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

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 will continue to discuss companies’ views regarding the RACH aspects in 2nd round:

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

Updated scope: Continue the discussion on p1, p2 and (updated) p6 from R2-2108882, as well as on remaining FFSs in the agreements.

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)

Updated deadline (for companies' feedback): Monday 2021-08-23 1400 UTC

Updated deadline (for rapporteur's summary in R2-2108897): Monday 2021-08-23 1600 UTC

Proposals marked "for agreement" in R2-2108897 not challenged until Tuesday 2021-08-24 0800 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue online during the CB session).

Status: Ongoing

# 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)

From 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)

The agreements via email at RAN2#115-e are listed as following

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| --- |
| **Agreements via email - from offline 106:**  1.     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).  2.     Reporting on the information about UE specific pre-compensation in connected mode is supported, FFS via RRC signalling or MAC CE  3.     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  4.     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).  5.    Information about UE specific TA pre-compensation is not reported in RA procedures triggered due to “Request for Other SI” |

## 2.1 What content of information about UE specific TA in connected mode

**Work assumption: It is agreed to support reporting on the information about UE specific TA in connected mode.**

Based on the work assumption above, RAN2 will further discuss the content of UE specific TA, e.g. UE specific TA pre-compensation or UE position.

We list the main views of two methods provided by companies in first round for your information to take into consideration.

**Views of reporting UE specific TA:**

* UE specific TA is straightforward;
* UE specific TA is more useful for NW’s scheduling adaption;
* If network has UE location, there is no need to report TA. But TA report should belong to TA associated with UL scheduling, Network may need this fast information via MAC CE.

**Views of reporting UE position:**

* The UE position will facilitate the NW to predict TA change, thus minimize the Uu signalling
* UE position shall be reported by RRC signalling.
* With UE position, network can calculate UE-specific TA and UE position is quite amenable to event trigger.

Rapporteur’s comments:

The UE position discussed in LCS aspect offline #102 may also applies to UE specific TA because the coarse UE location is just ~2km. Any UE specific TA (from UE to reference/satellite) within 2km radius already works smoothly for gNB scheduling.

Therefore, the rapporteur suggests discussing the following question

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| **Question 1: Which option of content of UE specific TA in connected mode do you prefer, under the Work assumption?**  **Option 1. UE specific TA pre-compensation; Option 2. UE position ; Option 3. Other** | | |
| **Company** | **Option1/2/3** | **Comment** |
| Huawei, HiSilicon | Option 1 | Reporting UE position may have security concerns and is dependent on SA3 reply. Besides, the motivation for this reporting is to facilitate scheduling, and UE specific TA can serve this purpose well. |
| MediaTek | Option 1 | UE specific TA pre-compensation is simple and has no potential security issues. |
| Lenovo | Option 1 | TA reporting could be of less size and can be directly used for scheduling. |
| CATT | Option 1 |  |
| Xiaomi | Option 1 |  |
| Apple | Option 3 | Reporting TA has the same security concerns as directly reporting UE position. We do not understand what advantage the network will have when 100s of UEs RACHing will start reporting their TA for network to process. We should wait for RAN1 decision on this before continuing. Additionally, this should strictly be limited to at most 1 depending on if the UE wants to report it or not. |
| Nokia | Option 2 | Agree with Rapporteur’s comments in the description. In the email discussion *“[AT115-e][102][NTN] LCS aspects (Qualcomm)”,* RAN2 agreed a working assumption: “*Event triggered-based UE location reporting are configured by gNB to obtain UE location update of mobile UEs in RRC\_CONNECTED*” . This means, for a UE in RRC Connected, NW can achieve UE’s location based on event. With UE’s location and satellite ephemeris data, NW can estimate the UE’s UE-gNB RTT (i.e. UE-specific TA). This is same as what UE can do before UE’s initial access to decide offset (i.e. UE-gNB RTT) for RAR timer start.  If the NW predicted UE-specific TA can be used for gNB scheduling, we don’t see the reason why UE should report the UE estimated TA again with the cost of Uu interface. |
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[Summary]

## 2.2 How to report the information about UE specific TA in connected mode

**Work assumption: It is agreed to support reporting on the information about UE specific TA in connected mode.**

Based on the first round discussion of RACH Aspect, it is agreed to support reporting **on the information about UE specific TA** in connected mode, FFS via RRC signalling or MAC CE.

