**3GPP TSG-RAN WG2 Meeting #116 electronic *R2-211xxxx***

**Online, November 1st – November 12th, 2021**

**Agenda Item: 8.10.2.1**

**Source: OPPO**

**Title: Summary of [AT116-e][106][NTN] RACH aspects (OPPO)**

**Document for: Discussion and Decision**

# Introduction

This document aims to summarize the following offline discussion.

* [AT116-e][106][NTN] RACH aspects (Oppo)

Initial scope: Continue the discussion on RACH aspects (with focus on TA reporting)

Initial intended outcome: Summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
		- List of proposals that require online discussions
		- List of proposals that should not be pursued (if any)

Initial deadline (for companies' feedback): Thursday 2021-11-04 1000 UTC

Initial deadline (for rapporteur's summary in R2-2111338): Thursday 2021-11-04 1600 UTC

Proposals marked "for agreement" in R2-2111338 not challenged until Friday 2021-11-05 0800 UTC will be declared as agreed via email by the session chair (for the rest the discussion will further continue offline until the CB session in Week2).

# Discussion

This offline discussion mainly focuses on proposals related to TA reporting in [1-18] and touches some other RACH issues which are brought up by companies.

## 2.1 TA reporting

### 2.1.1 TA reporting during RACH

On TA reporting during RACH procedure, RAN2 has made following agreements:

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| RAN2#114-e agreement:1. If enabled by the network, the UE reports information about UE specific TA pre-compensation at the random access procedure (MSGA/MSG3 or MSG5) using a MAC CE. Actual content is FFS and also depends on further RAN1 input (we can revise this whole agreement if RAN1 come to a different conclusion in terms of what needs to be conveyed to the NW)
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| RAN2#115-e agreement:1. UE specific TA reporting during RACH procedure is enabled/disabled by SI (FFS for RACH in connected mode)
2. The content of UE specific TA pre-compensation reported in RA procedure using MAC CE is UE specific TA (this can be revisited after receiving RAN1 response).
3. If configured, the UE shall report information of the UE specific TA pre-compensation to the target cell during the random access. FFS if a new indication in RRC reconfiguration with sync is needed or not (besides the SIB indication carried in HO command on whether TA report is enabled/disabled in the target cell).
4. Information about UE specific TA pre-compensation is not reported in RA procedures triggered due to “Request for Other SI”
5. No new indication in RRC reconfiguration with sync is needed to configure the UE to report information about UE specific TA in handover procedure (besides the SIB indication carried in HO command on whether TA report is enabled/disabled in the target cell).
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**Content of TA reporting**

RAN2#115e has agreed that the content of UE specific TA pre-compensation reported in RA procedure using MAC CE is UE specific TA, and we also received RAN1 LS on TA reporting in R2-2111221. RAN1’s definition of UE’s TA is provided to RAN2 as shown below, and it is stated that it is up to RAN2 to decide which component or what combination of the components in the UE’s TA formula to use in TA reporting.

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| Agreement:The Timing Advance applied by an NR NTN UE in RRC\_IDLE/INACTIVE and RRC\_CONNECTED is given by:$$T\_{TA}=\left(N\_{TA}+N\_{TA, UE-specific}+N\_{TA,common}+N\_{TA,offset}\right)×T\_{c}$$Where:* $N\_{TA}$ is defined as 0 for PRACH and updated based on TA Command field in msg2/msgB and MAC CE TA command.
	+ FFS: details of NTA update/accumulation.
* $N\_{TA, UE-specific}$  is UE self-estimated TA to pre-compensate for the service link delay.
* $N\_{TA,common}$ is network-controlled common TA, and may include any timing offset considered necessary by the network.
* $N\_{TA,common}$ with value of 0 is supported.
	+ FFS:  details of signaling including granularity.
* $N\_{TA,offset}$ is a fixed offset used to calculate the timing advance.

Agreement:The granularity of the reported TA is slot.* FFS how to round TA value to slot level granularity
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Relevant RAN2 proposals on the content of TA reporting are listed below:

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| Tdoc No. | Relevant Proposals | Source |
| [1] R2-2109498 | Proposal 6: Include UE-specific TA (i.e.$ T\_{TA}$) in the new TA Report MAC CE. | OPPO |
| [2] R2-2109660 | Proposal 2: TA reporting during RACH and in connected mode is via MAC CE and the content is NTA, UE-specific. | Huawei, HiSilicon |
| [7] R2-2110733 | Proposal 3: TA reported via RACH procedure is Full TA, i.e, $T\_{TA}$ (applied TA for UL transmission) as defined in the UE’s TA formula: $T\_{TA}=\left(N\_{TA}+N\_{TA, UE-specific}+N\_{TA,common}+N\_{TA,offset}\right)×T\_{c}$  | ZTE |
| [9] R2-2110774 | Proposal 1: If enabled by the network in SI, the UE reports in random-access procedure (MSGA/MSG3 or MSG5) the difference between the full TA that UE applies and the configured common TA. | Samsung Research America |
| [11] R2-2110952 | Proposal 1 When information about the UE specific TA pre-compensation is reported, the reporting quantity is [Cell-specific-Koffset \* 10-3 – TTA] / [slot time] rounded down to closest integer, that is the cell-specific- Koffset minus the full TA as defined by RAN1 divided by the slot time rounded down to closest integer.Proposal 2 The new MAC CE format for TA reporting during random access uses one field of fixed size 8 bits. | Ericsson |
| [15] R2-2111207 | Proposal 1: The UE specific TA $N\_{TA, UE-specific}$ specified in RAN1 is used for the content of information about UE-specific TA pre-compensation. | CATT |

In summary, four options are proposed by companies:

* Option 1: Full TA (i.e., $T\_{TA}$ as defined in the UE’s TA formula) [1][7]
* Option 2: UE’s service link TA (i.e., NTA, UE-specific as defined in the UE’s TA formula) [2][15]
* Option 3: The difference between the full TA that UE applies and the configured common TA (i.e., $T\_{TA}-N\_{TA,common}$) [9]
* Option 4: The difference between full TA and the cell-specific Koffset (i.e., [Cell-specific-Koffset \* 10-3 – $T\_{TA}$] / [slot time] rounded down to closest integer) [11]

Option 1, 2 and 3 use some component or whole of the UE’s TA formula defined by RAN1. It is stated in [1] that option 1 is the simplest and most straightforward way for the purpose of configurating UE-specific K-offset. For Option 2, it is stated by [2][15] that the network is aware of the other parameters besides **NTA, UE-specific**, and network can obtain the **TTA** from **NTA, UE-specific** to save signalling overhead. While it is stated in [7] that the signalling cost on the required bit-string length between full TA and partial TA reported, when slot level is used, is only 1 bit assuming worst case, however, Option 2 would lead to extra complexity at NW’s implementation, and could lead to possible error case when UE and NW’s understanding on common TA broadcast. Option 3 is similar to Option2. For Option 4, it is the difference between TTA (the TA applied by the UE as defined by RAN1) and the cell-specific Koffset, and it is proposed by [11] that it would limit the range of values that need to be reported in the TA report by using that.

**Question 1: Which is the preferred option regarding the content of TA reporting?**

* **Option 1: Full TA (i.e.,** $T\_{TA}$ **as defined in the UE’s TA formula)**
* **Option 2: UE’s service link TA (i.e.,** **NTA, UE-specific as defined in the UE’s TA formula)**
* **Option 3: The difference between the full TA that UE applies and the configured common TA (i.e.,** $T\_{TA}-N\_{TA,common}$**)**
* **Option 4: The difference between full TA and the cell-specific Koffset (i.e., [Cell-specific-Koffset \* 10-3 –** $T\_{TA}$**] / [slot time] rounded down to closest integer)**

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| **Company** | **Option** | **Additional comments** |
| OPPO | Option 1 | Option 1 is the simplest and most straightforward way for the purpose of configurating UE-specific K-offset. Note that TA is reported in both initial access and connected mode and RAN2 has just agreed the following event trigger (which is related to reported TA):1. A TA offset threshold can be used for event-triggered reporting, at least the offset threshold can be between current information about UE specific TA and the last successfully reported information about UE specific TA

We think using full TA for TA reporting is more straightforward for network to configure the offset threshold. |
| Huawei, HiSilicon | Option 2 | The motivation for TA reporting is to inform the gNB about UE specific TA that the NW is not aware of. There is no need to tell the NW what the NW already knows. Therefore reporting **NTA, UE-specific** as defined by RAN1 is clear and enough. As for the possible misunderstanding of common TA between the gNB and UE as mentioned, we don't think it exists as validity timer for common TA has been introduced. |
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**[Rapporteur summary]:**

TBA…

**Where to report TA during RACH**

As shown above, RAN2 has agreed that UE may report information about UE specific TA pre-compensation at RA procedure (MSGA/MSG3 or MSG5) using MAC CE. In [2], [3], [5], [7], [9] and [16], it is proposed for further discussion regarding where to include TA report during RACH, i.e., in MSG3/MSGA or MSG5.

Here are the related proposals:

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| Tdoc No. | Relevant Proposals | Source |
| [2] R2-2109660 | Proposal 1: Include TA report in MSG5 rather than MSG3/MSGA.  | Huawei, HiSilicon |
| [3] R2-2110019 | Proposal 4 During RACH, TA report MAC CE can either be included in MsgA/Msg3, or Msg5, depending on the UL grant size for Msg3 or MsgA PUSCH resource size. | Xiaomi |
| [5] R2-2110125 | Proposal 3: Whether the TA report is via msgA/msg3 or msg 5 shall be fixed in specification.Proposal 4: If the size of TA MAC CE does not worse the coverage performance, msgA/msg3 shall be applied, else msg5 shall be applied. | Spreadtrum Communications |
| [7] R2-2110733 | Proposal 4: Msg3 is used for TA report via 4stepRACH if enabled by NW. | ZTE |
| [9] R2-2110774 | Proposal 1: If enabled by the network in SI, the UE reports in random-access procedure (MSGA/MSG3 or MSG5) the difference between the full TA that UE applies and the configured common TA. | Samsung Research America |
| [16] R2-2110859 | Proposal 3: Network can implicitly control which message UE transmits UE-specific TA reporting during RACH procedure by modifying the size of the UL grant for Msg3 transmission. Proposal 5: If UE specific TA reporting during RACH procedure is enabled and UE did not include UE-specific TA MAC CE in Msg3/MsgA transmission, UE-specific TA MAC CE to be included in Msg5. | InterDigital |

It seems that most of the companies have the understanding that the TA report via MSG3/MSGA is supported [3][5][7][9][16]. One company [2] holds the different view that TA report should be included in MSG5 rather than MSG3/MSGA to minimize standard efforts and avoid decreasing the coverage.

Note that in the MAC running CR, TA reporting in MSGA/MSG3 has been captured, see the excerpt as below. Rapporteur understands that it might be difficult to capture Msg5 in MAC spec.

