it in Rel-18. Note that Rel-18 enhancement would not be supported for all the NTN UEs.  If RAN2 want to disable a legacy function, it is natural to show strong technical reason why this is the reasonable way-forward. However, we don’t see that in this proposal.  To solve the root issue addressed by this proposal (i.e. declare unintended Contention Resolution failure during UE-gNB RTT), there is an alternative option2 without negative impact (i.e. simply capture UE does not consider the contention resolution failure in NOTE or MAC procedure).  ***Option 2: If ra-ContentionResolutionTimer expires during the UE-gNB RTT after Msg3 retransmission, the UE does not consider the Contention Resolution not successful.***  Hence, we think above Option2 is the simple and right way-forward for both Rel-17 and Rel-18 based on technical analysis.  We cannot accept the proposal. |
| Intel | Agree |  |
| Apple | Agree |  |
| vivo | Agree | The proposal is acceptable to us. |
| Lenovo, Motorola Mobility | Agree |  |
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# Other MAC Aspects

## LCP

### DRX and LCP parameter names

Based on comment to offline [AT116bis][107], several companies note that naming/descriptions of *allowedHARQ-DRX-LCP,* *uplinkHARQ-DRX-LCP-Mode* and HARQ DRX-LCP modes should be revised for further clarity in the specification.

**Question 9a: What is your preferred parameter naming?**

* **Option 1: *uplinkHARQ-mode*, *allowedHARQ-mode, and HARQ mode A/B***
* **Option 2: *uplinkHARQ-DRX-mode, allowedHARQ-DRX-mode, and HARQ-DRX mode A/B***

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| **Company** | **Preferred option?** | **Additional comments** |
| CATT | Option 1 | The UL HARQ transmission mode has impacts on LCP and DRX procedure, therefore the option 1 is more acceptable. |
| OPPO | Option 1 |  |
| Samsung | Option 1 |  |
| Nokia | Keep the original names | We think original parameter names is good enough to reflect the LCP and DRX impacts by seting different HARQ mode. So we prefer to keep the original names. However, to make progress, we are fine to accept Option1. |
| Intel | option 1 |  |
| Apple | Option 1 |  |
| vivo | None |  |
| Lenovo, Motorola Mobility | Option 1 |  |
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**Question 9b: Companies are invited to provide a revised/updated description of any of the above- listed parameters.**

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| **Company** | **Comments** |
| vivo | We propose to rename “allowedHARQ-DRX-LCP” , “uplinkHARQ-DRX-LCP-mode” and “HARQ DRX-LCP modes” into “allowedHARQ-Schemes”, “uplinkHARQ-Schemes” and “HARQ-Schemes”, respectively. |
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### HARQ mode for PUSCH transmission scheduled by RAR

During offline [AT116bis][107], HARQ mode for PUSCH transmission scheduled by RAR was discussed over multiple rounds. Final round outcome resulted in the following proposal, which was acceptable to 9/12 companies:

***Proposal: When HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, configuration of HARQ mode and allowedHARQ-DRX-LCP is up to NW implementation, and UE always follows it (no specification impact).***

During discussion, the following technical concerns were raised regarding the proposed solution:

**Technical Issue 1)** we need to clarify whether the configuration of “No HARQ state” is per HARQ process or per UE?

* *Rapporteur understanding is that based on agreement in RAN2#116e [6]: “if uplinkHARQ-DRX-LCP-Mode-r17 is configured, a HARQ process may be mapped to either ‘HARQ mode A’ or ‘HARQ mode B’.” either all HARQ processes are configured as “no HARQ state” or as “HARQ mode A/B”. This implies that “no HARQ state” is configured per UE.*

**Technical Issue 2)** if network configure HARQ process #0 with no HARQ state, dynamic scheduling may not be able to use this HARQ process since DRX RTT timer can not be extended by RTT.

* *Rapporteur understanding is that if a UE is not configured with uplinkHARQ-DRX-LCP-Mode-r17 or allowedHARQ-DRX-LCP, the LCH mapping rules do not apply.* *In this case legacy LCP operation applies and there should be no issue. Note: dynamic scheduling may rely on e.g., the UE being in Active time for other reasons if DRX timers prematurely expire.*

**Technical Issue 3):** if network configure HARQ process #0 with HARQ state, it means the LCHs configured with other HARQ state can not use it even if the RACH is triggered by them due to data arrival. It will greatly increase the delay.

