**3GPP TSG-RAN WG2 Meeting #116bis electronic**[***R2-22xxxxx***](file:///C:\Data\3GPP\RAN2\Inbox\R2-2111338.zip)

**Online, January 17th – January 25th, 2022**

**Agenda Item: 8.10.2.1**

**Source: OPPO**

**Title: Summary of [AT116bis][101][NTN] RACH aspects (OPPO)**

**Document for: Discussion and Decision**

# Introduction

This document aims to discuss the issues that have been raised by contributions submitted to AI 8.10.2.1.

# Discussion

## 2.1 TA reporting

**Content of TA reporting**

RAN2 has agreed that the content of UE specific TA pre-compensation reported using MAC CE is UE specific TA, and has also received RAN1 LS on TA reporting after RAN1#106bis e-meeting. The definition of UE’s TA is provided to RAN2 as below, and based on the LS, 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.

|  |
| --- |
| Agreement:  The Timing Advance applied by an NR NTN UE in RRC\_IDLE/INACTIVE and RRC\_CONNECTED is given by:  Where:   * 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. * is UE self-estimated TA to pre-compensate for the service link delay. * is network-controlled common TA, and may include any timing offset considered necessary by the network. * with value of 0 is supported.   + FFS:  details of signaling including granularity. * 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 |

In RAN1#107e meeting, RAN1 made the following further agreements for the details of the TA value:

|  |
| --- |
| Agreement  15 kHz is used as the reference subcarrier spacing value for the unit of TA reported in FR1.  Agreement  The reported TA is the least integer number of slots greater than or equal to the corresponding TA value. |

Relevant RAN2 proposals on the content of TA reporting are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [1]R2-2200214 | Proposal 1: the content of TA report MAC CE is UE specific differential delay, i.e., [T\_TA – minimum TA] / [slot time] rounded down to closest integer. Minimum TA is broadcast in system information, and the default value is 477.48 ms for GEO and 8ms for LEO. | Intel Corporation |
| [2]R2-2200243 | Proposal 1: Include UE’s full TA (i.e. TTA) in TA Report MAC CE. | OPPO |
| [3]R2-2200270 | Proposal 1: For idle/inactive or connected mode, the content of TA report MAC CE is TTA – Koffset. | Xiaomi |
| [4]R2-2200347 | Proposal 1: the content of TA reporting during RACH is UE specific TA (i.e. NTA, UE-specific×Tc) defined in the UE’s TA formula in the granularity of slot. | Huawei, HiSilicon |
| [5]R2-2200377 | Proposal 1: The content of UE specific TA reporting is full TA (i.e., TTA as defined in the UE’s TA formula). | vivo |
| [6]R2-2200520 | Proposal 1: The content of TA report is UE’s service link TA (option 2). | China Telecom |
| [8]R2-2200688 | Proposal 1: The content of TA report is the UE’s service link TA (i.e., NTA, UE-specific as defined in the UE’s TA formula). | CATT |
| [11]R2-2200764 | Proposal 1: The TA reporting in Msg3 or Msg5 via MAC CE is the UE’s service link TA or UE’s service link propagation delay.  Proposal 2: The TA reporting in connected mode via MAC CE is the UE’s service link TA, or UE’s service link propagation delay, or the difference value compared to the last reporting. | Lenovo, Motorola Mobility |
| [13]R2-2201007 | Proposal 9: For UE-specific TA pre-compensation reporting, the reporting content is full TA. | Nokia, Nokia Shanghai Bell |
| [14]R2-2201034 | Proposal 3: If UE specific TA reporting during RACH procedure is enabled by SI, UE reports UE specific TA pre-compensation, i.e. , in TA reporting MAC CE.  Proposal 4: For connected mode, UE reports UE specific TA pre-compensation, i.e. , in TA reporting MAC CE. | Samsung Research America |
| [15]R2-2201164 | Proposal 1: TA report content during RACH is the UE’s service link TA (i.e., N\_TA, UE-specific as defined in the UE’s TA formula). | InterDigital |
| [16]R2-2201193 | Proposal 1: Option 1 (full TA) is preferable to Option 2 (UE service link TA).  Proposal 2: Option 1 (full TA) is preferable to Option 4 (difference between full TA and the cell-specific Koffset).  Proposal 3: The UE reports full TA in Connected mode. | NEC Telecom MODUS Ltd. |
| [17]R2-2201324 | Proposal 1: UE reports full TA in TA report if configured by NW and the report unit is ms. | ZTE Corporation, Sanechips |
| [18]R2-2201363 | Proposal 2. The UE reports the UE specific TA in MAC CE for TA pre-compensation. | LG Electronics Inc. |
| [19]R2-2201630 | Proposal 4: When information about the UE specific TA pre-compensation is reported in a MAC CE, the reporting quantity is the [cell-specific-Koffset – TTA]/[slot length] rounded down to closest integer and where all quantities are expressed in the same unit of time, for example seconds. | Ericsson |

In summary, the following options are proposed by companies:

* Option 1: Full TA (i.e., as defined in the UE’s TA formula) [2][5][13][16][17]
* Option 2: UE’s service link TA (i.e., NTA, UE-specific or NTA, UE-specific×Tc as defined in the UE’s TA formula) [4][6] [8][11][14][15][18]
* Option 3: The difference between full TA and the cell-specific Koffset (i.e., [Cell-specific-Koffset \* 10-3 – ] / [slot time] rounded down to closest integer, or [vice](javascript:;) [versa](javascript:;)) [3][19]
* Option 4: The difference between full TA and minimum TA, i.e., [ – minimum TA] / [slot time] rounded down to closest integer, where the minimum TA is broadcast in system information, and the default value is 477.48 ms for GEO and 8ms for LEO. [1]
* Option 5: For RRC connected mode, the difference value compared to the last reporting. [11]

For Option 1, it is stated in [2] and [13] that it is simple and straightforward for network to configure UE-specific K-offset. For Option 2, it is stated in [8] and [14] that in the equation for calculating , only NTA, UE-specific is estimated by UE itself, the rest of components of the equation are all known to NW. Therefore, only the NTA, UE-specific is the useful information for network. However, it is stated in [2] and [5] that since the common TA may change over time, the common TA used by network to derive UE’s full TA may differ from the actual common TA pre-compensated by the UE, which makes it even more difficult for network to derive UE’s full TA. For Option 3, it is the difference between TTA and the cell-specific Koffset, and it is proposed by [3] and [19] given that it would limit the range of values that need to be reported in the TA report by using that. Option 4 is similar to Option 3. Option 5 is mainly for RRC connected mode, which aims to reducing overhead or increasing accuracy.