We list the main views of two methods provided by companies in first round for your information to take into consideration.

**Views of report via RRC:**

* Considering the security of UEs, option1 in connected mode is more suitable.
* The TA/position information shall be protected 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)

**Views of report via MAC CE:**

* Reporting TA does not require high resolution of the UE position and can be made via MAC CE without using RRC security
* The UE position can be quantized (like discussed in the Control Plane discussion), or UE specific TA pre-compensation can be quantized;
* MAC CEs would be more efficient way to go

Therefore, the rapporteur suggests discussing the following question

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| **Question 2: Which option do you prefer to report UE specific TA pre-compensation in connected mode, under the work assumption?**  **Option 1. RRC signalling; Option 2. MAC CE** | | |
| **Company** | **Option 1/2** | **Comment** |
| Huawei, HiSilicon | Option 2 | It’s better to be aligned with the TA report for initial access. |
| MediaTek | Option 2 | No need to have two signalling options for the same information. |
| Lenovo | Option 2 | Aligned with reporting in initial access. |
| CATT | Option 2 | A single reporting mechanism should be applied in NTN. |
| Xiaomi | Option 2 |  |
| Apple | Option 1 (Maybe) | We do not see why this TA needs to be reported more than once when the TA provided by the network is applied by the UE anyway once the UE provided value is corrected by the network!! As mentioned in earlier question, we do not agree that the UE TA should be reported pre connection as we do not see any benefit to it. |
| Nokia | Option 1 | To report UE’s location (as indicated in Q1), RRC should be used since using RRC will have integrity protection and encryption on UE location information. |

[Summary]

## 2.3 The trigger conditions of UE specific TA reporting in connected mode

**Work assumption: It is agreed to support reporting on the information about UE specific TA in connected mode.**

### Network control method

There are two options for network control method:

* Option 1: UE specific TA report can be requested by network;
* Option 2: Periodical reporting of the information about UE-specific TA report.

**For the option 1,** we list the support and challenges provided by companies in first round for your information to take into consideration.

**Views of requested by network:**

* The scenarios where UE specific TA report can be requested by network in connected mode:
  + If NW does not enable TA report during RACH or TA cannot be reported in Msg3/Msg5 due to not enough resource, NW can indicate UE to report UE specific TA in connected mode;
  + The reporting on request can be useful for UEs within long connection time, especially if UE position is reported (fast UEs may have moved far away, say a plane at 1200 km/h);
  + The UE may move in the connected state, causing the change of the TA compensated by the UE. Such change may be invisible to NW and may not be easy for the NW to predict;
  + Network can request and UE shall report TA report as UE TA drift may be different based on satellite and UE movement.
* The benefit of supporting that UE specific TA report can be requested by network in connected mode:
  + If network wants an updated value for scheduling, the network can request the UE to report TA.

**Reasons of No:**

* There is no need to report UE specific TA in connected mode:
  + 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;
  + If conditions for TA reporting are configured during/following initial access, then one-off TA requests during connected mode will not be necessary.
* Requested by network is unnecessary when other trigger condition is agreed:
  + 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;
  + For UE in connected mode, event-triggered TA update should be supported (as indicated in Q3).

**For the option 2,** we list the support and challenges provided by companies in first round for your information to take into consideration.

**Views of periodical reporting:**

* The scenarios to support periodical reporting of UE-specific TA report:
  + UE-specific TA may constantly change due to the movement of satellite, so periodical reporting is straightforward in connected mode.
* The benefit of supporting that periodical reporting of UE-specific TA report:
  + The network can keep track of the UE specific TA pre-compensation value without additional signalling;
  + Periodical reporting is simpler than event-triggered reporting from UE implementation.

