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

**Electronic, February, 2022**

**Agenda Item: 9.2.3.1**

**Source: OPPO**

**Title: [Pre117-e][011][IoT-NTN] User plane Open Issues Input (OPPO)**

**Document for: Discussion and Decision**

# Introduction

This document is used to collect companies’ input to IoT NTN User Plane open issues identified after RAN2#116bis-e meeting and recommend proposals for RAN2#117e to discuss.

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# Discussion

For companies’ easy track, RAN2 agreements related to IoT NTN’s UP impact are copied below.

RAN2#115e:

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| * Start of ra-ResponseWindow is delayed by an offset. Postpone discussion on the offset value until further agreements regarding RACH are made in RAN1. * If the start of the RA Response window is accurately compensated by UE-eNB RTT and no extension of repetition is required, there is no need to extend the ra-ResponseWindowSize for IoT NTN. * Start of mac-ContentionResolutionTimer is delayed by an offset, (assumed equal to UE-eNB RTT). This can be revisited if RAN1 decides something that requires to change this. * If the start of mac-ContentionResolutionTimer is accurately compensated by UE-eNB RTT and no extension of repetition is required, there is no need to extend the mac-ContentionResolutionTimer for IoT NTN. * From RAN2 perspective, for UE with UE-specific pre-compensation as a baseline it is up to eNB implementation to ensure sufficient time on UE side for the Msg3 transmission for IoT NTN. * RAN2 assumes that TA information (FFS what) reporting by the UE on network enabling will be needed in IoT NTN. Expect RAN1 need to progress on this, and can maybe reuse NR NTN progress. FFS in which message this is provided. * UE-eNB RTT is taken into account when calculating the (UL) HARQ RTT timer. * RAN2 assumes that sr-ProhibitTimer need to be extended. Postpone treatment of sr-ProhibitTimer values until the NR NTN details have been decided. * From RAN2’s perspective, delayed start of pur-ResponseWindowTimer with UE-eNB RTT can be supported. This can be revised if RAN1 finds issues to support PUR that are not small. * pur-ResponseWindowSize is not extended for IoT NTN. * SPS is supported without modification for IoT NTN. * RAN2 confirm the SI agreement that the value range of the RLC t-Reordering timer will be extended to support IoT NTN. * Do not extend the PDCP discardTimer for NB-IoT over NTN. * FFS whether to extend the PDCP discardTimer for eMTC over NTN. * Do not extend PDCP t-Reordering for IoT NTN. |

RAN2#116e:

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| * The estimate of UE-eNB RTT is equal to the sum of UE’s TA and K\_mac, where the UE’s TA is given by , and K\_mac value is broadcasted by network. * RAN2 confirm that the start of mac-ContentionResolutionTimer is delayed by UE-eNB RTT in IoT NTN. * Any enhancements on (N)PRACH resource selection in IoT NTN will not be pursued in Rel-17. * An offset equal to UE-eNB RTT is added to the formula used for calculating the (UL) HARQ RTT timer in IoT NTN. * Support UE-specific TA reporting using MAC CE in Msg3/Msg5 for IoT NTN. * For IoT NTN, UE specific TA reporting during RACH procedure (MSG3/MSG5) in RRC IDLE is enabled/disabled by SI, similar with NR NTN. * Support TA reporting in RRC connected mode in IoT NTN. * UE-specific TA report uses MAC CE. * Support event-triggered for TA reporting in connected mode. Wait for NR NTN agreements for other triggers. * On how to extend RLC t-Reordering in IoT NTN, wait for NR NTN agreements and see if they can be reused. * Don’t change the L2 buffer requirement for IoT NTN (assume the network may need to limit the bit rate in order to not exceed L2 buffer). * The PDCP discardTimer should be extended to support eMTC over NTN. * If PDCP discardTimer is agreed to be extended to support eMTC over NTN, how to extend the timer value can wait for the conclusion for RLC t-reordering timer. * The ra window start offset is defined as sum (current offset, UE-eNB RTT) and current offset is defined in TS36.321 (FFS if applicable to NB-IoT 41ms offset) |

RAN2#116bis-e:

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| * Do not mandate Msg3 or Msg5 to include TA report MAC CE, and whether it can be included depends on the TB size of Msg3 or Msg5. * Reuse NR NTN’s TA reporting trigger event in IoT NTN, i.e., a TA offset threshold between current TA and the last successfully reported TA is used for event-triggered TA reporting. FFS for location used for TA reporting purpose. * Introduce a new MAC CE for provision of UE specific K\_offset and the size is fixed to 1 byte. FFS on the MAC CE’s name. * (Following NR NTN) Neither of the following options are supported “TA information requested by network”, “Periodical reporting of TA information” * (Following NR NTN) Upon reception of configuration or reconfiguration of TA reporting trigger event, if UE has not reported TA before, the UE triggers a TA reporting. FFS whether we need different behaviour for different re-configurations e.g. Handover. * On the RAR window’s start offset for the case of NB-IoT 41ms offset: The RA window start offset defined as sum (current offset, UE-eNB RTT) is applied to the case of NB-IoT 41ms offset. |

## 2.1 MAC

### 2.1.1 K\_Offset MAC CE

*MAC CE’s name:*

In the current running CRs of 38.321 and 36.321, the name of “Differential UE-Specific K\_Offset MAC CE” has been used for the MAC CE corresponding K\_Offset. Companies can comment if this is agreeable and if not, please indicate the suggested name.

**Question 1: Do companies agree to use the name of “Differential UE-Specific K\_Offset MAC CE”?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree |  |
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*MAC CE’s contents:*

Regarding MAC CE’s contents, NR NTN running CR has captured the following contents.

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

Rapporteur assumes 36.321 can follow the same text.

**Question 2: Do companies agree to follow the same text as 38.321 running CR for the contents of the MAC CE corresponding K\_Offset, i.e. “This field contains the differential UE-specific K\_Offset. The length of the field is 8 bits.”?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree |  |
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*MAC CE’s LCID:*

Regarding the LCID for the MAC CE corresponding K\_Offset, two options are mentioned in [6], i.e. using a reserved LCID or repurposing an existing LCID. Note that there are currently 4 reserved LCID for LTE.

**Question 3: Which option do companies prefer for the LCID used for the MAC CE corresponding K\_Offset?**

* **Option 1: use a reserved LCID**
* **Option 2: repurpose an existing LCID (and which one?)**

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| **Company** | **Option** | **Additional comments** |
| ZTE | Option 1 |  |
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### 2.1.2 TA reporting MAC CE

*MAC CE’s name:*

In the current running CRs of 38.321 and 36.321, the name of “UE-specific TA Report MAC CE” has been used for the TA reporting MAC CE. Companies can comment if this is agreeable and if not, please indicate the suggested name.

**Question 4: Do companies agree to use the name of “UE-specific TA Report MAC CE”?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree |  |
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*MAC CE’s contents:*

Regarding TA reporting MAC CE’s contents, NR NTN running CR has captured the following contents.

- 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.

Rapporteur assumes 36.321 can follow the same text.

**Question 5: Do companies agree to follow the same text as 38.321 running CR for the contents of the TA reporting MAC CE, i.e. “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.”?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree |  |
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*MAC CE’s LCID:*

Regarding the LCID for the TA reporting MAC CE, two options are proposed in [3][6][8], i.e. using a reserved LCID or repurposing an existing LCID. Note that there are currently 2 reserved LCID for LTE.

**Question 6: Which option do companies prefer for the LCID used for the TA reporting MAC CE?**

* **Option 1: use a reserved LCID**
* **Option 2: repurpose an existing LCID (and which one?)**

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| **Company** | **Option** | **Additional comments** |
| ZTE | Option 1 or Option 2 | Option 1 is simple.  As there are only two reserved LCID in uplink which are precious, we have sympathy with the analysis in [6] and are acceptable to Option 2. |
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*MAC CE’s logical channel priority:*

In NR NTN, logical channel priority of the TA reporting MAC CE has been agreed as below.

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| - C-RNTI MAC CE or data from UL-CCCH;  - Configured Grant Confirmation MAC CE or MAC CEs for BFR or Multiple Entry Configured Grant Confirmation MAC CE;  - Sidelink Configured Grant Confirmation MAC CE;  - LBT failure MAC CE;  - MAC CE for UE-Specific TA Report;  - MAC CE for SL-BSR prioritized according to clause 5.22.1.6;  - MAC CE for BSR, with exception of BSR included for padding;  - Single Entry PHR MAC CE or Multiple Entry PHR MAC CE;  - MAC CE for the number of Desired Guard Symbols;  - MAC CE for Pre-emptive BSR;  - MAC CE for SL-BSR, with exception of SL-BSR prioritized according to clause 5.22.1.6 and SL-BSR included for padding;  - data from any Logical Channel, except data from UL-CCCH;  - MAC CE for Recommended bit rate query;  - MAC CE for BSR included for padding;  - MAC CE for SL-BSR included for padding. |

Below is the list of MAC CEs in 36.321.