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| 5.1.4 Random Access Response reception(omit the text...)6> if the Random Access procedure was not initiated due to SI Request and *enableTA-Report* with value *enabled* is configured:7> indicate to the Multiplexing and assembly entity to include a UE-Specific TA Report MAC CE in the subsequent uplink transmission.Editor’s note: The above can be revisited if RAN1 comes to a different conclusion in terms of what needs to be conveyed to NW.Editor’s note: If *enableTA-Report* with value *enabled* is configured and UE-specific TA Report MAC CE was not included in Msg3 transmission e.g. due to limited UL grant size or explicit indication (if additional bit added in SI indication), additional procedural text may be necessary to ensure MAC CE is multiplexed in Msg5. This may be updated pending further RAN2 discussion.(omit the text...) |

**Question 2: Do companies agree that the existing procedure captured in the MAC running CR on MsgA/Msg3 is sufficient? or do companies disagree and think that some other procedures, e.g. related to Msg5, need to be captured?**

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| **Company** | **Agree / Disagree** | **Additional comments** |
| OPPO | Agree | If TA reporting during RACH procedure is enabled and the TA report MAC CE is not included in Msg3/MsgA, e.g. due to no enough Msg3 size, it would be included in the next available UL resource, e.g., Msg5, as long as the TA report MAC CE is not released. In any case, we don’t see the need to specify anything on top of what is captured in the running CR. |
| Huawei, HiSilicon | Disagree | Whether the content of TA report can be included in MSG3/MSGA is correlated with other discussions, e.g. the size of TA report. Besides, we may need RAN1 confirmation that this will pose no issue of uplink coverage if TA report is carried in MSG3/MSGA as history discussions of adding information to MSG3/MSGA have always been cautious. Anyway, in addition to MSG3/MSGA, procedures related to MSG5 need to be further considered in MAC specs as currently the TA MAC CE is “stored in the Msg3 buffer” and we should make sure it can be transmitted in MSG5. |
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**[Rapporteur summary]:**

TBA…

**TA report MAC CE design**

Regarding TA report MAC CE, two companies [3] [11] suggested to minimize the size of TA report MAC CE and use reserved LCID(1byte) instead of eLCID(2-3 bytes) to reduce the impact on UL coverage.

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| Tdoc No. | Relevant Proposals | Source |
| [3] R2-2110019 | Proposal 9 Reserved LCID instead of eLCID is used for TA report MAC CE.Proposal 10 The size of TA report MAC CE is limited within 1 byte. | Xiaomi |
| [11] R2-2110952 | Proposal 2 The new MAC CE format for TA reporting during random access uses one field of fixed size 8 bits.Proposal 3 The new MAC CE shall use one of the reserved LCID codepoints, that is not one of the reserved eLCID codepoints. | Ericsson |

Rapporteur would like to ask the following question:

**Question 3:** **Do companies agree that reserved LCID instead of eLCID is used for TA report MAC CE and the size of TA report MAC CE is 1byte?**

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| **Company** | **Agree / Disagree** | **Additional comments** |
| OPPO | Partially agree | We are ok to use the reserved LCID. Regarding the size of TA report MAC CE, we can discuss after RAN2 agrees to the content of TA reporting in Q1. |
| Huawei, HiSilicon | Partially agree | Same view with OPPO. |
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For Msg3/MsgA to carry the TA information, [7] proposed that to avoid impact on RACH coverage, enhancements are required to allow inclusion of TA information without extending Msg3 size. The proposals are listed below.

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| Tdoc No. | Relevant Proposals | Source |
| [7] R2-2110733 | Proposal 5: Enhancements is needed to allow inclusion of TA information without extending message size.Proposal 6: It is kindly asked RAN2 to further discuss enhancement on RACH at least based on the alternatives listed below: Option 1: CCCH with cut-off UE identity Option 2: 64-bit CCCH is always configured in NTN when TA report is enabled Option 3: Additional Msg3 for TA report in 4stepRACH  | ZTE |

The possible alternatives to allow TA inclusion in Msg3 without decrease Msg3 coverage are listed as below:

* Option 1: CCCH with cut-off UE identity
* Option 2: 64-bit CCCH is always configured in NTN when TA report is enabled
* Option 3: Additional Msg3 for TA report in 4stepRACH

**Question 4: Which option do companies prefer regarding the enhancement on RACH to allow inclusion of TA information without extending Msg3 size?**

* **Option 1: CCCH with cut-off UE identity**
* **Option 2: 64-bit CCCH is always configured in NTN when TA report is enabled**
* **Option 3: Additional Msg3 for TA report in 4stepRACH**
* **Option 4: No enhancement**

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| **Company** | **Option** | **Additional comments** |
| OPPO | Option 4 | If TA reporting during RACH procedure is enabled and the TA report MAC CE is not included in Msg3/MsgA, e.g. due to no enough Msg3 size, it would be included in the next available UL resource, e.g., Msg5, as long as the TA report MAC CE is not released. We don't see the need for any enhancement. |
| Huawei, HiSilicon | Option 4 | See our reply for Q2. If MSG3 coverage is seen as an issue, we should exclude the option to report TA via MSG3/MSGA.  |
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**[Rapporteur summary]:**

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**Logical channel priority of TA report MAC CE**

As RAN2 has agreed to use MAC CE for TA report, the issue is how to define the logical channel priority of TA report MAC CE. Based on TS38.321, the current logical channel priority is given as below.

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| Logical channels shall be prioritised in accordance with the following order (highest priority listed first):- C-RNTI MAC CE or data from UL-CCCH;- Configured Grant Confirmation MAC CE or BFR MAC CE or Multiple Entry Configured Grant Confirmation MAC CE;- Sidelink Configured Grant Confirmation MAC CE;- LBT failure MAC CE;- 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. |

Relevant proposals on TA report MAC CE’s logical channel priority are listed below:

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| Tdoc No. | Relevant Proposals | Source |
| [1] R2-2109498 | Proposal 3 RAN2 discuss the logical channel priority for the new TA Report MAC CE. | OPPO |
| [2] R2-2109660 | Proposal 3: The priority of TA report MAC CE should be lower than the LBT failure MAC CE and higher than the the MAC CE for SL-BSR. | Huawei, HiSilicon |
| [3] R2-2110019 | Proposal 8 The logical channel priority of TA report MAC CE is higher than MAC CE for SL-BSR prioritized and lower than LBT failure MAC CE. | Xiaomi |
| [5] R2-2110125 | Proposal 5: In LCP, the priority of this new MAC CE is between BSR and PHR. | Spreadtrum Communications |
| [6] R2-2110703 | Proposal 6: The priority of new UE-specific TA Report MAC CE should below C-RNTI MAC CE or data from UL-CCCH but above BSR MAC CE.  | Nokia, Noia Shanghai Bell |
| [7] R2-2110733 | Proposal 7: The priority of TA report MAC CE is right below C-RNTI MAC CE or data from UL-CCCH. | ZTE |
| [8] R2-2110765 | Proposal 3: MAC CE for TA report is mapped to a low priority logical channel. | NEC Telecom MODUS Ltd. |
| [14] R2-2111140 | Proposal 1. The priority of MAC CE for TA pre-compensation should be same as Configured Grant Confirmation MAC CE. | LG Electronics Inc. |
| [16] R2-2110859 | Proposal 4: Priority of new UE-specific TA MAC CE is at least lower than BFR MAC CE, and higher than “data from any Logical Channel” | InterDigital |
| [17] R2-2110951 | Proposal 12 The priority of the new MAC CE in the prio list in MAC spec section 5.4.3.1.3 shall be lower than “C-RNTI MAC CE or data from UL-CCCH” but higher than “data from any Logical Channel, except data from UL-CCCH”.Proposal 13 The priority of the new MAC CE in the prio list in the MAC spec section 5.4.3.1.3 shall be between “Single Entry PHR MAC CE or Multiple Entry PHR MAC CE” and “MAC CE for the number of Desired Guard Symbols”. | Ericsson |

Majority companies think that the priority of the new TA report MAC CE is lower than “C-RNTI MAC CE or data from UL-CCCH”, and higher than “data from any Logical Channel, except data from UL-CCCH”.

Rapporteur would like to confirm whether this is a common understanding.

**Question 5:** **Do companies agree that logical channel priority of the TA report MAC CE should be lower than that of “C-RNTI MAC CE or data from UL-CCCH” and higher than that of “data from any Logical Channel, except data from UL-CCCH”?**

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| **Company** | **Agree / Disagree** | **Additional comments** |
| OPPO | Agree | The overall RACH performance should not be impacted by TA report, e.g. due to pre-emption of TA report.  |
| Huawei, HiSilicon | Agree |  |
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**[Rapporteur summary]:**

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Regarding the detailed priority, companies’ views are:

* Option 1: Higher than “LBT failure MAC CE” [6][7][14][16]
* Option 2: Between “LBT failure MAC CE” and “MAC CE for BSR, with exception of BSR included for padding” [2][3][6][16]
* Option 3: Lower than “MAC CE for BSR, with exception of BSR included for padding” [5][16][17]

Rapporteur would like to ask the following question:

**Question 6:** **Among all the possible priorities (including but not limited to option 1/2/3) between “C-RNTI MAC CE or data from UL-CCCH” and “data from any Logical Channel, except data from UL-CCCH”, which is the suggested priority for the TA report MAC CE?**

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| **Company** | **Preferred priority** |
| OPPO | Between “LBT failure MAC CE” and “MAC CE for SL-BSR prioritized according to clause 5.22.1.6” |
| Huawei, HiSilicon | Option 2When evaluating the priority of the MAC CE, we should consider its contribution to the data transmission. LBT failure MAC CE is indispensable for the subsequent data transmission and should have higher priority. While BSR is just ancillary for scheduling and anyway BSR is not accurate. TA report MAC CE is important for UL synchronization between UE and gNB but not indispensable and should thus be higher than BSR but lower than LBT failure MAC CE.  |
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**[Rapporteur summary]:**

TBA…

**TA reporting during connected mode RACH**

In RAN2#115-e meeting, following agreement has been made.

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| RAN2#115-e agreement:1. UE specific TA reporting during RACH procedure is enabled/disabled by SI (FFS for RACH in connected mode)
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Regarding TA reporting during RACH in connected mode, following proposals were brought up by companies:

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| Tdoc No. | Relevant Proposals | Source |
| [3] R2-2110019 | Proposal 6 In connected mode, TA report MAC CE can be sent during RACH (i.e. in MsgA/Msg3/Msg5) if it is triggered based on the trigger condition configuration, regardless of the enable/disable configuration of TA report during RACH in SI. | Xiaomi |
| [5] R2-2110125 | Proposal 2: UE in connect mode does not report UE specific TA value in RA procedure. | Spreadtrum Communications |
| [6] R2-2110703 | Proposal 7: In RACH procedure triggered by UE in RRC Connected mode and when the UE has successfully reported TA information to current serving cell, whether the UE reports UE-specific TA during RACH procedure depends on whether a TA update event is triggered. | Nokia, Nokia Shanghai Bell |
| [7] R2-2110733 | Proposal 1: For connected UE, TA can be configured to report via RACH procedure if timeAlignmentTimer is stopped. | ZTE |
| [8] R2-2110765 | Proposal 1: From RAN2 point of view, information about UE specific TA pre-compensation is not reported in RA procedures triggered due to “UL data arrival during RRC\_CONNECTED when there are no PUCCH resources for SR available”, “SR failure”, “Beam failure recovery”, and “Consistent UL LBT failure on SpCell”.Proposal 2: From RAN2 point of view, information about UE s,pecific TA pre-compensation is reported in RA procedures triggered due to “DL or UL data arrival during RRC\_CONNECTED when UL synchronisation status is "non-synchronised"”. Ask RAN1 for confirmation. | NEC |

It is proposed in [8] that whether to report TA during RACH in connected mode is up to the events which trigger the RACH procedure, and the UE should report its UE specific TA during initial access and when out of RRC CONNECTED mode, but not report during RRC CONNECTED mode if the cause for triggering RACH is not related to synchronisation.

In [3][6], companies think TA reporting is not always necessary for the RACH in connected mode and suggest that whether to report TA during RACH in connected mode depends on whether a TA update event is triggered before, and it is proposed in [3] that the enable/disable configuration of TA report during RACH in SI has no impact on whether to report TA during RACH in connected mode.