**Reasons of No:**

* There is no need to report UE specific TA in connected mode:
  + 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.
* The method is unnecessary when other trigger condition is agreed:
  + Event triggered report with network based polling should be enough, it is not reasonable for UE to report the TA periodically even the TA is not changed (or change within the threshold);
  + NW request could be sufficient;
  + If periodical location reporting and event-triggered location reporting are supported for the connected UE. Then any RRC based UE-specific TA reporting is not needed.
* The disadvantage of periodical reporting of UE-specific TA report in connected mode:
  + Signaling overhead is not negligible. There is not much to be gained from periodic reporting;
  + 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.

Since many companies consider the one of the above option is enough for network control, we list the two options together for decision.

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| **Question 3: which option(s) do you prefer to report the information about UE specific TA, under the work assumption?**  **Option 1: UE specific TA report can be requested by network;**  **Option 2: Periodical reporting of the information about UE-specific TA report;**  **Or none?** | | |
| **Company** | **Option1/2/none** | **Comment** |
| Huawei, HiSilicon | None | TA report in connected mode does not look necessary to us. The reason has been listed by the rapporteur: 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.  With the legacy mechanism workable, adding additional UE reports increases complexity and signalling overhead. Besides, RAN2 needs to figure out how the legacy mechanism and the newly introduced UE report coexist; the two-tier adjustment looks duplicated, and the adjustment results are mutually influenced.  We can live with the majority view to have the event-triggered approach as in phase 1, but do not want more alternatives to add the complexity. |
| MediaTek | Option 1 | Network requested TA report can be useful in some scenarios, but periodic reporting is not necessary. |
| Lenovo | Option 1 | It can be requested by network if necessary. There is no need for periodic reporting. |
| CATT | Option 1 and option 2 | For the option 1, the TA report can be requested by NW when the NW wants to adjust TA.  The option 2 is beneficial for timely TA tracking. Since the option 2 can be configured as OPTIONAL, the network can configure it when there is a need for timely TA tracking. |
| Xiaomi | Option 1 | Option 2 is not necessary as network request & event trigger are enough. |
| Apple | None | Agree with Huawei. |
| Nokia | None | Event-triggered reporting is sufficient. |

[Summary]

### Event triggered method

Based on the first round discussion of RACH Aspect, it is agreed that event-triggers for reporting UE specific TA in connected mode is supported, FFS detail information.

The detail information of event-triggers is provided in [1] and [2], we list as following:

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| The proposal in [1]:  **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.**  The proposals in [2]:  **Proposal 8 The network may configure a number of TA levels that triggers reporting of information about UE specific TA pre-compensation.**  **Proposal 9 The network may configure an offset for triggering reporting of information about UE specific TA pre-compensation when going towards lower TA values.**  **Proposal 10 The network may configure an offset for triggering reporting of information about UE specific TA pre-compensation when going towards higher TA values.**  **Proposal 11 The network may configure a time threshold when going towards lower TA values where a report with information about UE specific TA pre-compensation is triggered if time since passing the TA threshold is above the time threshold.**  **Proposal 12 The network may configure a time threshold when going towards higher TA values where a report with information about UE specific TA pre-compensation is triggered if time until passing the TA threshold is below the time threshold.**  **Proposal 13 The network may configure the time thresholds and offsets separately or combine them together.**  **Proposal 14 The network may configure the UEs to report the times (or time until) it will cross each TA level with an indication if it will pass from lower to higher TA or from higher to lower TA.**  **Proposal 15 The network may configure the UE to only consider the TA levels closest to the TA when last successfully reported information about UE specific TA pre-compensation was triggered.** |

There are two methods provided in the above table: one is TA values related, the other is time threshold related. We will further discuss the detail information in two methods.

