3GPP TSG-RAN WG2 Meeting #115e R2-210xxxx

Online, 16th - 27th August, 2021

**Agenda item: 8.10.2.1**

**Source: CATT**

**Title: [draft] Report of [AT115-e][106][NTN] RACH aspects (CATT)**

**Document for: Discussion and Decision**

# 1 Introduction

This document aims at collecting companies’ views regarding the RACH aspects:

* [AT115-e][106][NTN] RACH aspects (CATT)

Scope: Continue the discussion on p1 and p2 from [R2-2107314](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2107314.docx) and p3-p7 and p16-p18 from [R2-2108453](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2108453%20-%20Random%20Access%20timers%20and%20reporting%20information%20about%20UE%20specific%20TA%20pre-compensation%20in%20NTNs.docx) (p8-p15 may be discussed in the future if p7 is agreed)

Intended outcome: Summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
		- List of proposals for further discussion
		- List of proposals that should not be pursued (if any)

Initial deadline (for companies' feedback): Thursday 2021-08-19 1000 UTC

Initial deadline (for rapporteur's summary in R2-2108882): Thursday 2021-08-19 1600 UTC

Proposals marked "for agreement" in R2-2108882 not challenged until Friday 2021-08-20 1000 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).

# 2 Discussion

At RAN2#113bis-e the reporting of TA was discussed with the following agreements

1. At least for uplink scheduling adaptations, the UE may report information about the UE specific TA pre-compensation. The exact information and frequency of reports depend on RAN1 outcome. FFS on when/how to report.
* [Post113bis-e][000] “It is FFS whether the UE reports the UE specific TA pre-compensation at the RACH procedure (MSG3 or MSG5) using a MAC CE. Actual content is FFS and also depends on further RAN1 input. Configurability is FFS”

Further at RAN2#114 the following was agreed

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)

At the online discussion of RAN2 #115-e meeting, the agreement regarding UE specific TA reporting was achieved as following:

Agreements:

1. UE specific TA reporting during RACH procedure is enabled/disabled by SI (FFS for RACH in connected mode)

## 2.1 The trigger conditions of UE specific TA reporting in connected state

The UE specific TA report may be used by network to schedule the UE accurately at the initial RA procedure. It is agreed to enabled/disabled UE specific TA reporting by SI. There are three options on the trigger conditions of UE specific TA reporting in connected mode. We are going to discuss them one by one.

* Request and response in connected mode
* Periodical reporting in connected mode
* Event triggering in connected mode
* **Request and response in connected mode**

It is proposed that the network can request the UE-specific TA Report to calculate UE-specific K\_offset for scheduling [1]. Therefore, the network can request the UE to report the calculated TA when the network detects the scheduling problem or there is a requirement to schedule UE. It is also clarified that in some scenarios (especially for LEO earth fixed cells) the UEs in connected mode may experience a TA pre-compensation that changes greatly during the connection to a cell while in GEO the TA may be stable during the connection [2]. Therefore, there is a need to inform the gNB about the updated TA pre-compensation.

The proposals in [1] and [2] are given as following:

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| **Proposal 1: For the UE-specific TA reporting under network control, two options can be supported [1]:****Option 1: the UE-specific TA Report requested by network;****Proposal 6: Network can request the UE to report information about UE specific TA pre-compensation [2].**  |

From the online discussion, there is confusion on whether the above mechanism is applied in connected mode or initial random access. The initial random access was already discussed and achieved agreements list above, so the proposals in above table only apply to connected mode.