Given split views from companies, rapporteur would like to ask the following question:

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

* **Option 1: Full TA (i.e., as defined in the UE’s TA formula)**
* **Option 2: UE’s service link TA (i.e., NTA, UE-specific or NTA, UE-specific×Tc as defined in the UE’s TA formula)**
* **Option 3: The difference between full TA and the cell-specific Koffset (i.e., [Cell-specific-Koffset \* 10-3 – ] / [slot time] rounded down to closest integer, or** [**vice**](javascript:;)[**versa**](javascript:;)**)**
* **Option 4: The difference between full TA and minimum TA (i.e., [ – minimum TA] / [slot time] rounded down to closest integer)**
* **Option 5: For RRC connected mode, the difference value compared to the last reporting.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Option** | | **Additional comments** |
| Nokia | Option 1 | | Option 1 is simple for implementation. Further, by reporting the full TA, the information will reflect the UE experienced RTT by the time of reporting, and would hence not be depending on potential updates to the Common TA (since Common TA will change as a function of time and may experience step-wise changes when UE re-reads the information). |
| ZTE | Option 1 | | RAN1 has agreed on report the least integer number of TA that is used by UE, it is suggested to respect RAN1’s conclusion and selects a solution that is independent of K-offset. As for option 4, additional parameters will need to be broadcast by NW, and similar to option2, NW will need to track the broadcasted parameters continuously therefore it is possible the parameter used by NW and the parameter used by UE is different thus result in error case. Therefore to avoid complexity in NW’s implementation it is prefer to report full TA.  Regarding option 5 it is related to event triggered connected mode reporting, which is more like enhancements. We may first decide the TA content reported in RACH procedure during idle/inactive state and then discuss if enhancement is necessary.  While the TA size issue, as agreed earlier UE can based on existing LCP to decide whether Msg3 or Msg5 can be used for reporting. Also, it can be further enhanced by using varied size MAC CE or using different MAC CEs with one or two octets. |
| OPPO | Option 1 | | Share the same view with Nokia.  Reporting full TA is most simple and straightforward to assist NW for UE-specific K offset configuration and it also simplifies network’s task to estimate the full TA. |
| Thales | Option 1 | |  |
| Xiaomi | Option 3/4 | | We think it is important to restrict the size to 1 byte, and only option 3/4 can achieve it. For the concern of SCS240KHz, it is currently only used for SSB not for PUSCH. And according to RAN1 agreement on using 15KHz as the reference subcarrier spacing for FR1 TA report, 240KHz will not be used as the reference subcarrier spacing for FR2. As such, there is no issue for option 3/4 to limit the size to 1 byte. |
| MediaTek | Option 2 | | UE’s service link TA is the only parameter that is unknown to the network. |
| Qualcomm | Option 1 | | It is simple and does not depend on any value broadcast in SIB. However, we think option 2 is also fine. |
| Apple | Option 1 | | Prefer simplicity; also OK with option 2. |
| Sequans | Option 1 | | We agree with Nokia. |
| Lenovo, Motorola Mobility | Option 2  Option 5 | | We think Option 2 can reduce size or improve accuracy. Besides as we addressed in [11], for Option 1 the common TA included in report may not be the same as the actual value at network when received.  For connected mode reporting (if agreed), we think Option 5 can reduce size or improve accuracy as well. |
| Ericsson | Option 3 | | This needs to be technically evaluated together with the effects on the UE specific TA report MAC CE and the triggering of UE specific TA reports. The choice will affect the size of the UE specific TA report MAC CE, and a large report size may decrease the cell coverage.  Option 4 has the same advantages as Option 3 of limiting the range of the UTR, but option 4 require broadcasting a minimum TA (or a complex specification of minimum TA that depends on the actual constellation) while the broadcasting needed for option 3 is the cell-specific-Koffset which is mandatory to in NTNs. Further, for option 4, the minimum TA may be dependent on the height above earth that the UE is located at giving a larger needed range of the report.  For Option 3 or 4 only the differential RTT of UEs within a cell affect the required reporting range while Option 1 and 2 needs to cover all possible TA values.  Option 5 is fine, but for option 1, 2 and 5; the triggering condition for reporting will be “compared to last reporting” as that requires the UE (and gNB) to determine what was the “last reporting” which introduces opportunities for state mismatch between UE and gNB.  When using option 3 it is natural to use the quantity Qta = [current-Koffset – TTA] for triggering UTRs, for example when Qta > ThUp and when Qta < ThDown. This is beneficial as 1) there is no need to reconfigure the measurement thresholds after a report, 2) no need to save the “last successfully reported TA”/“last successfully reported UE location” 3) no need for UE/gNB to guess on when a report is successful or not, 4) no report is triggered unless there is need for it (reports only needed if there is an opportunity to decrease the Koffset or a need to increase Koffset).  Further, we do not see that there will be step changes in the common TA except if there is a change of feeder link – but that will affect all options for TA reporting; and it is known to the NW when it takes place. Neither will there be frequent (if any) updates to the cell-specific-Koffset as this is a design parameter, decided based on the UEs that are farthest away from the satellite. |
| ASUSTeK | Option 1 | | Also option 2 is acceptable. |
| Intel | Option 1/4 | | From signalling overhead perspective, option 4 is better; but option 1 is also acceptable. |
| vivo | Option 1 | TA reporting is used for NW to configure suitable UE specific Koffset. The prerequisite of configuring suitable Koffset is that NW should know the exact TA value which is compensated by UE. Thus, option 1 is the most straightforward way.  For option 2, since the common TA may change over time, there could be potential misalignment between the common TA used by network and the common TA used by UE, which actually goes against the original intention of reporting TA.  For option 3, since Cell-specific-Koffset also change over time, this option 3 will result in the same issue as option 2.  Option 4 leads to more complex NW implementation, which is not preferable. For example, NW should maintain multiple minimum TAs for different satellite types and the associated satellite type that the UE is connected to. Also, the complication applies at the UE side.  Option 5 cannot work well if the TA MAC CE is lost. In NR (other than NR-U), there is no explicit HARQ feedback for UL transmission. Thus, UE may inevitably assume that the MAC PDU carrying TA MAC CE is transmitted successfully when receiving new scheduling grant for the corresponding HARQ process, but in the contrary NW may actually give scheduling retransmission of the MAC PDU carrying TA MAC CE which has not been successfully transmitted. Then, misalignment on the transmission status of TA MAC CE between NW and UE will occur, and this further causes the consequence that UE’s full TA derived by NW is misaligned with the one compensated by UE. | |
| Samsung | Option 2 | | Common TA at the network side should be more accurate, and the UE specific TA is the only unknown part to the network and exactly reflects the service link delay. |
| Huawei, HiSilicon | Option 2 or Option1 | | We think Option2, i.e. reporting UE service link TA is enough. But can accept Option1 for progress if that is the majority view. |
| CATT | Option 2 | | We think UE service link TA is enough. And for Option 1, as stated in the summary that, the common TA may change over time, then if the network updates and broadcasts the common TA after UE reporting full TA and during the full TA transmission duration during the long propagation time, it will be not clear the behaviour of the network. But for Option 2, the UE and network can always use the freshest common TA. |
| NEC | Option 1 | | Option 1 does not depend on the NW making assumptions on up-to-date SIBs at UE side and accurately captures the TA used by the UE at the time of sending the report.  We understand that this may result in an additional byte in the MAC CE but as ZTE pointed out, the UE can always use Msg5 if Msg3 is not sufficient. |

**TA report MAC CE**

Relevant RAN2 proposals on TA report MAC CE design are listed below:

|  |  |  |  |
| --- | --- | --- | --- |
| Tdoc No. | | Relevant Proposals | Source |
| [1]R2-2200214 | | Proposal 2: if P1 is agreed, the TA report MAC CE consists of a single field with 8 bits length. | Intel Corporation |
| [5]R2-2200377 | | Proposal 2: TA reporting MAC CE has a fixed size and consists of two octets. | vivo |
| [17]R2-2201324 | | Proposal 2: RAN2 to discuss and select between alt2 or alt3 as given below for TA report MAC CE design. | ZTE Corporation, Sanechips |
| [19]R2-2201630 | Proposal 5 The new MAC CE format for TA reporting during random access uses one field of fixed 8 bits size. | | Ericsson |

All the proposals above are related to the size of TA report MAC CE. Rapporteur understands the TA report MAC CE size depends on the value range of the reported TA, meanwhile which content is used for TA reporting also depends on the targeted MAC CE size.