* *Rapporteur understanding is that based on RAN2#116bis-e discussion outcome, majority think that this can be handled by NW implementation without specification impact.*

**Question 10a: Companies are invited to comment on the above technical issues or provide additional comments regarding the above proposal.**

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| **Company** | **Comments** |
| OPPO | Agree with the proposal, and regarding the above issues we have the same understanding as rapporteur. |
| Samsung | Agree with the proposal. We share the same understanding. |
| Nokia | Agree with Rapporteur for the technical issues analysis. |
| Intel | Agree with Rapporteur |
| Apple | Agree with rapporteur. |
| vivo | For technical issue 1~3, we share the views with Rapporteur. |
| Lenovo, Motorola Mobility | We agree that “no HARQ state” should be per UE.  As outlined in our previous contributions, we think that a PUSCH transmission scheduled by RAR, which is a dynamically scheduled PUSCH transmission, e.g. in the 4-step contention based random access procedure the RAR schedules PUSCH msg3 transmission and for CFRA RAR schedules a “normal” PUSCH transmission, requires some specific handling since the HARQ process is fixed to zero.  If NW configures HARQ process #0 with a HARQ state, it may lead to some delay for the transmission of UL data, since LCHs configured with a different HARQ state cannot use the PUSCH resource. It’s not clear to us how the NW could make sure that it configures the “correct” HARQ state in order to avoid the problem of delaying data.  There are companies which argue that this could be generally handled by NW implementation, i.e. NW configuring “no HARQ state” for HARQ process = 0 in order to ensure that a PUSCH transmission scheduled by RAR UL grant doesn’t undergo any further LCH restrictions (apart from the LCH restrictions defined for Rel-16). However, such solution will be quite restrictive in terms of NW scheduling flexibility in particular given that UE may not perform a RACH procedure very often. It would basically mean that HARQ process = 0 cannot be used by gNB according to its scheduling strategy.  It should be also note that PUSCH transmission scheduled by RAR have some special handling since Rel-15. For example In TS38.213 it is specified that UE always transmits the PUSCH scheduled by a RAR UL grant without repetitions. Even though UE is configured with a pusch-AggregationFactor, which indicates the number of repetitions to be used for a PUSCH transmission scheduled by an UL grant, UE uses no repetition for PUSCH transmission scheduled by RAR UL grant. Basically, UE ignores the field pusch-Aggregation configured by the network for cases when a PUSCH transmission is scheduled by a RAR UL grant. We think similar behaviour should be used for this case here, i.e. specifying that UE applies always “no HARQ state” for PUSCH scheduled by RAR. |
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In the RRC open issues email discussion [Pre117][NTN][101], Open issue 19 describes the following:

***Open issue 19:*** *HARQ type for SRBs or RRC message may need to be clarified to guarantee the reliability.*

*The open issue is about the LCP procedure in MAC, where it is decided to enable configuring either HARQ mode A or Mode B or none (any HARQ mode is fine) for each LCH, and then only allow data from that LCH to be transmitted on a HARQ process configured with that HARQ mode. Then the question is about do we need to enable configuring a HARQ mode also for SRBs. This open issue is moved to [Pre117-e][NTN][103] MAC open issues.*

**Question 10b: Companies are invited to comment on the above issue (e.g., whether configuration of HARQ mode and *allowedHARQ-DRX-LCP* is applied also for SRBs?)**

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| **Company** | **Comments** |
| OPPO | We think configuration of HARQ mode and *allowedHARQ-DRX-LCP* can also be applied for SRBs, depending on network implementation. |
| Samsung | SRBs are all using logical channels, then LCP mapping rules should be applied to SRBs. |
| Nokia | The configuration of HARQ mode and *allowedHARQ-DRX-LCP* is applied for SRB 1 to SRB3. |
| Intel | also applied for SRBs |
| Apple | Should apply to SRBs too. |
| vivo | We think there is no need to restrict the HARQ type for SRB, as SRB is anyway configured with AM mode, which can guarantee the reliability. |
| Lenovo, Motorola Mobility | No strong opinion here. But seems simpler to have same behaviour for DRBs and SRBs |
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## Miscellaneous timers

### Details of HARQ RTT Timer extention

In Rel-17 NTN, HARQ RTT timer behaviour is modified based on configuration of *downlinkHARQ-FeedbackDisabled* and *uplinkHARQ-DRX-LCP-Mode*. As an example, how the UE sets *drx-HARQ-RTT-TimerDL* length in NTN is captured in the NTN MAC running CR as follows:

1> if this Serving Cell is part of a non-terrestrial network:

2> if this Serving cell is configured with *downlinkHARQ-FeedbackDisabled* and DL HARQ feedback is enabled for a HARQ process:

3> set *drx-HARQ-RTT-TimerDL* length for the corresponding HARQ process to *drx-HARQ-RTT-TimerDL* included in *DRX-Config* plus UE-gNB RTT.