**Question 7:** **Regarding whether TA reporting during RACH in connected mode should be controlled by the enable/disable indication configured in SI, which option do companies prefer?**

* **Option 1: Yes, TA reporting during RACH in connected mode is also controlled by the enable/disable indication configured in SI**
* **Option 2: No, it depends on which event triggers RACH procedure**
* **Option 3: No, it depends on whether a TA update event is triggered**
* **Option 4: Other**

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| **Company** | **Option** | **Additional comments** |
| OPPO | Option 3 | In connected mode, whether UE can report TA is up to the configuration of event, and the indication configured in SI only controls RACH procedure that is not triggered in connected mode.For Option 2, note that if it depends on which event triggers RACH procedure, we need to specify case by case for all RACH triggers, which is not small spec impact. However, reporting TA value is always beneficial for NW to facilitie the update of UE specific K-offset. Therefore, whenever TA update event is triggered, it should be reported in any available UL resources. |
| Huawei, HiSilicon | Option 2 | For option 3, if a TA update event is triggered, there is another mechanism that we agreed for connected mode separately and no need to mix the usage with TA report via RACH. For option 2, if RACH procedure is triggered by at least the following event, it is beneficial to report TA during RACH:*- DL or UL data arrival during RRC\_CONNECTED when UL synchronisation status is "non-synchronised"* |
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**[Rapporteur summary]:**

TBA…

### 2.1.2 TA reporting in connected mode

**How to report TA in connected mode**

For TA reporting in connected mode, following agreements and working assumption have been made in RAN2#115-e meeting.

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| RAN2#115-e agreement:1. Under the work assumption "the UE location information cannot be reported in connected mode", the content of UE specific TA reported in connected mode is UE specific TA pre-compensation(for the details of the TA value, confirmation from RAN1 is needed).
2. If the reported content of information about UE specific TA is UE location information in connected mode, RRC signalling is used to report.
3. Under the work assumption "the UE location information can be reported in connected mode", for TA reporting purposes in connected mode, the network can configure the UE to send either the UE specific TA pre-compensation (for the details of the TA value, confirmation from RAN1 is needed) or the UE location information
4. Working Assumption: If the reported content of information about UE specific TA is TA pre-compensation value in connected mode, MAC CE is used to report
 |

It has been agreed that if the reported content of information about UE specific TA is UE location information, RRC signalling is used to report. However, for the case of TA pre-compensation value, it is still a working assumption on using MAC CE to report.

Proposals in [2], [3], [4], [6], [7], [11] and [15] related to how to report TA in connected mode are listed below.

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| Tdoc No. | Relevant Proposals | Source |
| [2] R2-2109660 | Proposal 2: TA reporting during RACH and in connected mode is via MAC CE and the content is NTA, UE-specific.  | Huawei, HiSilicon |
| [3] R2-2110019 | Proposal 5 RAN2 to agree “If the reported content of information about UE specific TA is TA pre-compensation value in connected mode, MAC CE is used to report”. | Xiaomi |
| [4] R2-2110044 | *Proposal 3: RAN2 to consider a unified RRC Message for UE reporting of UE specific TA pre-compensation*  | Apple |
| [6] R2-2110703 | Proposal 2: In the case UE location information can be reported to network, network can configure UE report either the UE location or the UE specific TA information via RRC for the purpose of TA reporting. | Nokia, Nokia Shanghai Bell |
| [7] R2-2110733 | Proposal 10: When event triggered TA is configured, UE reports full TA using RRC signalling in a first report, and reports delta TA in subsequent TA report using MAC CE. | ZTE |
| [11] R2-2110952 | Proposal 4 If the UE reports TA value or UE position after random access procedure, RRC signalling is used after security has been activated. | Ericsson |
| [15] R2-2111207 | Proposal 2: If the reported content of information about UE specific TA is TA pre-compensation value in connected mode, MAC CE is used to report. | CATT |

There are still 4 companies who are in favour of RRC signalling, however, RAN2 has already made a working assumption on using MAC CE. Rapporteur would like to ask if companies would like to confirm the working assumption, or they want to reverse it.

**Question 8: Do companies agree to confirm the working assumption that “If the reported content of information about UE specific TA is TA pre-compensation value in connected mode, MAC CE is used to report”?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| OPPO | Agree | We can compromise to this although we prefer RRC approach which is more secure. |
| Huawei, HiSilicon | Agree |  |
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**[Rapporteur summary]:**

TBA…

**Event trigger for TA reporting**

It is proposed in [9] that to define the triggering event for reporting information on UE specific TA in connected mode, related parameters other than triggering offset threshold, like hysteresis, time to trigger, etc., may be considered, i.e., defining entering condition and leaving condition by introducing parameter hysteresis $Hys$, and introducing parameter $timeToTrigger$ to define the duration for which the event needs to be met to trigger reporting.The following is the company’s proposal.

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| Tdoc No. | Relevant Proposals | Source |
| [9] R2-2110774 | Proposal 2: RAN2 considers additional parameters including hysteresis and time to trigger to define the trigger event for reporting information on UE specific TA in connected mode. | Samsung Research America |

**Question 9: Do companies agree that additional parameters, e.g. hysteresis and time to trigger, are needed to define the trigger event for TA reporting?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| OPPO | Disagree | For TA report in MAC CE rather than in RRC, event configuration should be kept simple, like phr-Tx-PowerFactorChange for PHR reporting configuration. So no need to introduce hysteresis and time to trigger. |
| Huawei, HiSilicon | FFS | We should first settle down the basic mechanism before discussing any additional enhancements. |
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**[Rapporteur summary]:**

TBA…

**Trigger condition of TA reporting in connected mode**

In the last meeting, NW requested TA reporting, periodical TA reporting and event-triggered TA reporting were discussed for connected mode, and only event-triggered TA reporting was agreed. Following proposals are brought up by companies.