Based on companies’ input, rapporteur would like to ask the following question:

**Question 2: Which is the preferred option regarding the size of the TA report MAC CE?**

* **Option 1: a single field with 8 bits length.**
* **Option 2: a fixed size of two octets.**
* **Option 3: Two separate MAC CE identified by different LCIDs which includes following:**
  + **One-octet fixed size Short TA report MAC CE with only UE specific TA values filed**
  + **Two-octet fixed size Long TA report MAC CEs with R field and UE specific TA values filed**
* **Option 4: Varied size TA report MAC CE with one or two octets, which including following fields:**
  + **L filed to indicate the length of TA report MAC CE, which is set to 1 if two octets is used to for TA report MAC CE, zero if one octet is used for TA report MAC CE.**
  + **UE specific TA values field with either 7 or 10 bits**
  + **R field, which is set to zero. It presents if two-octet long TA report MAC CE is used (i.e., L is set to 1).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Nokia | Option 1 or 2, depending on conclusion of Q1 | For Option3 and Option4, we wonder if it is necessary to have this minor optimization which is not essential for Rel-17. For Option3, it is too expensive to use two reserved LCIDs for the same purpose. For Option4, the L bit is proposed as part of MAC CE payload. However, there is principle that L field is always needed in MAC subheader for variable size MAC CE, not indicated by the MAC CE payload itself. |
| ZTE | Opt3/4, which depends of outcome of Q1 | We are opponent of option 3/4 since we prefer to report full TA. And opt3 and opt 4 can bring additional gain for some UEs when the maximum required TA size could exceed 1 byte. But the final option is actually dependent on which content RAN2 selected for reporting |
| OPPO | Option 2 | It would depend on the content of TA reporting. If we decide to use UE’s full TA as the content of TA reporting, 2 bytes would be needed for TA report MAC CE. |
| Thales | Option 1 or 2, depending on conclusion of Q1 |  |
| Xiaomi | Option 1 |  |
| MediaTek | Option 1 or 2, depending on Q1 |  |
| Qualcomm | Option 2 |  |
| Apple | Option 2 |  |
| Sequans | Option 2 | Assuming full TA is reported. |
| Lenovo, Motorola Mobility | Option 1 | If only service link TA is reported, we think Option 1 is sufficient. |
| Ericsson | Option 1 | The intention of this MAC CE is to be included in Msg3/MsgA where gNB do not have proper information of the propagation link, it may therefore be limiting the coverage. It is therefore important to keep down the size of this MAC CE to increase the satellite coverage. |
| ASUSTeK | Option 1 or 2 | It could depend on Q1. |
| Intel | It depends on the outcome of Q1 | If full TA is reported, option 2 can be adopted. |
| vivo | Option 2 | If RAN2 agrees that the full TA is reported, then the size of MAC CE can be fixed to two bytes. |
| Samsung | Option 2 | Depend on Q1 |
| Huawei, HiSilicon | Option 2, but | Still depends on the outcome of Q1. |
| CATT | Option 2 |  |
| NEC | Option 2,  or Option 1 depending on conclusion of Q1 | Option 3 and 4 add complexity, the outcome of Q1 should give a clear 1 byte or 2 bytes fixed solution. |

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

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

|  |
| --- |
| 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. |

In RAN2#116e meeting, RAN2 discussed the logical channel priority of TA report MAC CE and made the following agreements.

Agreements:

1. 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”.
2. RAN2 further discuss the exact priority of the TA report MAC CE between “C-RNTI MAC CE or data from UL-CCCH” and “MAC CE for BSR, with exception of BSR included for padding.

Relevant RAN2 proposals on logical channel priority of the TA report MAC CE are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [1]R2-2200214 | Proposal 3: the priority of the TA report MAC CE is right above “MAC CE for BSR, with exception of BSR included for padding.” | Intel Corporation |
| [2]R2-2200243 | Proposal 4: Logical channel priority of the TA report MAC CE is lower than LBT failure MAC CE and higher than MAC CE for SL-BSR prioritized. | OPPO |
| [3]R2-2200270 | Proposal 2: The logical channel priority of TA report MAC CE is higher than MAC CE for BSR, with exception of BSR included for padding. | Xiaomi |
| [4]R2-2200347 | Proposal 2: 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 |
| [5]R2-2200377 | Proposal 3: The priority of TA reporting MAC CE is higher than CG confirmation MAC CE. | vivo |
| [7]R2-2200627 | Proposal 3: In LCP, the priority of TA report is between LBT failure MAC CE and MAC CE for SL-BSR. | Spreadtrum Communications |
| [8]R2-2200688 | Proposal 3: Logical channel priority of the TA report MAC CE should be lower than that of “LBT failure MAC CE” and higher than that of “MAC CE for SL-BSR prioritized according to clause 5.22.1.6”. | CATT |
| [13]R2-2201007 | Proposal 10: The priority of new UE-specific TA Report MAC CE should be below CG confirmation/BFR MAC CE but above MAC CE for SL-BSR prioritized. | Nokia, Nokia Shanghai Bell |
| [14]R2-2201034 | Proposal 1: The priority of TA reporting MAC CE is higher than BSR MAC CE, i.e. MAC CE for SL-BSR prioritized according to clause 5.22.1.6 and MAC CE for BSR, with exception of BSR included for padding.  Proposal 2: The priority of TA reporting MAC CE is at least lower than BFR MAC CE. | Samsung Research America |
| [15]R2-2201164 | Proposal 2: 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 |
| [18]R2-2201363 | Proposal 1. The priority of MAC CE for TA reporting should be between C-RNTI MAC CE or data from UL-CCCH and Configured Grant Confirmation MAC CE. | LG Electronics Inc. |
| [19]R2-2201630 | Proposal 3: The priority of the new MAC CE in the prioritization list in the MAC spec section 5.4.3.1.3 shall be lower than “Configured Grant Confirmation MAC CE or BFR MAC CE or Multiple Entry Configured Grant Confirmation MAC CE” and higher than “Sidelink Configured Grant Confirmation MAC CE”.  Proposal 8: RAN2 to discuss the case a TBS can fit all data if a new TA report MAC CE is not included, whether the UE shall then not send the new TA report MAC CE. | Ericsson |

Regarding the exact priority of the TA report MAC CE between “C-RNTI MAC CE or data from UL-CCCH” and “MAC CE for BSR, with exception of BSR included for padding, the following options were proposed by companies:

* Option 1: right above “MAC CE for BSR, with exception of BSR included for padding.” [1]
* Option 2: lower than LBT failure MAC CE and higher than MAC CE for SL-BSR prioritized. [2] [4][7][8]
* Option 3: higher than MAC CE for BSR, with exception of BSR included for padding. [3]
* Option 4: higher than CG confirmation MAC CE. [5] [18]
* Option 5: below CG confirmation/BFR MAC CE but above MAC CE for SL-BSR prioritized. [13] [14][19]
* Option 6: lower than BFR MAC CE, and higher than “data from any Logical Channel”. [15]

Rapporteur would like to ask the following question:

**Question 3: Which the preferred option regarding the exact priority of the TA report MAC CE?**

* **Option 1: right above “MAC CE for BSR, with exception of BSR included for padding.”**
* **Option 2: lower than LBT failure MAC CE and higher than MAC CE for SL-BSR prioritized.**
* **Option 3: higher than MAC CE for BSR, with exception of BSR included for padding.**
* **Option 4: higher than CG confirmation MAC CE.**
* **Option 5: below CG confirmation/BFR MAC CE but above MAC CE for SL-BSR prioritized.**
* **Option 6: lower than BFR MAC CE, and higher than “data from any Logical Channel”.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Option** | | **Additional comments** |
| Nokia | Option 2 or Option 5 | |  |
| ZTE | Option 5 | | It is preferred to have higher priority for TA report MAC CE so it can be sent as earlier as possible. Considering that NR-U and sidelink might not use in NTN, therefore we suggest to put the priority higher than LBT failure MAC CE as well, or in another option we can leave it to implementation. |
| OPPO | Option 2 | |  |
| Xiaomi | Option 2 | |  |
| MediaTek | Option 5 | |  |
| Qualcomm | Option 1 | |  |
| Apple | Option 5 | |  |
| Lenovo, Motorola Mobility | Option 2 or 5 | |  |
| Ericsson | Option 5 or Option 2 | | We prefer to put it right above the “Sidelink Configured Grant Confirmation MAC CE”, but we are fine with any prio above “MAC CE for SL-BSR prioritized”.  In the interest of progress, we may accept a majority view if the priority is above “MAC CE for BSR, with exception of BSR included for padding”. |
| ASUSTeK | Option 2 | |  |
| Intel | Option 1 | |  |
| vivo | Option 4 | TA MAC CE is beneficial for resource allocation. CG confirmation MAC CE is used for confirming the receiving of CG activation MAC CE and avoiding NW re-sending CG activation command. It is preferred that TA MAC CE has higher priority than CG confirmation MAC CE. Specifically，a use case is that there have already been some outdated CG resources when UE receives the CG activation command due to the change of propagation delay. Under this case, UE ought to send TA MAC CE as soon as possible to avoid NW re-sending CG activation command. | |
| Samsung | Option 3, 6 | |  |
| Huawei, HiSilicon | Option 2 | | Huawei, HiSilicon |
| CATT | Option 2 | |  |
| NEC | Option 2 or 5 | |  |

**TA reporting during connected mode RACH**

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

|  |
| --- |
| RAN2#115-e agreement:   1. UE specific TA reporting during RACH procedure is enabled/disabled by SI (FFS for RACH in connected mode) |

Regarding TA reporting during RACH in connected mode, following proposals were brought up by companies:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [2]R2-2200243 | Proposal 3: TA reporting during RACH in connected mode should not be controlled by the enable/disable indication configured in SI, but should depend on whether a TA update event is triggered. | OPPO |
| [3]R2-2200270 | Proposal 3: 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 |
| [4]R2-2200347 | Proposal 5. No specs change is needed for TA reporting during RACH in connected mode (i.e legacy behaviour applies).  [Rapporteur’s comments]: Based on the statements in [4], rapporteur assumes the intention of this proposal is aligned with Option2. | Huawei, HiSilicon |
| [5]R2-2200377 | Proposal 4: Except handover procedure, TA reporting during RACH in connected mode should not be controlled by the enable/disable indication configured in SI.  Proposal 5: For an RRC\_CONNECTED UE, UE specific TA is reported during the RACH triggered due to the following events:   * RRC Connection Re-establishment procedure; * DL or UL data arrival during RRC\_CONNECTED when UL synchronisation status is "non-synchronised"; * SR failure; * Request by RRC upon synchronous reconfiguration (e.g. handover); * RRC Connection Resume procedure from RRC\_INACTIVE; * CBRA due to beam failure recovery for SpCell.   [Rapporteur’s comments]: Rapporteur wonders whether the intention of this P5 is that for RACH triggered by these events TA should be reported during RACH regardless of the enable/disable configuration of TA report during RACH in SI. If yes, P5 seems to conflict with P4. Besides, rapporteur understands that RACH during RRC connected mode does not include the case of RACH triggered by RRC Connection Resume procedure from RRC\_INACTIVE.  [vivo] By P4 and P5 together, the intention is that for the RACH in RRC\_CONNECTED (other than that during HO), the UE checks whether to perform TA reporting only based on the specific trigger event, regardless of the enabling/disabling bit in the SI. So, there is no contradiction between the two proposals. For P5, thanks for the clarification from the Rapp, the proposal was intended to cover also INACTIVE UEs (i.e. should have been “For an RRC\_CONNECTED/INACTIVE UEs” with “/INACTIVE” missing in the original proposal somehow…). | vivo |
| [7]R2-2200627 | Proposal 2: UE in connect mode does not report UE specific TA value in RA procedure.  [Rapporteur’s comments]: Based on the statements in [7], rapporteur assumes the intention of this proposal is aligned with Option2. | Spreadtrum Communications |
| [8]R2-2200688 | Proposal 2: Information about UE specific TA pre-compensation is reported in RA procedure triggered due to “UL synchronisation status is “non-synchronised”” in connected mode. | CATT |
| [9]R2-2200746 | Proposal 1: The “UE specific TA report during RA procedure” is triggered by RA procedure for connecting to a cell from RRC idle/inactive mode or in RRC connected mode (i.e., RA procedure triggered due to initial access from RRC idle mode, RRC connection resume, RRC connection re-establishment and handover).  Proposal 2: Event-triggering TA report via RA procedure in connected mode is not controlled by the enable/disable indication configured in SI. | ASUSTeK |
| [13]R2-2201007 | Proposal 15: UE specific TA reporting for RACH in RRC Connected mode should be enabled/disabled by SI, and the TA reporting update should be triggered by TA update event. | Nokia, Nokia Shanghai |
| [18]R2-2201363 | Proposal 3. The TA reporting in CONNECTED is not controlled by the enable/disable indication configured in SI.  [Rapporteur’s comments]: Based on the statements in [18], rapporteur assumes the intention of this proposal is aligned with Option2. | LG Electronics Inc. |

Regarding whether TA reporting during RACH in connected mode should be controlled by the enable/disable indication configured in SI, following options were proposed by companies:

* Option 1: Yes, and it also depends on whether a TA update event is triggered or not. [13]
* Option 2: No, it depends on whether a TA update event is triggered or not [2] [3] ([4]) [7][18]
* Option 3: No, it depends on which event triggers RACH procedure [5] [8] [9]

Rapporteur would like to ask the following question:

**Question 4: Regarding whether** **TA reporting during RACH in connected mode should be controlled by the enable/disable indication configured in SI, which is the preferred option?**