2> else:

3> set *drx-HARQ-RTT-TimerDL* length for the corresponding HARQ process to *drx-HARQ-RTT-TimerDL* included in *DRX-Config*.

During CR review in [Post116bis-e][109], two comments have been raised regarding current CR implementation of setting HARQ RTT timer behaviour:

**Comment 1)** The use of additional helper variables to set timer length

One company comments that when the drx HARQ RTT timers are extended for some HARQ processes and not extended for some HARQ process (in UL respectively DL), the description in MAC spec section 5.7 becomes messy as it in legacy always refer to the RRC parameters (*drx-HARQ-RTT-TimerDL/UL*) while the timer values will depend on the HARQ process ID.

They note to avoid ambiguity of what the UE shall do with received RRC parameters it is proposed to introduce two helper variables *HARQ\_RTT\_TIMER\_DL* and *HARQ\_RTT\_TIMER\_UL* to replace *drx-HARQ-RTT-TimerDL/UL* in all procedural text (companies are encouraged to refer to R2-2201629 for further discussion and an example text proposal).

**Question 11: What is your preferred method of implementing HARQ RTT timer extension?**

* **Option 1: Current implementation is sufficient**
* **Option 2: Introduce new helper variables *HARQ\_RTT\_TIMER\_DL* and *HARQ\_RTT\_TIMER\_UL* to replace existing instances of *drx-HARQ-RTT-TimerUL/DL.***

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| **Company** | **Preferred option?** | **Additional comments** |
| CATT | Option 1 |  |
| OPPO | Option 1 |  |
| Samsung | Option 1 |  |
| Nokia | Option 1 or Option2 | We are open to capture the UE-gNB RTT delay in a clear way. |
| Intel | option 1 |  |
| Apple | Option 2 | Seem cleaner to go this way, but no strong view. |
| vivo | No strong view | We slightly prefer the option 2, which has cleaner spec descriptions. But fine to follow the majority’s preference. |
| Lenovo, Motorola Mobility | Option 1 |  |
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**Comment 2)** The location of specification text setting the timer length

Considering agreement that uplinkHARQ-DRX-LCP-Mode also applies to CG, a unified procedure to modify RTT timer length was introduced in latest MAC running CR to simplify specification. one company comments that DRX RTT timer length cannot be set with UE-gNB RTT at the start of DRX section. This is because UE will set the DRX RTT with the current UE-gNB RTT instead of the UE-gNB RTT when DRX RTT is actually started. Thus, UE can only set the DRX RTT timer right before DRX RTT is started/restarted.

**Question 12: What is your preferred location for HARQ RTT timer extension text?**

* **Option 1: Current implementation is sufficient**
* **Option 2: Repeated at each instance prior to start of *drx-HARQ-RTT-TimerUL/DL.***

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| **Company** | **Preferred option?** | **Additional comments** |
| CATT | Option 1 |  |
| OPPO | Option 1 |  |
| Nokia | Option 1 with comments | Agree to further clarify that the UE-gNB RTT should be the one right before DRX RTT timer started/restarted. |
| Intel | option 1 |  |
| Apple | Option 1 |  |
| vivo | Option 2 |  |
| Lenovo, Motorola Mobility | Option 1 |  |
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### Extension of the *configuredGrantTimer*.

During offline [AT116bis][107], extension of the *configuredGrantTimer* was discussed over multiple rounds. Final round outcome resulted in several observations, which led to the following proposal:

***Proposal: configuredGrantTimer length is extended by UE-gNB RTT in NTN.***

During subsequent discussion, several technical issues were raised regarding the proposed solution:

**Technical Issue 1):** Mismatch between UE and gNB

Mismatch between UE and gNB making the UE not transmit when the gNB expects the UE to (UE misses a CG opportunity) or making the gNB not decoding a CG when the UE transmits (This is maybe not a severe issue as it shall not happen frequently).

* *Rapporteur notes that based on past discussion outcome companies recognize this as an issue, however a large majority (8/11) think this may be handled by existing mechanisms with no further specification impact.*

**Technical Issue 2):** gNB resource planning

gNB cannot plan the future resource usage as gNB cannot know how the UE-gNB RTT will vary in advance. In legacy periodicity times configuredGrantTimer gives the time that the timer will be running. A change to base the running of this timer on the UE-gNB RTT means the gNB do not know in advance when in time a CG will be reused by one UE. It also means that the running time of this timer for different UEs will vary differently depending on where in a cell they are located. The gNB may handle thousands of UEs, and not knowing how a CG-config will be used by the UEs is a new limitation for the gNB that it would need to handle the overhead from. This decreases the possibility for the gNB to use CG for as many users as possible.