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| - MAC control element for C-RNTI or data from UL-CCCH;  - MAC control element for DPR;  - MAC control element for SPS confirmation;  - MAC control element for AUL confirmation;  - MAC control element for BSR, with exception of BSR included for padding;  - MAC control element for PHR, Extended PHR, or Dual Connectivity PHR;  - MAC control element for Sidelink BSR, with exception of Sidelink BSR included for padding;  - MAC control element for DCQR and AS RAI, with exception of when DCQR is to be included in Msg3;  - data from any Logical Channel, except data from UL-CCCH;  - MAC control element for DCQR and AS RAI, when DCQR is to be included in Msg3;  - MAC control element for Recommended bit rate query;  - MAC control element for BSR included for padding;  - MAC control element for Sidelink BSR included for padding. |

Rapporteur assumes LTE can follow the same priority as NR and propose that TA report MAC CE is put between “MAC control element for AUL confirmation” and “MAC control element for BSR, with exception of BSR included for padding”. Companies can comment if this is agreeable, and if not, please indicate the suggested order.

**Question 7: Do companies agree to put TA report MAC CE between “MAC control element for AUL confirmation” and “MAC control element for BSR, with exception of BSR included for padding”?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree | Even we slightly prefer that BSR/DCQR can have higher priority, the current suggested sequence is also acceptable to us (e.g., fine to follow NR NTN). |
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### 2.1.3 Enable/disable indication applied for TA reporting in connected mode?

This is a common issue which is also being discussed in NR NTN. Note that the enable/disable indication in SI was initially introduced to control whether to trigger TA report during initial access (i.e. in Msg3/Msg5), and later RAN2 agreed to introduce event-triggered TA reporting in connected mode.

For connected mode UE TA reporting, we might need to look into following cases.

Case 1: re-establishment

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.

**Question 8: Do companies agree that in re-establishment procedure, UE should follow the enable/disable indication broadcasted by the target cell’s SI to determine whether to trigger TA report during RACH?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree | After RLF, the UE would perform cell reselection and access to the target cell as that in idle state.  Therefore, it’s naturally that UE should follow the enable/disable indication broadcasted by the target cell’s SI to determine whether to trigger TA report during RACH. We assume no specification impacts for this part. |
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Case 2: handover

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.

**Question 9: Do companies agree that in handover procedure, UE should follow the target cell’s enable/disable indication carried in handover command to determine whether to trigger TA report during RACH?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree | For handover case, UE should follow the target cell’s enable/disable indication in SIB2 carried in handover command to determine whether to trigger TA report during RACH.  This is also aligned with the assumption that enable/disable indication in SIB is used to control whether to trigger TA report during RACH. |
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Other than re-establishment and handover procedure, there seems no value to have extra control of TA reporting by checking enable/disable indication since network can have UE-specific TA reporting event configuration to control TA reporting in connected mode.

**Question 10: Do companies agree that other than re-establishment and handover procedure, TA reporting in connected mode is not controlled by enabling/disabling indication in SI?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree |  |
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### 2.1.4 TA reporting upon configuration/reconfiguration

During RAN2#116bis-e online discussion, some comments are raised for the following proposal.

Proposal 5: Upon reception of configuration or reconfiguration of TA reporting trigger event, if UE has not reported TA before, the UE triggers a TA reporting.

Eventually proposal 5 is agreed with the following FFS added.

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| * (Following NR NTN) Upon reception of configuration or reconfiguration of TA reporting trigger event, if UE has not reported TA before, the UE triggers a TA reporting. FFS whether we need different behaviour for different re-configurations e.g. Handover. |

One issue related to handover seems to be that handover command may use delta-configuration and target cell may not provide explicit TA reporting event configuration in handover command. In such case, UE still has valid event configuration (i.e. the one used in the source cell), but based on above agreement, UE will not trigger TA report in the target cell (assuming target cell’s SI has disabled TA reporting during RACH) until the target cell reconfigures the triggering event.

Another issue is that UE may change cell during handover. Even if UE has reported TA to the source cell, the source cell TA may not be suitable to be compared to when evaluating the triggering condition in the target cell as it may lead to too late TA reporting. Before that late reporting, the target cell cannot know UE’s TA and thus cannot configure UE-specific K\_Offset properly.

Rapporteur understands that the above FFS may also apply to re-establishment and it can be resolved by adding explicit triggers in the spec that upon re-establishment or handover, UE triggers a TA reporting if the UE has a valid TA reporting event configuration. Companies please share views whether this is agreeable and if not, please indicate the suggested UE behaviours.