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| **Question 1: Do you agree that UE specific TA report can be requested by network when UE in connected mode?** |
| **Company** | **Yes/No** | **Comment**  |
| MediaTek | Yes | If the network wants it, UE can report it to the network. |
| Xiaomi | Yes | If network can predict the TA change, it can choose to request TA report instead of configuring periodic TA report. |
| Lenovo | FFS | NW can adjust TA using TAC command. Therefore if UE has reported TA in RA, NW will always be aware of the adjusted TA value at UE in RRC\_CONNECTED. We wonder if there is other reason for such request. |
| China Telecom | Yes | NW needs TA for scheduling strategy. |
| Huawei, HiSilicon | No | From our perspective, the TA report during random access procedure is enough. When UE is in connected mode, the network can use the legacy TA adjustment mechanism. The TA is changing continuously, the network can estimate TA based on UL signals and use consecutive TA commands to make adjustment and keep the TA value credible. Even if the TA adjustment is not very precise, it is not a big issue since the UE specific TA is only used to make the scheduling more efficient.With the legacy mechanism workable, adding additional UE reports increases complexity and signalling overhead. |
| Samsung | See comments | If MAC CE is used for UE-specific TA reporting, it sounds reasonable to have network requested (i.e. via DCI or MAC CE) UE specific TA report. However, if RRC is used for UE-specific TA reporting, we’re not sure whether it is additionally required on top of periodic reporting and event-triggered reporting. Also note one-shot reporting can be done by configuring the number of reporting as “1” in periodic reporting.  |
| Ericsson | Yes | The reporting on request can be useful for UEs with long connection time, especially if UE position is reported (fast UEs may have moved far away, say a plane at 1200 km/h). The gNB can then opportunistically piggyback a request for UE position when sending other grants instead of using periodic or triggered reporting. This may save the signalling to configure the reporting and the few UEs that stay connected for long in the same cell can be polled. In most scenarios it is sufficient with the indication in the SIB and triggered reporting. If SIB indicate no reporting is needed, then reports shall never be sent except on request.  |
| LG | No | If the periodical reporting of UE-specific TA report is introduced, there is no reason to request the UE-specific TA report by the network. However, the periodical reporting of UE-specific TA report is not introduced, the UE specific TA report should be requested by network |
| InterDigital | Yes | Network requested TA report or event-based reporting would allow the network to receive updated UE-specific TA when most important/useful (e.g. if network wants an updated value for scheduling or if TA difference has exceeded a threshold). Periodic reporting may introduce unnecessary signalling if the TA value doesn’t change that much. |
| NEC | No | If conditions for TA reporting are configured during/following initial access, then one-off TA requests during connected mode will not be necessary. |

Summary:

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* **Periodical reporting in connected mode**

It is also proposed to support triggering the periodical report of UE-specific TA for timely TA tracking and saving the request signalling [1].

The proposal in [1] is as following:

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| **Proposal 1: For the UE-specific TA reporting under network control, two options can be supported[1]:****Updated proposal: periodical reporting of UE-specific TA report in connected** |

Therefore, the rapporteur suggest to discuss whether to support periodical reporting of UE-specific TA report in connected mode.

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| **Question 2: Do you agree that periodical reporting of UE-specific TA report is supported in connected mode?** |
| **Company** | **Yes/No** | **Comment**  |
| MediaTek | No | There is no need to report the TA periodically. Event triggered report with network based polling should be enough. |
| Xiaomi | Maybe No | Agree with MediaTek, network trigger and event based may be enough |
| Lenovo | No | NW can adjust TA using TAC command. Therefore if UE has reported TA in RA, NW will always be aware of the adjusted TA value at UE in RRC\_CONNECTED. If there is other reason for TA reporting in RRC\_CONNECTED, we think NW request could be sufficient. |
| China Telecom | No | Periodical reporting UE-specific TA will consume too much power of UEs. We prefer to focus on NW based solutions. |
| Huawei, HiSilicon | No | Same comment as in Q1. |
| Samsung | No | We assume periodical location reporting and event-triggered location reporting are supported for the connected UE. Then we think any RRC based UE-specific TA reporting is quite duplicated with them, i.e. UE-specific TA is calculated by UE location.  |
| Ericsson | No | Periodic reporting has the issues:* many users will send unnecessary reports using precious radio resources and waste UE energy even they are far from a TA pre-compensation level that will require the gNB to adjust the Koffset.
* the period needs to be shorter for UEs close to the nadir path on the ground, compared to UEs far from the nadir path to give the same amount of time for the gNB to signal a new Koffset before the UE passes the TA level corresponding to a needed change in Koffset
* if the info in the report is the UE position, then one position is sufficient for the gNB in most scenarios, and periodic reporting seems unnecessarily wasteful
 |
| LG | Yes | If the network configures the periodicity for reporting the UE specific TA pre-compensation value to the UE, the network can keep track of the UE specific TA pre-compensation value without additional signalling. |
| InterDigital | No | Network requested TA report or event-based reporting would allow the network to receive updated UE-specific TA when most important/useful (e.g. if network wants an updated value for scheduling or if TA difference has exceeded a threshold). Periodic reporting may introduce unnecessary signalling if the TA value doesn’t change that much. |
| NEC | No (see comments) | It should be up to network implementation how the UE reports TA, which includes periodical reporting.However, periodical TA reporting may not be optimal so it should not warrant a specific feature, as opposed to reporting scheduling from the NW. |