* **Option 1: Yes, and it also depends on whether a TA update event is triggered or not.**
* **Option 2: No, it depends on whether a TA update event is triggered or not**
* **Option 3: No, it depends on which event triggers RACH procedure**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Nokia | Option 1 with comment | We agree the TA reporting during RACH depends on whether a TA update event is triggered or not.  However, RAN2 need to discuss the issue how the UE triggers the first TA reporting for event triggered TA reporting when it enters RRC Connected mode (i.e. the issue discussed in Question 5). We are open to discuss below two alternatives though we slightly prefer Alt2:   * Al1: If the TA reporting configuration is received, UE can trigger the first TA reporting if the UE has not reported TA before. * Alt2: If the UE-specific TA reporting flag in the SI is enabled, UE can trigger the first TA reporting if the UE has not reported TA before.   Alt 2 is simple since a uniform solution (reuse the same flag) will be used in both RRC idle and RRC Connected mode. Alt 1 is flexible to support UE-specific TA reporting enable/disable in RRC Connected mode but we are wondering if this is necessary. |
| ZTE | Option2 or option3 | In our previous discussion we mentioned that for RA triggered in connected mode when TAT is not running, it would be beneficial that TA report can be triggered, but it haven’t be agreed. If it is agreed, then the SI indication can be used. But if there is only event triggered TA report in connected mode, then there is no need for such indication, since the configuration it self can be served whether UE shall report TA, and for TA generated in this event triggered mechanism, whether the TA report MAC CE will goes into Msg3 can rely on LCP procedure, which is the same as legacy (i.e. UE based on LCP to decide which data can be carried in UL grant received in RAR). |
| OPPO | Option 2 | We think it would be sufficient to have connected mode TA reporting controlled by the configured triggering event. The main purpose of TA reporting is to aid network to configure proper UE specific K\_offset, as long as TA change does not exceed the configured offset, there is no need to trigger TA reporting. No need to have any other control over TA reporting in connected mode. |
| Thales | Option 1 |  |
| Xiaomi | Option 2 | Whether MAC CE is reported during RACH or not can be simply controlled by network scheduling different size of UL grant. No need to further referring to the enabling/disabling indication in SI. In fact, since network doesn’t know whether the CBRA is from idle/inactive mode UE or connected mode UE, it will always allocate larger UL grant when TA report during RA is enabled in SI, and smaller UL grant when TA report during RACH is disabled in SI. UE can simply react based on the allocated UL grant size. |
| MediaTek | Option 3 | If RACH is triggered by DL/UL data arrival during RRC\_CONNECTED when UL synchronisation status is "non-synchronised", TA report can be sent. |
| Qualcomm | Option 2 | Regardless of the events, if UE’s TA has not changed by the configured threshold, the UE may not need to report TA. |
| Apple | Option 2 | Only needed when a TA event is triggered in Connected state. |
| Sequans | Option 2 | In connected TA event triggering will be configured if required. So Si indication could be kept for RA from non-connected only. |
| Lenovo, Motorola Mobility | Option 2 | We think Option 2 is sufficient for CONNECTED. |
| Ericsson | None. For simplicity, the UE always report TA in RA procedures if it is indicated in system info that gNB want it. | For simplicity, the UE always report TA if it is indicated in SI that the gNB want it during RA procedures.  We think that conditioning the report on some state (RRC state, whether RRC reestablishment is to a new cell or not, or on the last successful TA report) will make the modelling in MAC and/or RRC complex and will require a few meetings to settle (just see the divergent opinions stated so far) which shall be avoided at this late stage of the WI. |
| ASUSTeK | Option 2/3 | It seems not very clear about what exactly the “TA reporting during RACH in connected mode” is.  We think whether a TA report transmitted via RA procedure is controlled by SI or not depends on the triggering of the TA report. The event-triggered TA report in connected mode, which may be transmitted during a RA procedure based on LCP, would not be controlled by the enable/disable indication in a SI. While the “TA report during RA procedure”, triggered by a RA procedure for connecting to a cell, could be controlled by the SI indication. |
| Intel | Option 2 |  |
| vivo | Option 3 | At least for RACH that is triggered by DL/UL data arrival during RRC\_CONNECTED when UL synchronisation status is "non-synchronised", TA report can be sent. |
| Samsung | Option 2 |  |
| Huawei, HiSilicon | Option 2 with comments | We can accept option 2 if there is no extra spec effort. Specifically, if a TA report is triggered and not yet reported, it can be carried in RACH if allowed by the MSG3 size and LCP. This is similar with legacy behaviour: if allowed by MSG3 size and LCP, MAC CE or data can be carried by MSG3. |
| CATT | Option 3 | For example, the RACH is initiated by UL synchronization status is "non-synchronised", or if TA report is triggered, but there is no UL grant or SR resources, and RACH procedure is triggered (if Question 8 below is agreed). |
| NEC | Option 2 | If TA report is enabled during initial RACH, the NW can configure the relevant TA update triggers. |

**Event trigger for TA reporting**

In RAN2#115e meeting, RAN2 has agreed to introduce event-triggered TA reporting for RRC connected UEs. More specifically, for a UE in RRC connected, a TA offset threshold is used for event-triggered TA reporting. If the difference between current UE specific TA and the last successfully reported UE specific TA exceeds the offset threshold, UE triggers a TA reporting.

Relevant proposals on more detials on the event triggered TA reporting are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [2]R2-2200243 | Proposal 2: Upon receiving configuration or reconfiguration of UE-specific TA reporting, if the UE has not reported TA before, the UE triggers a TA reporting. | OPPO |
| [3]R2-2200270 | Proposal 5: Do not introduce additional parameters, e.g. hysteresis and time to trigger, to define the trigger event for TA reporting. | Xiaomi |
| [13]R2-2201007 | Proposal 11: To enable event-triggered UE specific TA reporting, network should configure a TA change threshold via RRC.  Proposal 12: For UE specific TA pre-compensation 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. | Nokia, Nokia Shanghai Bell |
| [19]R2-2201630 | Proposal 6 The quantity used by the UE to trigger TA reports is Qta = [Koffset – TTA] expressed in seconds, where Koffset is the cell-specific-TA (or UE-specific-TA if configured) and TTA is the full TA.  Proposal 7 The UE may be configured with two thresholds to trigger TA reports based on Qta. ThDown triggers a TA report if Qta < ThDown. ThUp triggers a TA report if Qta > ThUp. | Ericsson |

For the issue how the UE triggers the first TA reporting for event triggered TA reporting, in [2], it is proposed that the UE triggers a TA reporting upon reception of configuration or reconfiguration of TA reporting trigger event if the UE has not reported TA before. Otherwise, the UE will not have ”the last successfully reported UE specific TA” for event triggering.