**Question 11: Do companies agree that upon re-establishment or handover, UE triggers a TA reporting if UE has a valid TA reporting event configuration? If you disagree, please indicate the suggested UE behaviours.**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Disagree | For re-establishment case:  With reference to the summary from rapporteur, we can see the problematic case is that UE is configured event-trigger TA report in source cell while the TA report is disabled in SIB in target cell.  Considering the target cell may not need TA report in connected mode or may have different event configuration, we think the simpler or safer way may be that, only if the UE is (re)configured with new event by target cell via *RRCConnectionReestablishment* or *RRCConnectionReconfiguration*, UE can send TA report in connected mode. In other word, whether UE can send TA report after RRC reestablishment should follow explicit configuration in target cell and the event configuration in source cell cannot be reused.  We also agree with the rapporteur’s analysis and think the source cell TA is not suitable to be used as reference value for later comparison. Similar as that for UE in idle, no matter enable/disable in SIB, UE can record the TA value during RACH procedure in target cell as new reference.  One special sub-case may be that UE re-establish RRC connection in the same cell. It may be no issue even if UE continue to use the previous event-trigger configuration. But we prefer UE to have common process as that in re-establishing RRC connection in different cell case. We are open to discuss this.  For handover case (it’s only applicable to eMTC NTN):  We have similar thought as that for re-establishment, e.g., not to reuse the event configuration in source cell. Only if the UE is (re)configured with event by target cell via handover command, the UE can send TA report after handover. This may also related how to define the event configuration in reconfiguration message, e.g., use NEED OR or NEED ON.  Similarly, UE can record the TA value during RACH procedure in target cell as new reference for later comparison. |
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### 2.1.5 TA reporting aligned with NR NTN?

With the above RAN2#116bis-e agreements “Reuse NR NTN’s TA reporting trigger event in IoT NTN, i.e., a TA offset threshold between current TA and the last successfully reported TA is used for event-triggered TA reporting.”, the current running CR for 36.321 basically reused the formatting and progress of NR-NTN in Section “5.4.X UE-Specific TA Reporting”. During running CR discussion, some companies provided the following comments.

“We think that most of what is described below has not been fully agreed or even discussed. We suggest to remove the description and capture all the related agreements in Editor’s Notes. We suggest to add a MAC open issue on UE-specific TA reporting, covering e.g.:

* scope of enableTA-Report indication (only RACH during initial access, also Re-establishment, Handover, MAC triggered RACH)
* configuration of event-triggered reporting
* triggering during reconfiguration
* RRC-MAC interaction”

Rapporteur is not sure whether the intention of the above comments is to deviate anywhere from NR NTN, but it might be good to check companies’ views whether alignment with NR NTN should be targeted or any deviation would be favoured. If deviation is favoured, please indicate which part should be deviated from NR NTN.

**Question 12: Do companies agree that the threshold-based TA-Trigger needs to align with NR-NTN?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree | We are fine to reuse NR NTN agreements/description as much as possible.  The contents should also be aligned with our own agreements in IoT NTN. |
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### 2.1.6 Extension of *sr-ProhibitTimer*

How to extend *sr-ProhibitTimer* was discussed in [6]. It states that in NR, sr-ProhibitTimer is signalled as a value in the unit of ms so it is straightforward to extend the value range to take into account the RTT in NTN. In NB-IoT and eMTC, sr-ProhibitTimer is signalled as a value in number of SR period(s). The length of a SR period can take very different values depending on the configuration, i.e. 1ms, 2ms, 5ms, 10ms, 20ms, 40ms and 80ms for eMTC and 40ms, 80ms, 160ms, 240ms, 320ms, 640ms, 1280ms, 2560 ms, 5120 ms for NB-IoT. Thus it seems better to add an offset to the signalled value of the timer length.

**Question 13: Which option do companies prefer to extend *sr-ProhibitTimer* in IoT NTN?**

* **Option 1: add an offset to the legacy value**
* **Option 2: follow NR NTN and add more extended values (in number of SR periods)**