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| Tdoc No. | Relevant Proposals | Source |
| [3] R2-2110019 | Proposal 11 Network request based TA report is supported.Proposal 12 Periodic TA report is not supported. | Xiaomi |
| [7] R2-2110733 | Proposal 1: For connected UE, TA can be configured to report via RACH procedure if timeAlignmentTimer is stopped.Proposal 11: TA report via PDCCH ordered RACH is supported in NTN. | ZTE |
| [9] R2-2110774 | Proposal 3: RAN2 considers semi-persistent report of information on UE specific TA pre-compensation in connected mode, by which periodical report is configured by the network and actual reporting is activated and deactivated dynamically.Proposal 4: Semi-persistent reporting of information on UE specific TA pre-compensation in connected mode is configured by RRC signalling.Proposal 5: The periodic reporting of information on UE specific TA pre-compensation in connected mode that is configured in semi-persistent report is activated and deactivated by MAC CE. | Samsung Research America |
| [15] R2-2111207 | Proposal 3: Periodically triggering the UE-specific TA reporting can be configured by network in NR NTN. | CATT |

Rapporteur would like to ask, in addition to event-triggered reporting, whether other options need to be introduced.

**Question 10: In addition to event-triggered TA reporting, what else do companies think is needed for TA reporting in connected mode?**

* **Option 1: NW requested TA reporting**
* **Option 2: Periodical TA reporting.**
* **Option 3: Semi-persistent TA reporting**
* **Option 4: None**

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| **Company** | **Option** | **Additional comments** |
| OPPO | Option 4 | We think event trigger is sufficient in Rel-17. |
| Huawei, HiSilicon | Option 4 | No need of additional trigger conditions. |
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**[Rapporteur summary]:**

TBA…

**Content of TA reporting in connected mode**

Regarding the content of TA reporting in connected mode, companies’ proposals are listed below.

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| Tdoc No. | Relevant Proposals | Source |
| [2] R2-2109660 | Proposal 2: TA reporting during RACH and in connected mode is via MAC CE and the content is NTA, UE-specific.  | Huawei, HiSilicon |
| [6] R2-2110703 | Proposal 2: In the case UE location information can be reported to network, network can configure UE report either the UE location or the UE specific TA information via RRC for the purpose of TA reporting. | Nokia, Nokia Shanghai Bell |
| [11] R2-2110952 | Proposal 5 The information about UE specific TA pre-compensation in connected mode is the UE position. | Ericsson |

It is note that in RAN2#115-e meeting, following agreement has been made.

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| RAN2#115-e agreement:1. Under the work assumption "the UE location information cannot be reported in connected mode", the content of UE specific TA reported in connected mode is UE specific TA pre-compensation(for the details of the TA value, confirmation from RAN1 is needed).
2. If the reported content of information about UE specific TA is UE location information in connected mode, RRC signalling is used to report.
3. Under the work assumption "the UE location information can be reported in connected mode", for TA reporting purposes in connected mode, the network can configure the UE to send either the UE specific TA pre-compensation (for the details of the TA value, confirmation from RAN1 is needed) or the UE location information
4. Working Assumption: If the reported content of information about UE specific TA is TA pre-compensation value in connected mode, MAC CE is used to report
 |

Under the work assumption "the UE location information can be reported in connected mode", RAN2 has agreed that NW can configure either UE specific TA pre-compensation reporting or UE location information reporting for TA reporting in connected mode. Proposal in [6] seems to suggest that this should be done via RRC.

Rapporteur would like to ask the following question:

**Question 11: Do companies agree that in case UE location information can be reported to network, network can configure UE to report either the UE location or the UE specific TA information via RRC for the purpose of TA reporting?**

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| **Company** | **Agree/****Disagree** | **Additional comments** |
| OPPO | Agree |  |
| Huawei, HiSilicon | Agree, but | We’re not sure about the difference between Q11 and the agreement from previous meeting:1. Under the work assumption "the UE location information can be reported in connected mode", for TA reporting purposes in connected mode, the network can configure the UE to send either the UE specific TA pre-compensation (for the details of the TA value, confirmation from RAN1 is needed) or the UE location information

Do we need an additional agreement or do we want re-evaluate the agreement? |
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**[Rapporteur summary]:**

TBA…

**Event-triggered TA reporting**

In RAN2#115-e meeting, following agreement has been made.

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| RAN2#115-e agreement:1. Event-triggers for reporting on the information about UE specific TA in connected mode is supported. FFS on the details. Confirmation by RAN1 is also needed
2. The event-triggers for reporting information about UE specific TA are based on TA values (confirmation from RAN1 is needed)
3. A TA offset threshold can be used for event-triggered reporting, at least the offset threshold can be between current information about UE specific TA and the last successfully reported information about UE specific TA
4. The event-triggers for reporting information about UE specific TA based on time threshold is not supported in NTN.
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Relevant proposals are shown below.

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| Tdoc No. | Relevant Proposals | Source |
| [6] R2-2110703 | Proposal 3: To enable event-triggered UE specific TA reporting, network should configure a TA change threshold via RRC.Proposal 4: For UE specific TA information reporting, if the UE detects the TA change between current UE-estimated TA and the last successfully reported TA is larger than network configured threshold, the UE should send the latest UE-estimated TA to the NW.Proposal 5: For UE location information reporting, if the UE detects that the TA deviation between TA estimation based on current UE location and the TA estimation based on last successfully reported UE location is larger than network configured threshold, the UE should send a location update to the NW. | Nokia, Nokia Shanghai Bell |
| [11] R2-2110952 | Proposal 5 The information about UE specific TA pre-compensation in connected mode is the UE position.Proposal 6 If Proposal 5 is agreed, then the event triggered report of information about the UE specific TA pre-compensation is based on the UE movement above a threshold compared to the last successfully reported UE location.Proposal 7 If Proposal 5 is not agreed, then the quantity used by the UE to trigger TA reports is Qta = [UE-specific-Koffset \* 10-3 – TTA], that is the UE-specific- Koffset minus the full TA as defined by RAN1.Proposal 8 If Proposal 7 is agreed, then the UE may be configured with two thresholds to trigger TA reports based on Qta. Th1 triggers a TA report if Qta < Th1. Th2 triggers a TA report if Qta > Th2. | Ericsson |