**Question 5: Do companies agree that the UE triggers a TA reporting upon reception of configuration or reconfiguration of TA reporting trigger event if the UE has not reported TA before?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| Nokia | See comments | As indicated in Question 4, we agree RAN2 need to discuss the issue how the UE triggers the first TA reporting for event triggered TA reporting when it enters RRC Connected mode. We are open to discuss below two alternatives though we slightly prefer Alt2:   * Al1: If the TA reporting configuration is received, UE can trigger the first TA reporting if the UE has not reported TA before. * Alt2: If the UE-specific TA reporting flag in the SI is enabled, UE can trigger the first TA reporting if the UE has not reported TA before.   Alt 2 is simple since a uniform solution (reuse the same flag) will be used in both RRC idle and RRC Connected mode. Alt 1 is flexible to support UE-specific TA reporting enable/disable in RRC Connected mode but we are wondering if this is necessary. |
| ZTE | No | It seems unnecessary, UE can still calculate difference between existing TA with the last reported TA and compares it with the received threshold to decide whether to report TA or not. For TA report configuration received for the first time we can define a initial value for the TA, it can be zero or the TA reported in RACH procedure. In general this issue more relates to how we address this issue in stage 3, thus can be discussed later. |
| OPPO | Yes | For the two alternatives raised by Nokia, we think Alt1 is straightforward and flexible to support UE-specific TA reporting in RRC connected mode.  For Alt2, we think the enabled/disabled indication in SI should only be used to control TA reporting during RACH, but not be applied to TA reporting in RRC connected mode. Whether UE reports TA in RRC connected mode should depend on the configured TA reporting event. |
| Thales | Yes |  |
| Xiaomi | Yes |  |
| MediaTek | No | Agree with ZTE |
| Qualcomm | May be | Only if there will be case the UE will not report TA during initial access. |
| Apple | No | Similar views as ZTE and MediaTek |
| Sequans | Yes | Alt1 alternative from Nokia seems ok. |
| Lenovo, Motorola Mobility | Yes |  |
| Ericsson | No. | This depends on the type of trigger.  With our proposed Qta = [Koffset – TTA] and trigger report if Qta < ThDown or if Qta > ThUp, there is never any need to send a TA report except if one triggering condition is fulfilled.  With the delta threshold deviation from one “last successfully reported TA”/”last successfully reported UE location” (as option 1 in Q6), obviously, if there is no report to compare to – configuring the triggered TA reporting must result in a TA report. It seems unnecessary to trigger a report when reconfiguring TA reporting triggering as the UE/gNB has a “last successfully reported TA/UE location”. |
| ASUSTeK | Yes | It is possible that the TA report during RA procedure for initial access is disabled and UE receives configuration of event-triggered TA report for RRC connected mode. In this case, TA report cannot be triggered in RRC connected mode because the UE is unable to compute the TA offset between the current TA and the TA included in the last TA report. We also think Alt1 provided by Nokia is straightforward. |
| Intel | No |  |
| vivo |  | Agree that the issue on how the UE triggers the first TA reporting for event triggered TA reporting is valid. But it seems more like a stage 3 issue. Maybe we can discuss it later. |
| Samsung | No | Agree with ZTE |
| Huawei, HiSilicon | No | Agree with ZTE |
| CATT | No | Agree with ZTE, if TA report is not transferred before, a default value zero can be used as initial TA value. |
| NEC | Yes | Triggers to report the TA should be a threshold between current estimated TA and last reported TA. Thus, a first reported TA is needed. |

RAN2 has agreed to adopt TA offset threshold based event trigger for TA report, and it is FFS whether additional parameters, e.g. hysteresis and time to trigger, are needed similar to other events. In [3], it is stated that the logic for introducing such parameters is to avoid false TA reported due to jitter of TA change. However, it will introduce additional delay for reporting TA, so it thinks no additional parameters, e.g. hysteresis and time to trigger, are needed for the trigger event for TA reporting. In [19], it presents different view, and proposes to introduce two thresholds (i.e. ThDown and ThUp) to trigger TA report in order to avoid frequent TA report.

**Question 6: For event triggered TA reporting, which is the preferred option?**

* **Option 1: use a single TA offset threshold**
* **Option 2: introduce additional parameters (e.g. hysteresis and time to trigger, or another offset threshold)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Option** | **Additional comments** | |
| Nokia | Option 1 |  | |
| ZTE | Option 1 | This issue has been discussed several meetings back, and it is majorities’ preference to only have one threshold, no need to further delay the TA report. Also it is not sure for us why the direction of change matters, it seems to us only the difference value counts for determining whether a TA report shall be triggered. | |
| OPPO | Option 1 | For TA report using MAC CE, event configuration should be kept simple, like phr-Tx-PowerFactorChange for PHR reporting configuration. So no need to introduce hysteresis and multiple offset thresholds. | |
| Thales | Option 1 |  | |
| Xiaomi | Option 1 |  | |
| MediaTek | Option 1 |  | |
| Qualcomm | Option 1 |  | |
| Apple | Option 1 |  | |
| Sequans | Option 1 |  | |
| Lenovo, Motorola Mobility | Option 1 |  | |
| Ericsson | Option 2 with  Qta = [Koffset – TTA]  and trigger a TA report if  Qta < ThDown  or if  Qta > ThUp | Option 1 seems not feasible as there are two situations that needs to be conveyed to the gNB:  A) T\_TA is increasing and therefore the UE-specific-Koffset need to be increased to allow sufficient processing time in the UE to process a grant/assignment.  B) T\_TA is decreasing and therefore there is an opportunity to decrease the UE-specific-Koffset to improve the delay.  Alternatively, if option 1 is interpreted as a delta threshold and any deviation above the delta threshold from “last reported TA” (or “last reported UE location”) triggers a TA report, option 1 has several drawbacks:  a) The UE/gNB needs to estimate what the last successfully reported “TA” or “UE location” is.  This gives a risk of misalignment between the UE and the gNB, and the UE may think it has reported a TA but the gNB did not receive it and therefore gNB do not update the Koffset and the next TA report triggering comes too late.  b) The optimal delta threshold depends on the last reported TA/UE location.  c) After an update to the UE-specific-Koffset, the optimal delta threshold may have changed requiring update.  d) To mitigate issue b and c, we may use a smaller threshold resulting in more frequent TA reports – even when there is no reason to reconfigure the UE-specific-Koffset.  Concerning the need for two different thresholds: when TA is increasing and getting closer to the current-Koffset it is more urgent to update the Koffset than when TA is decreasing, therefore the different thresholds allow earlier reports for the serious case. This has the benefits listed above.  In summary, option 1 is more complex, have more error cases and either require more frequent configuration signalling and/or more frequent TA reports. Option 2 is simpler, only needs to be configured once, and only produces TA reports when needed. | |
| ASUSTeK | Option 1 |  | |
| Intel | Option 1 |  | |
| vivo | Option 1 | |  |
| Huawei, HiSilicon | Option 1 |  | |
| CATT | Option 1 |  | |
| NEC | Option 1 |  | |

**Other trigger condition of TA reporting in connected mode**

In addition to event-triggered TA reporting, whether to introduce other trigger conditions of TA reporting (e.g. NW requested TA reporting, periodical TA reporting) in RRC connected mode was discussed in previous RAN2 meeting with no conclusion.

Relevant proposals on trigger condition of TA reporting in connected mode are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [3]R2-2200270 | Proposal 6: Periodic TA report and network request based TA report is not supported in this release. | Xiaomi |
| [4]R2-2200347 | Proposal 7. In connected mode, no other trigger than event trigger is supported for TA reporting. | Huawei, HiSilicon |
| [6]R2-2200520 | Proposal 2: Event-triggered TA reporting is enough and no other methods are introduced. | China Telecom |
| [8]R2-2200688 | Proposal 4: Periodically triggering the UE-specific TA reporting should be supported and can be configured by network in NR NTN. | CATT |
| [13]R2-2201007 | Proposal 7: When UE in RRC Connected mode, the feature switch on TA reporting enable/disable should be controlled by NW.  Proposal 8: UE specific TA reporting for UE in RRC Connected mode is enabled/disabled by SI. | Nokia, Nokia Shanghai Bell |
| [15]R2-2201164 | Proposal 4: Periodic reporting of UE specific TA is not supported in Rel-17.  Proposal 5: Aperiodic reporting of UE specific TA is not supported in Rel-17.  Proposal 6: Additional triggering events other than a TA offset threshold are not supported in Rel-17. | InterDigital |
| [19]R2-2201630 | Proposal 9: The gNB can request the UE to report TA in connected mode. | Ericsson |

In summary, following views are supported by companies:

* Option 1: Periodical TA reporting. [8]
* Option 2: NW requested TA reporting [19]
* Option 3: TA reporting for UE in RRC Connected mode is enabled/disabled by SI [13]
* Option 4: None [3] [4] [6] [15]

For Option 1, it is stated that in [8] that periodically triggering UE-specific TA reporting is beneficial for real-time TA tracking and most useful for earth-fixed cell scenario.