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| **Company** | **Option** | **Additional comments** |
| ZTE | Option 2 | It seems NR NTN still allow smaller value than RTT to be configured (technically, we think small value may be useless). Then maybe Option 1 is not so flexible.  Generally, the *sr-ProhibitTimer* is used to avoid UE frequently sending SR, e.g., after UE send the first SR, it should wait for some time and then send another SR. Some factors needs to be taken into account for setting this SR prohibit time, e.g., transmission RTT, the possible delay of UL grant scheduling for BSR in eNB side, e.g., due to resource congestion, and the loss of BSR and/or UL grant scheduling for BSR.  Yes, different from NR NTN, In NB-IoT and eMTC, sr-ProhibitTimer is signalled as a value in number of SR period(s).  If we only consider the possible delay of UL grant scheduling for BSR in eNB side, Option 1 may be ok. That is, the maximal time duration of the *sr-ProhibitTimer* in NTN could be UE-eNB RTT + 7 \* SR period.  But if also the loss of BSR and/or UL grant scheduling for BSR are considered, we think SR should be avoided during the possible multiple UL grant scheduling for BSR. Then the maximal time duration of the *sr-ProhibitTimer* may need to be multiple UE-eNB RTT. Following the legacy, such multiple factor can be with maximal value of 7, e.g., maximal time duration of the SR prohibit time can be 7 \* UE-eNB RTT.  Furthermore, with unit of SR period, when determine the value range of *sr-ProhibitTimer*, we need to do some conversion. We think we need to ensure the required maximum SR prohibit time can be achieved in the case of minimum SR period (1ms for eMTC and 40ms for NB-IoT). So the value range is calculated as follows:   * For eMTC:   + For LEO NTN, the maximum required SR prohibit time can be 32 (i.e., 4ms\*7/1ms=28, and ceiling to a value with 2^n=32) and minimum is 4ms. For LEO NTN, the maximum required SR prohibit time can be 4096 (i.e., 541ms\*7/1ms=3787, and ceiling to a value with 2^n=4096) and minimum is 541ms. After merge, we propose the value of *sr-ProhibitTimer* is extended to INTEGER (1...4096) * For NB-IoT:   + Mainly considering GEO NTN case, the maximum required SR prohibit time can be 128 (i.e., 541ms\*7/40ms=94.675, and ceiling a value with 2^n =128). We propose the value of *sr-ProhibitTimer* is extended to INTEGER (1...128)   With Option 2, we think the legacy configure rules which may take into account the network scheduling flexibility and tolerable UL/DL transmission loss can be kept as much as possible. |
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If option 1 is preferred, the next question is whether the offset is fixed (e.g. equal to UE-eNB RTT) or signalled by the network.

**Question 14: If option 1 is preferred in Q13, how to decide the offset?**

* **Option 1: the offset is fixed (e.g. equal to UE-eNB RTT)**
* **Option 2: the offset is signalled by the network**

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| **Company** | **Option** | **Additional comments** |
| ZTE | Option 2 | Even we prefer Option 2 in Q13, here we just give our opinion for Option 1. For simplicity, UE can just add a fixed offset (e.g. UE-eNB RTT) to the configured SR prohibit time by UE itself.  But network may want a smaller or larger value than RTT, then it may be better to let network configure this value. |
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## 2.2 RLC t-Reordering timer extension

NR NTN has agreed to extend t-Reassembly timer: {ms210, ms220, ms340, ms350, ms550, ms1100, ms1650, ms2200} and it is suggested that IoT NTN reuses the same values for IoT NTN.

**Question 15: Do companies agree to extend RLC t-Reordering timer by adding values {ms210, ms220, ms340, ms350, ms550, ms1100, ms1650, ms2200}?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Disagree | Please note the maximum value of RLC *t-Reordering* for eMTC and NB-IoT is already ms1600.  We think a double value may be needed. So simply suggest to add ms2200 and ms3200. |
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## 2.3 PDCP discardTimer extension

NR NTN has agreed to introduce a new discardTimerExt-r17 IE with a new value ms2000 and it is suggested that eMTC over NTN reuses the same values for IoT NTN.

**Question 16: Do companies agree to introduce a new discardTimer value ms2000 for eMTC over NTN?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| ZTE | Agree | Fine with ms2000.  But it may be better to add one more value for eMTC NTN e.g., ms3000 (just a double value of the existing maximum value of ms1500 for eMTC).  BTW, the existing maximum value of *discardTimer* for NB-IoT is ms81920, that’s enough. |
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# 3. Summary and Proposals

*To be updated…*

# 4. References

1. R2-2200253, Discussion on UP impact for IoT over NTN, OPPO
2. R2-2200692, Discussion on TA information reporting for IoT NTN, CATT
3. R2-2200698, Remaining FFSs on UP in IoT NTN, ZTE Corporation, Sanechips
4. R2-2200878, Remaining issues on UP aspects for IoT-NTN, CMCC
5. R2-2201010, On User Plane left issues for IoT NTN, Nokia, Nokia Shanghai Bell
6. R2-2201454, User plane for IOT NTN, Huawei, HiSilicon
7. R2-2201547, Location Reporting in RRC\_CONNECTED, Interdigital, Inc.
8. R2-2201631, User plane aspects of NB-IoT and LTE-M in NTNs, Ericsson