* **TA values aspect**

Work assumption:

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| **Question 4: Do you agree that the event-triggers for reporting information about UE specific TA are based on TA value?** | | |
| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | Yes |  |
| MediaTek | Yes |  |
| Lenovo | Yes |  |
| CATT | Yes |  |
| Xiaomi | Yes |  |
| Apple | Yes |  |
| Nokia | Yes with modification | We agree it should base on UE estimated Timing Advance. However, it is ambiguous to say the trigger is based on TA value because actually it should base on the change of TA value estimated by UE instead of TA value itself. So, we suggest modifying as below:  **The event-triggers for reporting information about UE specific TA are based on the change of TA value estimated by UE.** |

[Summary]

Last successful reported TA is proposed as a benchmark in both [1] and [2]. The proposals 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 15 The network may configure the UE to only consider the TA levels closest to the TA when last successfully reported information about UE specific TA pre-compensation was triggered. [2]** |

Thus, the rapporteur suggests discussing the following question:

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| **Question 5: if you agree with Q4, do you agree an offset threshold can be used based on between current TA and the last reported TA?** | | |
| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | Yes |  |
| MediaTek | Yes |  |
| Lenovo | Yes |  |
| CATT | Yes |  |
| Xiaomi | Yes |  |
| Apple | Yes |  |
| Nokia | No | **The content of the reported information is not decided yet (as discussed in Q1), we agree an offset threshold can be used but whether it is based on the *last reported TA* is FFS. If UE’s location is reported, the threshold is not based on last reported TA. To make progress, we suggest proposal as below:**  **An TA offset threshold can be used for event-triggered reporting, how to define the threshold is FFS.** |

[Summary]

**Proposal 9 The network may configure an offset for triggering reporting of information about UE specific TA pre-compensation when going towards lower TA values. [2]**

**Proposal 10 The network may configure an offset for triggering reporting of information about UE specific TA pre-compensation when going towards higher TA values. [2]**

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| **Question 6: if you agree with Q4, do you agree that the offset threshold also can be**  **Option 1: an offset when going towards lower TA values;**  **Option 2: an offset when going towards higher TA values;** | | |
| **Company** | **Option1/2/neither** | **Comment** |
| Huawei, HiSilicon | neither | We are wondering why Option 1 and Option 2 are separate options. In our understanding, as long as the absolute value exceeds a certain threshold, the report can be triggered. It does not matter whether it is a positive value or negative value. |
| MediaTek | Option 1 and 2 | A hysteresis around the previous reported value (TA\_old +/- hys) should be fine. |
| Lenovo | Both | For flexibility both can be supported. |
| CATT | See comments | The same offset should be applied to when going towards lower TA values and when going towards higher TA values, i.e. the solution in Q5.  We agree with Q6 if the offset in option 1 and option 2 are same. |
| Xiaomi | Neither | A single offset can be applied for both increase and decrease case. |
| Apple | Neither |  |
| Nokia | Neither |  |

[Summary]

* **Time threshold aspect**

The time threshold method was suggested by P11/P12/P13/P14 in [2], thus, the rapporteur suggests discussing the following question regarding time threshold one by one:

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| **Question 7: Do you agree that event-triggers for reporting information about UE specific TA also can be based a time threshold?** | | |
| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | No |  |
| MediaTek | No |  |
| Lenovo | No |  |
| CATT | No |  |
| Xiaomi | No |  |
| Apple | No |  |
| Nokia | No |  |

[Summary]

**Proposal 11 The network may configure a time threshold when going towards lower TA values where a report with information about UE specific TA pre-compensation is triggered if time since passing the TA threshold is above the time threshold. [2]**

**Proposal 12 The network may configure a time threshold when going towards higher TA values where a report with information about UE specific TA pre-compensation is triggered if time until passing the TA threshold is below the time threshold. [2]**

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| **Question 8: If you agree with Q7, do you agree that time related method is as following?**   * **The network may configure a time threshold when going towards lower TA values where a report with information about UE specific TA pre-compensation is triggered if time since passing the TA threshold is above the time threshold.** * **The network may configure a time threshold when going towards higher TA values where a report with information about UE specific TA pre-compensation is triggered if time until passing the TA threshold is below the time threshold.** | | |
| **Company** | **Option1/2/other** | **Comment** |
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[Summary]