For option 2, it is stated in [19] that in some use cases there is no need for all UEs to send TA reports during RACH, instead the gNB shall be allowed to request the UE to report the TA for the UEs that fulfil criteria where TA reporting is useful or when the cell load allows.

For Option 3, it is stated in [13] that it is NW’s implementation to decide whether to enable UE to report the TA information considering the potential delay reduction gain and the side effects. Instead of using “implicit” flag to enable/disable UE-specific TA reporting for UE in RRC Connected mode, we believe using the flag in SI is clean and simple, not only for NW design but also for UE implementation.

For option 4, all the supporter think that event triggered TA reporting is enough and see no need to introduce other methods.

Given that majority companies do not support to introduce other trigger conditions for TA reporting in RRC connected mode, rapporteur would like to ask the following question:

**Question 7: Do companies agree that other than event-triggered TA reporting, no more triggers are introduced for TA reporting in connected mode?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| Nokia | Yes with comment | How NW control the TA reporting enable/disable in connected mode can be addressed in Question 5. |
| ZTE | Yes with comments | We believe there are benefits for NW to request UE to report or to support RACH triggered TA report in connected mode when TAT is not running, since it bring additional possibilities for UE to report TA ASAP, but we respect majorities’ view and can accept not to do enhancements at this release. |
| OPPO | Yes |  |
| Thales | Option 2 | However the question is unclear |
| Xiaomi | Option 4 |  |
| MediaTek | Yes | No more triggers are needed |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| Lenovo, Motorola Mobility | Yes |  |
| Ericsson | Option 2 | There are use cases where there is no need for all UEs to send TA reports during RACH, instead the NW shall be allowed to request a UE to report the TA only for the UEs that fulfil criteria where TA reporting is useful or when the cell load allows. Option 2 will be beneficial to support these use cases.  Further we note that there are many proposed triggers besides event triggered TA reporting discussed in Q4 and Q5, thus it is unclear how to interpret any of the answers to this question. |
| ASUSTeK | Yes |  |
| Intel | Yes |  |
| vivo | Yes | Event-triggered TA reporting is enough. |
| Huawei, HiSilicon | Yes |  |
| CATT | Option 1 | But we are also ok with no enhancement in this release, with respect to the majorities’ view. |
| NEC | Yes |  |

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

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [2]R2-2200243 | Proposal 5: 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 6: 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 |
| [3]R2-2200270 | Proposal 4: TA report MAC CE can trigger SR/RACH procedure. | Xiaomi |
| [4]R2-2200347 | Proposal 4: If UL resource is not available for TA report in connected mode, UE triggers an SR if SR is configured or triggers RACH if SR is not configured. | Huawei, HiSilicon |
| [5]R2-2200377 | Proposal 6: SR/RACH is triggered when TA reporting has been triggered but there is no available UL-SCH resources for TA reporting. | vivo |
| [18]R2-2201363 | Proposal 4. SR/RACH procedure should be triggered when TA reporting has been triggered and there is no available UL-SCH resources for TA reporting.  Proposal 5. The dedicated RA preamble is allocated for the TA reporting. | LG Electronics Inc. |

As all the 5 companies above propose that TA reporting can trigger SR/RACH when there is no available UL-SCH resources for TA report MAC CE, rapporteur would like to ask the following question:

**Question 8: Do companies agree that SR/RACH can be triggered when TA reporting has been triggered but there is no available UL-SCH resources for TA reporting?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| Nokia | - | Though we think NW can address the issue of TA reporting delay, we are OK to go with majority view. |
| OPPO | Yes | 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 the triggered TA report to reach the gNB as soon as possible. |
| Thales | Yes |  |
| Xiaomi | Yes |  |
| MediaTek | No | TA report is only necessary if there is data to transmit, which would trigger SR/RACH anyways, so there is no need to trigger SR/RACH separately. |
| Qualcomm | Yes | TA report would also be needed for proper gap between PDSCH (DL) to HARQ ACK. So the UE should be able to report the TA as soon as possible. |
| Apple | Yes |  |
| Sequans | Yes |  |
| Lenovo, Motorola Mobility | Yes |  |
| Ericsson | No | If RRC is used for the report, then a BSR will be triggered and an SR if no UL-SCH resources are available.  If MAC CE is used, and the UE has UL data a BSR is triggered which gives an SR anyway if no UL-SCH resources are available. If the UE do not have any UL data that triggers a BSR but there are DL data, the NW can request the UE to send TA reports or NW may schedule the UE with longer k1/k2 even if the UE has an outdated UE-specific-Koffset. |
| ASUSTeK |  | We share the view with Ericsson. When TA reporting has been triggered but there is no available UL-SCH resources, BSR then SR/RACH can be triggered. |
| Intel | Yes |  |
| vivo | Yes |  |
| Huawei, HiSilicon | Yes |  |
| CATT | Yes |  |
| NEC | Yes |  |

In [18], it is stated that due to the long RTT (up to 544.75ms) in NTN, the network would take a long time to get the changed UE specific TA. In order to align the TA between network and UE as soon as possible, it is proposed the dedicated RA preamble is allocated for the TA reporting. In this way, the network knows which the UE wants to report the TA right after receiving the RA preamble, so that the latency for TA reporting would be reduced.

**Question 9: Do companies agree to support allocating dedicated RA preamble for the RACH procedure triggered by TA reporting?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| Nokia | No | Dedicated RA preamble for TA reporting will partition the preamble resource which may cause more preamble collision. Instead, the setting of TA change threshold can consider the high latency between UE and NW to help NW get proper TA value. |
| ZTE | No | More like enhancements, if the condition for reporting is not fulfilled then it is no need to sent TA. |
| OPPO | No |  |
| Thales | No |  |
| Xiaomi | No | Too complicated to go this way |
| MediaTek | No |  |
| Qualcomm | No |  |
| Apple | No | Wasteful of RACH resources |
| Sequans | No |  |
| Lenovo, Motorola Mobility | No |  |
| Ericsson | No | In case the NW estimate that the UE-specific-Koffset is too short, the NW can adapt the k1/k2 in the scheduling until it has received a TA report and update the UE-specific-Koffset. |
| ASUSTeK | No |  |
| Intel | No |  |
| vivo | No | It seems like some forms of optimization, which is not preferred considering the limited remaining time. |
| Samsung | No |  |
| Huawei, HiSilicon | No |  |
| CATT | No |  |
| NEC | No |  |

**Impact of TA reporting 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. The issue on whether the timeAlignmentTimer should be started or restarted after UE reports its TA was discussed in RAN2#116e meeting with no conclusion.