Note: We will further discuss the way how to configure period to UE in detail proposed by [1] at second round if Q2 is agreed.

Summary:

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* **Event triggering in connected mode**

In some cases, initial UE-specific TA reporting can be used for long period or the UE moves too fast to trigger the TA reporting by network control, the event-triggered method may be more suitable for these scenarios [1]. The UE may trigger transmission of information about the UE specific TA pre-compensation to minimize the signalling [2].

The proposals in [1] and [2] are as following:

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| **Proposal 2: For the UE-specific TA reporting under UE control, event triggered method should be supported in NTN, e.g. a threshold between current TA and the last reported TA [1].****Proposal 7: The network may configure triggers for reporting information about UE specific TA pre-compensation [2].**  |

Therefore, the rapporteur suggests discussing whether to support event triggered method for the UE-specific TA report.

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| **Question 3: Do you agree that the network may configure event-triggers for** **reporting UE specific TA?** |
| **Company** | **Yes/No** | **Comment**  |
| MediaTek | Yes | The UE should report the TA when there is a change beyond a certain threshold. |
| Xiaomi | Yes | It can work together with network request. Network can predict the TA change and request for TA in case that the prediction error accumulates. Event trigger serves for the situation of TA change dramatically.  |
| Lenovo | Yes for IDLE/INACTIVEFFS for CONNECTED | NW can adjust TA using TAC command. Therefore if UE has reported TA in RA, NW will always be aware of the adjusted TA value at UE in RRC\_CONNECTED. |
| China Telecom | Yes | NW can configure a threshold to trigger UE specific TA report. |
| Huawei, HiSilicon | No | Same comment as in Q1. |
| Samsung | No | We assume periodical location reporting and event-triggered location reporting are supported for the connected UE. Then we think any RRC based UE-specific TA reporting is quite duplicated with them, i.e. UE-specific TA is calculated by UE location. |
| Ericsson | Yes | Triggered reporting saves radio resources and UE energy. If triggered reporting is configured, then RA in connected mode (besides for handover and “Request for Other SI”) can send the report only if a triggering condition is fulfilled.  |
| LG | Yes | It would be helpful to inform UE specific TA pre-compensation value when the UE specific TA pre-compensation value is significantly changed in a short time. |
| InterDigital | Yes | Network requested TA report or event-based reporting would allow the network to receive updated UE-specific TA when most important/useful (e.g. if network wants an updated value for scheduling or if TA difference has exceeded a threshold). Periodic reporting may introduce unnecessary signalling if the TA value doesn’t change that much. |
| NEC | Yes | We support event-triggered TA report from the UE. The network can help configuring the triggers.Since both the UE and the network should have the same knowledge regarding the TA, the network should define rules for TA reporting. |

Note: We will further discuss what the trigger event is in detail proposed by [1] and [2] at second round if Q3 is agreed.

Summary:

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## 2.2 What and how to report about UE specific TA

* **The content of** **UE specific TA in RA procedure**

For the content of UE specific TA in RA procedure, [2] notes that reported TA can be used by the gNB to estimate the position of the UE. Meanwhile, reporting TA and TA drift will give faster estimation of UE position. Reporting TA or UE position in a MAC CE will enable any entity to estimate the UE position.

The proposal in [2] is as following:

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| 1. The report about UE specific TA pre-compensation using MAC CE is the UE TA or UE position with a low resolution.
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Therefore, the rapporteur suggests discussing the content of UE specific TA in RA procedure.