For UE location information reporting, two options are proposed in [6] [11]:

* Option 1: TA-based trigger condition, i.e., when TA change between current UE-estimated TA and the last successfully reported TA is larger than network configured threshold.
* Option 2: Location-based trigger condition, i.e., the UE movement above a threshold compared to the last successfully reported UE location

**Question 12: If the content of TA reporting is UE location information, which is the preferred option regarding the trigger condition?**

* **Option 1: TA-based trigger condition, i.e. when TA change between current UE-estimated TA and the last successfully reported TA is larger than network configured threshold.**
* **Option 2: Location-based trigger condition, i.e. when UE moves above a threshold compared to the last successfully reported UE location.**
* **Option 3: Other.**

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| **Company** | **Option** | **Additional comments** |
| OPPO | Option 1 | For simplicity, we prefer to reuse the same event for TA reporting. |
| Huawei, HiSilicon | Option 1 |  |
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**[Rapporteur summary]:**

TBA…

**Whether TA reporting can trigger SR/RACH?**

It is proposed in both [1] and [2] that TA reporting can trigger SR when there is no available UL-SCH resources, so that TA report can still reach the network and assist network to update K-offset. However, company in [3] holds different view.

Relevant proposals are listed below.

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| Tdoc Num | Involved Proposals | Source |
| [1] R2-2109498 | Proposal 4 SR can be triggered if TA reporting has been triggered but there is no available UL-SCH resources, or if the UL-SCH resources cannot accommodate the TA report MAC CE plus its subheader as a result of LCP.Proposal 5 TA report MAC CE can be mapped to one SR configuration, which is configured by RRC using a new parameter, e.g. schedulingRequestID-TA-Report-r17. | OPPO |
| [2] R2-2109660 | Proposal 4: If UL resource is not available for TA report, UE triggers an SR if SR is configured or triggers RACH if SR is not configured. | Huawei, HiSilicon |
| [3] R2-2110019 | Proposal 7 Do not support TA report MAC CE triggering SR/RACH procedure. | Xiaomi |

**Question 13: Do companies agree that SR/RACH should be triggered when TA reporting has been triggered but there is no available UL-SCH resources for TA reporting?**

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| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments** |
| OPPO | Agree | 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. Therefore, we think SR/RACH should be triggered for TA reporting as soon as possible. |
| Huawei, HiSilicon | Agree | Similar with BFR MAC CE mechanism. But we may not need to specify a dedicated SR for TA MAC CE. Common SR will do. |
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**[Rapporteur summary]:**

TBA…

**Impact of TA report on timeAlignmentTimer**

The timeAlignmentTimer is used for the maintenance of UL time alignment, which controls how long the MAC entity considers the Serving Cells belonging to the associated TAG to be uplink time aligned. For NTN, UE’s TA is not only controlled by network via Timing Advance Command. It is proposed in [2] that after UE reports its TA to the gNB, the timeAlignmentTimer should also be started or restarted.

And it is further proposed in [2], in order to make sure the timeAlignmentTimer in UE and gNB are aligned, the propagation delay should be taken into consideration. Two options can be considered:

* Option 1: UE starts or restarts the timeAlignmentTimer after RTT/2 after UE reports its TA to the gNB.
* Option 2: UE starts or restarts the timeAlignmentTimer after UE reports its TA to the gNB. The gNB starts or restarts the timeAlignmentTimer after receiving the TA report and decreases the duration of the timeAlignmentTimer by RTT/2.

Companies’ proposal is listed below.

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| Tdoc No. | Relevant Proposals | Source |
| [2] R2-2109660 | Proposal 5: The timeAlignmentTimer is started or restarted after UE reports its TA. FFS whether started or restarted instantly or after RTT/2.  | Huawei, HiSilicon |

Rapporteur would like to ask the following question:

**Question 14: Do companies agree that the timeAlignmentTimer is started or restarted after UE reports its TA?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| OPPO | Agree | Each time TA is communicated between UE and NW, the timer should be restarted. Otherwise, it has to unnecessarily rely on TAC MAC CE to keep UE synchronized even though UE has not lost synchronization. |
| Huawei, HiSilicon | Agree | This aligns with the legacy principle that when UE and gNB have reached UL synchronization, the timeAlignmentTimer should be started or restarted (two mechanisms for UL synchronization now: TA command and TA report). Otherwise the timeAlignmentTimer may run out shortly after TA is reported which will lead to another unnecessary UL synchronization. |
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**[Rapporteur summary]:**

TBA…

**Question 15: If Q14 is agreed, which option do companies prefer?**

* **Option 1: UE starts or restarts the timeAlignmentTimer after RTT/2 after UE reports its TA to the gNB.**
* **Option 2: UE starts or restarts the timeAlignmentTimer after UE reports its TA to the gNB.**

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| **Company** | **Option** | **Additional comments** |
| OPPO | Option 2 | Option 2 is simple. |
| Huawei, HiSilicon | Option 2 | It is up to gNB implementation to align the timeAlignmentTimer with UE.  |
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**[Rapporteur summary]:**

TBA…

## Other RACH issues

**Broadcasting K-mac**

RAN1 has agreed to broadcast K-mac value for UE to acquire UE-gNB RTT. In the following contribution, it is proposed to discuss how to broadcast K-mac.

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| Tdoc No. | Relevant Proposals | Source |
| [1] R2-2109498 | Proposal 1 RAN2 discuss where to provide K\_mac value in SIB, e.g. in SIB1, or in the NTN-specific SIB carrying satellite ephemeris. | OPPO |

In Monday’s online discussion, more companies favour the new SIB since UE anyway needs to acquire the common TA and ephemeris in another SIB during RA procedure. For progress, following question is asked to collect more companies’ views.