**Technical Issue 3)** Overhead

Using a new field configuredGrantTimer-r17 of 8 bits will not lead to any overhead, as configuredGrantTimer is an optional parameter.

* *Rapporteur agrees a new IE of 8 bits does not increase overhead. However, based on past discussion a majority (7/11) do no not think that values in Option 2 can be selected to balance overhead and approximately compensate UE-gNB RTT. Comments should therefore focus on whether companies think 8 bits is sufficient to approximately compensate UE-gNB RTT.*

**Question 13: Companies are invited to comment on the above technical issues or provide additional comments regarding the above proposal.**

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| **Company** | **Comments** |
| OPPO | Argee with the proposal.  For issue 1, extension by UE-gNB RTT applies to various timers in NTN, and the mismatch issue between UE and gNB has not been identified for the other timers such as drx-HARQ-RTT-TimerUL/DL. For configuredGrantTimer the situation is the same, and there is no reason to consider it problematic.  Issue 2 is related to issue 1, with TA reporting, network could know UE-gNB RTT and plan the cell radio resourece properly. |
| Samsung | We don’t agree with the proposal and we think issue 1 and 2 are valid issues when extending by UE-gNB RTT. Different from other timers extended by UE-gNB RTT, e.g. drx-HARQ-RTT-TimerUL/DL, for which the network does not need to know how much the timer is extended nor the status of the timer, for *configuredGrantTimer* the network need to fix the timer length and know the timer status to schedule transmission as the purpose of the configured grant is to allocate resources in a semi-static manner. However, the dynamic UE-gNB RTT contradicts the purpose of configured grant. We think *configuredGrantTimer* should be extended by fixed values that accommendate UE-gNB RTT as much as possible. |
| Nokia | For Issue 1), we think the issue is not a rare case. It can happen frequently in LEO when the satellite is moving which will cause a time-varied UE-gNB RTT. It will cause the CG timer mismatch between UE and gNB.  For example, if the configuredGrantTimer is extended by the UE-gNB RTT right before the CG transmission time, while the UE-gNB RTT is increasing due to the UE-gNB distance increased with satellite moving, the NW scheduled retransmission may arrive in UE later than the CGT timer expiry. UE may recover the new CG transmission in CG occasion after the timer expiry while it received a retransmission for the same HARQ process later. It will cause the CG new transmission missed by gNB in the end. Furthermore, it is not possible for NW to avoid the issue via predicting the UE-gNB RTT change since NW may not have UE’s location at all.  For Issue 2), agree the Rapporteur analysis. Any mismatch between UE and gNB will cause gNB hard to schedule the UE since gNB can only guess what will happen in UE.  For Issue 3), we are not sure whether the NW configured value (via new field configuredGrantTimer-r17) can work well. The time-varied UE-gNB RTT may impact the NW scheduling as well because NW only start the time when it received the CG transmission from the UE, but NW cannot predict how the UE-gNB RTT will change when the UE received the dynamic retransmission. It seems the same mismatch problem in issue 1) can happen in NW configured CGT value solution too. |
| Apple | Prefer extending CGT explicitly by providing new llarger values. |
| vivo | We don’t think the mismatch between UE and gNB (if any) is really a big issue in this case, which can be handled by NW implementation. |
| Lenovo, Motorola Mobility | We see no essential problem for Issues 1) and think NW implementation can handle if any. |
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## Other Issues

### Identification of non-terrestrial network cells

To identify when UE is to perform NTN-specific actions (e.g., timer extensions to accommodate addition RTT) text such as the following is used in the current version of the running NTN MAC CR [2]:

1> if this Serving Cell is part of a non-terrestrial network:

2> if this Serving cell is configured with *downlinkHARQ-FeedbackDisabled* and DL HARQ feedback is enabled for a HARQ process:

3> set *drx-HARQ-RTT-TimerDL* length for the corresponding HARQ process to *drx-HARQ-RTT-TimerDL* included in *DRX-Config* plus UE-gNB RTT.

….

This has led to the following Editor’s Note:

Editor’s note: How UE detects cell originates from a non-terrestrial network to be confirmed by RAN2.