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| **Question 4: Which option of the content of UE specific TA reported in RA procedure using MAC CE do you prefer?****Option 1. UE specific TA; Option 2. UE position with a low resolution; Option 3. Others** |
| **Company** | **Option 1/2/3** | **Comment**  |
| MediaTek | Option 1 | UE should report the UE-specific TA. |
| Xiaomi | FFS | In LCS discussion, coarse UE position(GNSS) report in initial access was agreed, but subject to SA3 privacy check. Perhaps we need to wait for the answer from SA3 to see if common design is applicable here. |
| Lenovo | Option 1 | TA reporting could be of less size and can be directly used for scheduling. |
| China Telecom | Option 1 | Option 1 is the most straightforward way. |
| Huawei, HiSilicon | Option 1 | Reporting UE position may have security concerns and is dependent on SA3 reply (same view as Xiaomi). Besides, the motivation for this reporting is to facilitate scheduling, and UE specific TA can serve this purpose well. |
| Samsung | Option-1 |  |
| Ericsson | Option 2  | We are fine with any option, but resolution will need to be low. The UE position can be quantized (like discussed in the Control Plane discussion), or UE specific TA pre-compensation can be quantized. It may be that RAN1 will have an opinion on what the UE shall report.The gNB needs to know the TA or UE position to select a UE specific Koffset. Note that in IoT NTN, the eNB also needs to know the TA or UE position to respect Half Duplex constraints.  |
| LG | Option 1 |  |
| InterDigital | Option 1 |  |
| NEC | Option 1 | Since the UE uses its UE-specific TA in Msg1/MsgA, it should report it to the NW. |

Summary:

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* **How to report in connected mode after RA procedure**

As repeated reports of TA or UE position give the UE position to any observer if using MAC CEs, the UE shall not report using MAC CE in connected mode. Using RRC will give integrity protection and encryption and thus do not reveal the UE position to unwanted parties [2].

Thus, for privacy reasons the TA reporting or position reporting is better done using RRC after security have been activated. If TA reporting is done using MAC CEs, it is better to not report often and not having fine-grained TA report. [2].

The proposal in [2] is as following:

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| 1. If the UE reports information about UE specific TA pre-compensation after random access, RRC signalling is used after security has been activated.
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However some companies think that after security is activated we can actually send TA value via MAC CE during online discussion. So the rapporteur suggests discussing the following question.

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| **Question 5: Which option do you prefer to report UE specific TA pre-compensation in connected mode after random access and security has been activated?****Option 1. RRC signalling; Option 2. MAC CE; Option 3. Others** |
| **Company** | **Option 1/2/3** | **Comment**  |
| MediaTek | Option 2 | We prefer using a single method to report the TA using MAC CE (option 2) all the time. |
| Xiaomi | FFS | Same as Q5, wait for SA3 answer for LCS |
| Lenovo | FFS | NW can adjust TA using TAC command. Therefore if UE has reported TA in RA, NW will always be aware of the adjusted TA value at UE in RRC\_CONNECTED. We wonder if there is other reason for TA reporting in CONNECTED. |
| China Telecom | Option1 | Considering the security of UEs, we prefer Option1 in connected mode. |
| Huawei, HiSilicon | Option 3 | Same answer as in Q1, UE specific TA is only reported during initial access. |
| Samsung | Option-2 | We assume periodical location reporting and event-triggered location reporting are supported for the connected UE. Then we think any RRC based UE-specific TA reporting is quite duplicated with them, i.e. UE-specific TA is calculated by UE location. |
| Ericsson | Option 1 | We think we shall protect the TA/position information as much as possible. Using MAC CEs will enable unwanted parties to detect it, using multiple MAC CE reports from the same user (potentially after a handover, or satellite must have moved substantially or using other information).  |
| LG | Option 2 |  |
| InterDigital | Option 1 or Option 2 | No strong view. If there is already a MAC CE introduced for UE-specific TA reporting in RA then a unified solution might be preferrable. However, we can understand the arguments for RRC-based signalling especially if TA value is not expected to change that quickly. |
| NEC | Option 2 | Reporting TA does not require high resolution of the UE position and can be made via MAC CE without using RRC security |

Summary :

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* **The content of UE specific TA in connected mode after RA procedure**

With the UE position and the satellite ephemeris, the gNB can predict TA variations with less signalling than the UE reporting TA or TA+TA drift [2]. For the content of UE specific TA after procedure, the proposal in [2] is as following:

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| 1. The report about UE specific TA pre-compensation using RRC is the UE position.
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Therefore, the rapporteur suggests discussing the following question.