**Question 16: Which SIB is preferred to be used to carry K-mac?**

* **Option 1: SIB1**
* **Option 2: the new SIB, e.g. the one carrying satellite ephemeris and/or common TA**

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|  **Company** | **Option** | **Additional comments** |
| OPPO | Option 2 |  |
| Huawei, HiSilicon | Option 2 |  |
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**[Rapporteur summary]:**

TBA…

**Other RACH enhancement**

In Monday’s online discussion, proposals on enhanced RACH type selection were discussed and following agreements were made.

Agreements:

1. Enhancements for RA type selection in NTN will not be pursued in Rel-17. FFS for BSR

Regarding enhancements on BSR over 2-step RACH, some companies think that it is not related to RACH type selection, while some other companies believe that they are optimization not needed now. Since it is now marked as FFS, it would be good to check companies’ views here.

**Question 17: Do companies agree to introduce additional enhancement on BSR over 2-step RACH?**

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|  **Company** | **Agree/disagree** | **Additional comments** |
| OPPO | Disagree | We think the current MAC spec is sufficient to support BSR over 2-step RACH, e.g. by not configuring SR resources for some logical channel if NW wants UE to send BSR over 2-step RACH. No need for any enhancement in Rel-17. |
| Huawei, HiSilicon | Disagree | No enhancement is needed. |
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**[Rapporteur summary]:**

TBA…

**ra-ContentionResolutionTimer**

In RAN2#111-e and RAN2#115-e meeting, following agreements have been made.

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| RAN2#111-e agreement:An offset to the start of the ra-ContentionResolutionTimer is introduced for both LEO and GEO scenarios.RAN2#115-e agreement:In the MAC specification section 5.1.5, delay the start of ra-ContentionResolutionTimer by the UE-gNB RTT (i.e. sum of UE's TA and K\_mac). |

It is stated in [13] that if ra-ContentionResolutionTimer would be restarted after the end of Msg3 retransmission plus UE-gNB RTT, ra-ContentionResolutionTimer could expire during the UE-gNB RTT after Msg3 retransmission, which may lead to issue that the UE considers Contention Resolution as not successful, even if Msg4 would arrive later.

To avoid this issue, [13] proposed that the UE should stop ra-ContentionResolutionTimer upon Msg3 retransmission and start ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT, then the ra-ContentionResolutionTimer would not unexpectedly expire in the case of Msg3 retransmission. One more benefit brought by this solution is power saving since the UE could reduce PDCCH monitoring during UE-gNB RTT [13].

Companies’ proposal is listed below.

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| Tdoc No. | Relevant Proposals | Source |
| [13] R2-2111006 | Proposal 1: RAN2 should consider the issue that ra-ContentionResolutionTimer would expire during UE-gNB RTT after Msg3 retransmission (i.e., ra-ContentionResolutionTimer would expire before it is restarted).Proposal 2: The UE stops ra-ContentionResolutionTimer once Msg3 is retransmitted and then starts ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT. RAN2 could take the proposed text into account. | ASUSTeK |

Rapporteur would like to ask the following question:

**Question 18: Do companies agree that the UE should stop ra-ContentionResolutionTimer once Msg3 is retransmitted and then start ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| OPPO | Agree with comments | We share the intention of ASUSTeK’s proposal. However, to further decrease the UE power consumption, we think it would be more reasonable to stop the timer upon receiving PDCCH scheduling Msg3 retransmission. Therefore, we suggest the following updated proposal:**Proposal: the UE should stop ra-ContentionResolutionTimer once receiving PDCCH which schedules Msg3 retransmission and then start ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT.** |
| Huawei, HiSilicon | Agree with comments | Agree with OPPO.  |
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**[Rapporteur summary]:**

TBA…

# 3. Summary and Proposals

This section summarizes the discussion and reports the following proposals:

To be added…

# 4. References

1. R2-2109498 Discussion on RACH and TA report in NTN OPPO discussion Rel-17 NR\_NTN\_solutions-Core
2. R2-2109660 Further consideration on TA reporting Huawei, HiSilicon discussion Rel-17 NR\_NTN\_solutions-Core
3. R2-2110019 RACH Type selection and TA report Xiaomi discussion Rel-17
4. R2-2110044 UE Reported UE Specific TA Pre-Compensation Apple discussion Rel-17 NR\_NTN\_solutions-Core
5. R2-2110125 TA report procedure Spreadtrum Communications discussion Rel-17
6. R2-2110703 Reporting information about UE specific TA and RA Type Selection Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_NTN\_solutions-Core
7. R2-2110733 Remaining issues on TA report ZTE Corporation, Sanechips discussion Rel-17
8. R2-2110765 TA reporting Remaining issues NEC Telecom MODUS Ltd. discussion
9. R2-2110774 Further considerations on TA report Samsung Research America discussion NR\_NTN\_solutions-Core
10. R2-2110941 Additional criterion for RA type selection Samsung Research America discussion
11. R2-2110952 Reporting information about UE specific TA pre-compensation in NTNs Ericsson discussion Rel-17 NR\_NTN\_solutions-Core
12. R2-2111005 Discussion on LCH-based RA type selection ASUSTeK discussion Rel-17 NR\_NTN\_solutions-Core
13. R2-2111006 Discussion on issue of restarting contention resolution timer ASUSTeK discussion Rel-17 NR\_NTN\_solutions-Core
14. R2-2111140 Discussion on RACH and TA report aspects LG Electronics Inc. discussion NR\_NTN\_solutions-Core
15. R2-2111207 Discussion on UE-specific TA information reporting in NTN CATT discussion Rel-17 NR\_NTN\_solutions-Core R2-2109551
16. R2-2110859 Remaining MAC open issues in NTN InterDigital discussion Rel-17 NR\_NTN\_solutions-Core
17. R2-2110951 On configured scheduling, DRX, LCP, HARQ and SR/BSR in NTNs Ericsson discussion Rel-17 NR\_NTN\_solutions-Core
18. R2-2110308 Remaining UP issues for NR NTN Lenovo, Motorola Mobility discussion Rel-17

# Contact information

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