In RAN2#116bis-e, the following was agreed [7]:

1.*UE can know the NW type implicitly no later than SIB1 reception, there is no explicit NW type indication in SIB1.*

RAN2 therefore needs to conclude whether existing text referring to non-terrestrial networks in MAC running CR is sufficient, or if additional clarification is needed how the UE implicitly detects NTN NW type.

**Question 14: Does MAC specification require further clarification on how UE detects a cell originates from a non-terrestrial network? If ‘Yes’, please describe how.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| CATT | No with comment | We agree with the current text, but it is better if the MAC can quote other specification (e.g. RRC) which will specify the related mechanism of NTN type determination. |
| OPPO | Maybe Yes |  |
| Samsung | No but | We don’t need specify “1> if this Serving Cell is part of a non-terrestrial network”. The description starting with “2> if this Serving…” is sufficient to work. |
| Nokia | No |  |
| Intel | No | if this clarification is needed, we can add reference to RRC spec |
| Apple | No | Current text is sufficient. |
| vivo | No |  |
| Lenovo, Motorola Mobility | No |  |
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# Summary

<To be generated based on company input>

# Conclusions

<To be generated based on company input>

# References

1. R2-2201755 – Summary of [AT116bis][101][NTN] RACH aspects (OPPO)
2. R2-2201899 – [DRAFT] 38.321 running NTN CR (InterDigital)
3. R2-2201739 – Summary of [AT116bis-e][107][NTN] Other MAC issues (InterDigital)
4. R2-2201849 – Summary of [AT116bis-e][107][NTN] Other MAC issues Phase 2 (InterDigital)
5. R2-2201900 – Summary of [Post116bis-e][109][NTN] MAC running CR and list of open issues (InterDigital)
6. R2-2201970 – Report of 3GPP TSG RAN WG2 meeting #116-e (ETSI MCC)
7. Draft\_R2-116bise\_Meeting\_Report\_v1 (ETSI MCC)

# Appendix: Remaining open issues

The following are identified open issues from R2-2201900 which have not been covered under the scope of this discussion.

## To be addressed by CR editor

**Open Issue 4:** Event triggering for UE-specific TA reporting

RAN2 to finalize details regarding event-triggered TA reporting for UE in RRC Connected in RRC specification, with update to MAC as needed (e.g. parameter name of offset threshold). NOTE: This is not to define new behaviour, but to update MAC specification based on RRC.

**Open Issue 5:** Details of UE-specific K\_Offset and TA reporting MAC CEs

Additional details of K\_Offset MAC CE can be updated as needed.

**Open Issue 12:** Details of SR-Prohibit Timer extension – MAC impact.

RAN2 to confirm values included in new *sr-ProhibitTimerExt-r17* IE in RRC discussion. MAC CR can be updated if any impact identified.

## To be addressed by contribution to RAN2#117e

**Open Issue 14:** drx-HARQ-RTT-TimerDL/UL behaviour for HARQ feedback enabled and UL HARQ state A

RAN2 to discuss UE DRX behaviour when PDCCH indicates a UL/DL transmission doesn’t consider the case where drx-HARQ-RTT-TimerUL/DL for the corresponding HARQ process has already been running. (Companies are referred to [R2-2201739](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Inbox/R2-2201739.zip), Section 5.2 for additional details).

**Open Issue 15:** Repetition transmission based HARQ retransmission

RAN2 to discuss whether repetition transmission based HARQ retransmission is always allowed and is explicitly indicated via DCI or semi-statically with RRC signalling (as in legacy). (Companies are referred to [R2-2201739](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Inbox/R2-2201739.zip), Section 5.2 for additional details).

**Open Issue 16:** details of DRX behaviour after sending SR and msg3 for CFRA

RAN2 to discuss whether:

* for DRX in NTN, in the case that a UE sends an SR, the UE enters Active time to monitor for a response after an offset time has elapsed.
* In the case that a UE sends msg3 as response to a RAR message during CFRA, the UE enters Active time when an offset time has elapsed.

(Companies are referred to [R2-2201739](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Inbox/R2-2201739.zip), Section 5.2 for additional details).

**Open Issue 17:** UL synchronization failure

RAN2 to discuss how to handle UL synchronization failure due to the validity timer expiry (discussed in R2-2201755 but no conclusion)

**Open Issue 18:** DL MAC CE execution delay

RAN2 to discuss if we need to capture the DL MAC CE execution delay by K\_MAC agreed by RAN1.

**Open Issue 19:** UE location information for pruposes of TA reporting

RAN2 to confirm support of UE location information for purposes of TA reporting.