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| **Question 6: Which option of content of UE specific TA in connected mode after RA procedure do you prefer?****Option 1. UE specific TA; Option 2. UE position; Option 3. Others** |
| **Company** | **Option1/2/3** | **Comment**  |
| MediaTek | Option 1 | UE should report the UE-specific TA. |
| Xiaomi | FFS | In LCS, there is also discussion on UE position report. Perhaps we need to wait for the answer from SA3 to see if common design is applicable here. |
| Lenovo | FFS | NW can adjust TA using TAC command. Therefore if UE has reported TA in RA, NW will always be aware of the adjusted TA value at UE in RRC\_CONNECTED. If there is other reason for TA reporting in CONNECTED, we slightly prefer Option 1 as TA reporting could be of less size and can be directly used for scheduling. |
| China Telecom | Option 1 | We can reuse the position report in LCS. However, if it is not sufficient, Option 1 is straightforward. |
| Huawei, HiSilicon | Option 3 | Same answer as in Q1, UE specific TA is only reported during initial access. |
| Samsung | See comments | If MAC CE is used, option-1, but if RRC is used, option-2.  |
| Ericsson | Option 2 | UE position shall be reported by RRC signalling. |
| LG | Option 1 |  |
| InterDigital | See comments | Agree with Samsung. Depends on outcome of Q5. |
| NEC | Option 1 | UE-specific TA is enough for synchronisation. |

Summary:

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## 2.3 UE specific TA reporting in RA procedure

To clarify the RACH aspects in connected mode, we list the following events that trigger the random access procedure:

- Initial access from RRC\_IDLE;(idle mode)

- RRC Connection Re-establishment procedure; (connected mode)

- DL or UL data arrival during RRC\_CONNECTED when UL synchronisation status is "non-synchronised"; (connected mode)

- UL data arrival during RRC\_CONNECTED when there are no PUCCH resources for SR available; (connected mode)

- SR failure; (connected mode)

- Request by RRC upon synchronous reconfiguration (e.g. handover); (connected mode)

- Transition from RRC\_INACTIVE;(inactive mode)

- To establish time alignment for a secondary TAG; (out of NTN Rel-17 scope)

- Request for Other SI (see clause 7.3); (connected mode)

- Beam failure recovery; (connected mode)

- Consistent UL LBT failure on SpCell; (out of NTN Rel-17 scope)

In [2], the paper proposes that reporting information about the UE specific TA pre-compensation is not necessary in some of these events. For example, if the UE has reported its position to the network, the network can estimate the UE specific TA pre-compensation after a handover regardless of which satellite or which gateway the new cell is associated with. Another example is if a new cell is in the same gNB and uses the same gateway.

We will discuss the P16-P18 one by one regarding the UE specific TA reporting in RACH in [2]:

* **TA reporting controlled by network during handover**

It is proposed by [2] TA reporting should be controlled by network during the handover.

1. For all types of handovers, the network indicates in the handover command whether the UE reports information about the UE specific TA pre-compensation during the random access to the target cell.

Therefore, the rapporteur suggests discussing the following question.

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| **Question 7: Do you agree that the network indicates in the handover command to UE - whether the UE should report information of the UE specific TA pre-compensation to the target cell during the random access?** |
| **Company** | **Yes/No** | **Comment** |
| MediaTek | Yes |  |
| Xiaomi | Yes |  |
| Lenovo | Yes |  |
| China Telecom | Yes |  |
| Huawei | Yes | It is a quite natural behaviour, since other important information in SIB1 is also carried in HO command, e.g. multiple fields in *ServingCellConfigCommon* have their counterparts in *ServingCellConfigCommonSIB*. |
| Samsung | Yes |  |
| Ericsson | Yes with comment: change “handover command” to “RRC reconfiguration with sync” | This avoids defining all cases where the UE knows if gNB has the UE position (or sufficient TA information to the new cell), if feeder link will be switched, or if the new cell is in a different satellite etc. Instead gNB tells the UE what it shall do. Better to write “RRC reconfiguration with sync” instead of “handover” to cover all cases.  |
| LG | Yes |  |
| InterDigital | Yes |  |
| NEC | Yes, but | But it is enough to just follow the indication in the target cell’s SI. |