**Proposal 13 The network may configure the time thresholds and offsets separately or combine them together. [2]**

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| **Question 9: If you agree with both Q4 and Q7, do you agree that the network may configure the time thresholds and offset threshold separately or combine them together?** | | |
| **Company** | **Yes/No** | **Comment** |
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[Summary]

**Proposal 14 The network may configure the UEs to report the times (or time until) it will cross each TA level with an indication if it will pass from lower to higher TA or from higher to lower TA. [2]**

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| **Question 10: if you agree with Q9, do you agree that the network may configure the UEs to report the times (or time until) it will cross each event-trigger with an indication if it will pass from lower to higher TA or from higher to lower TA?** | | |
| **Company** | **Yes/No** | **Comment** |
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[Summary]

* **event-trigger configuration**

Some event-triggers configuration was suggested by p8 in [2], thus, the rapporteur suggests discussing the following question:

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| **Question 11: Do you agree that the network may configure more than one event-triggers for reporting the information about UE specific TA?** | | |
| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | No | Multiple triggering conditions add significant complexity without clear gains. |
| MediaTek | No | A single event based trigger should be enough. |
| Lenovo | No | No need to do so. |
| CATT | No | One event-trigger is enough for triggering the UE specific TA reporting. |
| Xiaomi | No |  |
| Apple | No |  |
| Nokia | No |  |

[Summary]

## 2.4 UE specific TA reporting in RA procedure

Based on the first round discussion of RACH Aspect, it is agreed that 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).

We provide the discussion via email for your information:

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| Proposal 7: RAN2 to agree the UE should report information of the UE specific TA pre-compensation to the target cell during the random access, FFS a new indication in RRC reconfiguration with sync or not.  -     Oppo thinks the FFS part was not suggested by anyone and should be removed  -     Huawei suggests to reword as "RAN2 to agree the UE should report information of the UE specific TA pre-compensation to the target cell during the random access if the enable/disable indication of TA report in SI is also carried in HO command (similar to other IEs in SIB1 that are carried in HO command), FFS a new indication in RRC reconfiguration with sync or not.". Nokia agrees  -     ZTE wonders if some sort of implicit indication (e.g., presence of NTN parameters) can be used to inform the UE to report TA via HO, therefore the FFS can be kept for the moment  -     Ericsson thinks there are handover cases where the network do not need the reported TA because it can deduct it from known information (for example for HO to a cell in the same satellite without a feeder link switch, the UE shall use the same TA as before the HO and no TA report is needed), therefore proposes a new flag to trigger this report as the SIB indication from the new cell is not sufficient.  -     CATT is ok with Huawei's formulation with the addition of the FFS: "RAN2 to agree the UE should report information of the UE specific TA pre-compensation to the target cell during the random access if the enable/disable indication of TA report in SI is also carried in HO command (similar to other IEs in SIB1 that are carried in HO command). FFS a new indication in RRC reconfiguration with sync or not."  **Agreed with the formulation "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)"** |

Thus, the rapporteur suggests discussing the following question:

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| **Question 12: Is a new indication in RRC reconfiguration needed with sync 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)?** | | |
| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | No | We think the case where source node enables the flag whereas target node disables the flag is quite rare.  Most companies supported the UE specific TA report in connected mode in phase 1 discussion, with the understanding that UE shall adjust the TA continuously. Based on this understanding, reporting the latest TA to the target node makes sense. On the other hand, there’s no negative effect if the latest TA to be reported has no drastic change compared with the TA before HO. |
| MediaTek | No, but | We think this is not crucial, however if there is majority support, it can be considered. |
| Lenovo | No |  |
| CATT | No | The SIB indication is enough to trigger the UE specific TA reporting. |
| Xiaomi | No |  |
| Apple | No |  |
| Nokia | No | The SIB indication carried in HO command on whether TA report is enabled/disabled in the target cell is sufficient. |

[Summary]

# 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:\Data\3GPP\Extracts\R2-2107314.docx) Discussion on UE Specific TA Report CATT discussion

[2] [R2-2108453](file:///C:\Data\3GPP\Extracts\R2-2108453%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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| --- | --- |
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