Summary:

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* **Request for Other SI in RA procedures**

It is proposed that there is an exception not to report UE specific TA in RA procedure which is “Request for Other SI”.

1. In RA procedures triggered due to “Request for Other SI”, information about UE specific TA pre-compensation is not reported.

Therefore, the rapporteur suggests discussing the following question.

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| **Question 8: Do you agree that in RA procedures triggered due to “Request for Other SI”, information about UE specific TA pre-compensation is not reported?** |
| **Company** | **Yes/No** | **Comment** |
| MediaTek | Yes | TA information is not needed during on-demand SI Request. |
| Xiaomi | No | It seems like optimization. We do not see the need to differentiate different RACH trigger cases, no much gain observed. |
| Lenovo | Yes | TA reporting in RA is for scheduling, which is not necessary for on-demand SI Request. |
| Huawei, HiSilicon | Yes |  |
| Samsung | No | Agree with Xiaomi.  |
| Ericsson | Yes | If dedicated preambles are used for “Other SI”, there is no possibility to send an MAC CE. |
| LG | No | Same view as Xiaomi |
| InterDigital | Yes | Agree with MTK/Lenovo |
| NEC | Yes | As there is no UE identification during RA procedure in this case, the TA information is not needed/reported. |

Summary:

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* **TA reporting in other scenarios in RA procedures**

It is proposed that TA is required to report when not configured with a triggering condition for reporting information about UE specific TA pre-compensation in these scenarios in RA procedures in [2].

1. In RA procedures not due to handover and not due to “Request for Other SI” and when the UE is not configured with a triggering condition for reporting information about UE specific TA pre-compensation, the UE shall report information about UE specific TA pre-compensation in the RA procedure.

Therefore, the rapporteur suggests discussing the following question.

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| **Question 9: Do you agree that In RA procedures not due to handover and not due to “Request for Other SI” and when the UE is not configured with a triggering condition for reporting information about UE specific TA pre-compensation, the UE shall report information about UE specific TA pre-compensation in the RA procedure?** |
| **Company** | **Yes/No** | **Comment** |
| MediaTek | Yes | This is needed to maintain the synchronization with the network. |
| Xiaomi | Yes | In all RA cases, whether to report TA is only controlled by SI configuration. |
| Lenovo | Yes | For UE in NTN, reporting TA in RA is necessary in synchronization and scheduling. |
| China Telecom | Yes |  |
| Huawei, HiSilicon | No | Similar answer as in Q1. We don’t see a strong motivation for UEs in connected mode to report TA. |
| Samsung | See comments | Sorry, we’re not crystal clear on the question. If “when the UE is not configured” for UE specific TA reporting, why the UE shall report the UE specific TA information in RA procedure?  |
| Ericsson | Yes | Should be complemented with another proposal:In RA procedures not due to handover and not due to “Request for Other SI” and when the UE is configured with a triggering condition for reporting information about UE specific TA pre-compensation, the UE shall only report information about UE specific TA pre-compensation in the RA procedure when a report have been triggered. |
| LG | Yes |  |
| InterDigital | Yes |  |
| NEC | Yes |  |

Summary:

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# 3 Conclusions

Based on the views expressed in the previous sections, we propose the following:

Proposals

# 4 List of referenced documents

[1] [R2-2107314](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2107314.docx) Discussion on UE Specific TA Report CATT discussion

[2] [R2-2108453](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2108453%20-%20Random%20Access%20timers%20and%20reporting%20information%20about%20UE%20specific%20TA%20pre-compensation%20in%20NTNs.docx) Random Access timers and reporting information about UE specific TA pre-compensation in NTNs Ericsson discussion

# Contact information

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