Relevant proposals are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [3]R2-2200270 | Proposal 7: timeAlignmentTimer is not restarted after UE reports its TA. | Xiaomi |
| [4]R2-2200347 | Proposal 8: UE starts or restarts the *timeAlignmentTimer* after TA is reported to the gNB. | Huawei, HiSilicon |
| [5]R2-2200377 | Proposal 7: The *timeAlignmentTimer* is not started/restarted after UE reports its TA. | vivo |
| [7]R2-2200627 | Proposal 5: UE does not start or restart the timeAlignmentTimer after UE reports its TA. | Spreadtrum Communications |

3 out of 4 companies above propose that the *timeAlignmentTimer* is not started/restarted after UE reports its TA. In [3], it is stated that no matter UE report TA or not, the error of the TA part for network adjustment will accumulate. This kind of fine adjustment by gNB can not be well compensated by UE itself. If UE restarts the TAT timer, UE will falsely consider UL synchronized but actually it is not. It is also stated in [5] that the MAC PDU carrying TA MAC CE may suffer from multiple retransmissions. If UE starts or restarts the *timeAlignmentTimer* after UE reports its TA, there’ll be misalignment between the UE and NW on the understanding of the actual starting point of *timeAlignmentTimer*, which may impact the subsequent scheduling.

On the other hand, one company holds the different view. In [4], it is argued the concern that TA reporting is not accurate enough for UL synchronization is actually not an issue that prevents restarting the timeAlignmentTimer. Because the gNB can send TA command MAC CE to UE as soon as TA report is received. If timeAlignmentTimer is not started or restarted after TA reporting, the timeAlignmentTimer may run out shortly after TA is reported which will lead to unnecessary UL resource release and RACH initiation. In this case, restarting the timeAlignmentTimer can avoid this to happen as TA report can be seen as some kind of pre UL-synchronization.

Given majority companies’ views, rapporteur would like to ask the following question:

**Question 10: Do companies agree that UE do not start or restart the timeAlignmentTimer after the UE reports its TA?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| Nokia | Yes |  |
| ZTE | Yes | We prefer to stick to close loop TA maintaining procedure as in legacy, and not to couple it with TA report. To allow TAT be started automatically by UE will introduce additional complexity in NW’s implementation, since NW shall based on received TA report to derive the current TAT at UE’s side to align the understanding. |
| OPPO | Yes | Although we see some benefits, by starting/restarting the TAT timer, in leaving NW a longer time to adjust TA, we can compromise to follow majority’s views. |
| Thales | No |  |
| Xiaomi | Yes |  |
| MediaTek | Yes |  |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| Lenovo, Motorola Mobility | Yes |  |
| Ericsson | Yes, the UE do not start/restart TAT after reporting its TA. |  |
| ASUSTeK | Yes |  |
| Intel | Yes |  |
| vivo | Yes | MAC PDU carrying TA MAC CE may suffer from retransmission. This will result in misalignment on the status of UL synchronization between NW and UE, as NW has no way to know the exact starting time of TAT at UE side. |
| Samsung | Yes |  |
| Huawei, HiSilicon | No | As we illustrated in our contribution(R2-2200347), what matters is to make sure gNB can receive the TA report as early as possible. If timeAlignmentTimer is not started or restarted after TA reporting, the timeAlignmentTimer may run out shortly after TA is reported which will lead to unnecessary UL resource release and RACH initiation. In this case, restarting the timeAlignmentTimer can avoid this to happen as TA report can be seen as some kind of pre UL-synchronization. After all, the gNB can always use TA command to achieve finer UL-synchronization once TA report is receive. |
| CATT | Yes |  |
| NEC | Yes |  |

**Reporting location information for TA reporting purpose**

For TA reporting purpose, RAN2-115e agreed NW can configure UE to send either UE-specific TA pre-compensation or the UE location if the UE can report its location to NW. However, the working assumption should be confirmed by SA3. RAN2 has sent multiple liaison statements concerning UE location reporting and use those were mainly targeting SA3 and the intention was to verify if the user consent shall be given prior to any reporting of UE’s location.

|  |
| --- |
| RAN2-115 meeting agreement:  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 |

After RAN2#116e meeting, we have received SA3 reply LS [20], in which the following information is provided on NTN specific user consent.

|  |
| --- |
| Depending on the local jurisdiction and its regulations, NTN specific user consent may be needed before gNB can configure the UE to report the UE location information.  SA3 is currently introducing new requirements to TS 33.501 for user consent handling. Although such requirements are generic, they may need to be complemented in order to cover the different use cases, such as, in this context, the handling of user consent for UE location information for NTNs. SA3 has not yet studied how this user consent handling can be used specifically for the NTN use case. |

Relevant proposals on UE location based TA reporting are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [2]R2-2200243 | Proposal 7: If the gNB has NTN specific user consent to obtain UE location, the UE location information can be reported for TA reporting purposes in connected mode  Proposal 8: If the content of TA reporting is UE location information, reuse the TA-based trigger condition, i.e. when TA change between current UE-estimated TA and the last successfully reported TA (corresponding to the last successfully reported UE location) is larger than the network configured threshold. | OPPO |
| [3]R2-2200270 | Proposal 10: RAN2 to progress with UE location report for TA pre-compensation purpose (and may deprioritize issues related to UE location report for LCS), and send LS to SA3 to ask:   1. Whether “location information derived at the network side is considered as more reliable” is only related to A-GNSS measurement for core network reselection. If the answer is yes, whether SA3 has any concern on UE location report for TA pre-compensation purpose. 2. Whether UE location report for TA pre-compensation purpose requires separate user consent as for core network reselection purpose.   Proposal 11: For TA report using RRC, reuse existing signalling method(potential enhancement are not precluded) i.e., by configuring includeCommonLocationInfo in the corresponding reportConfig.  Proposal 12: RAN2 to confirm that MR is used to report the location information for TA pre-compensation purpose, and measurement results are always included in the MR as legacy.  Proposal 13: It is up to network implementation to decide to configure reportType in reportConfigure to either periodical or eventTriggered for location report for TA pre-compensation purpose, i.e. no specification modification is needed.  Proposal 14: if the content of TA reporting is UE location, location-based trigger condition is introduced, i.e. when the distance change between current UE location and the last successfully reported UE location is larger than network configured threshold.  Proposal 15: Do not introduce additional parameters, e.g. hysteresis and time to trigger, to define the trigger event for location report for TA pre-compensation purpose.  Proposal 16: Do not support concurrent configuration of report of UE location and UE specific TA for TA pre-compensation purpose.  Proposal 17: If location information (either finer or coarse location) is included in the report, all the triggers for location report for any purpose (e.g. for SON/MDT or NTN TA report) should be cancelled.  Proposal 18: If location information (either finer or coarse location) is reported, the comparison of location change for TA pre-compensation purpose should be compared with the location at the time of this location report.  Proposal 19: If location information (either finer or coarse location) is included in the report, an indication of whether the location is finer or coarse location is needed.  Proposal 20: If location information (either finer or coarse location) is included in the report for SON/MDT, UE needs to cancel the triggered TA report for TA pre-compensation purpose.  Proposal 21: If location information (either finer or coarse location) is reported, the comparison of TA change should be compared with the TA at the time of this location report.  Proposal 22: The location information for NTN TA report purpose only considers GNSS coordinates.  Proposal 23: if the gNB has user consent to obtain UE location for NTN TA report purpose, reporting of finer location information/full GNSS coordinates in RRC\_CONNECTED can be supported after AS security is enabled.  Proposal 24: When UE needs to report UE location for TA report purpose, UE acquires location information to report if location information is not available.  Proposal 25: If gNB has no user consent for NTN TA report purpose, coarse GNSS coordinates can be reported for TA pre-compensation purpose. Need to send LS to SA3 to ask if there is privacy issue.  Proposal 26: Network indicate UE whether to report finer or coarse GNSS location information when configuring UE to report location information for TA pre-compensation purpose.  Proposal 27: RAN2 to discuss the accuracy of coarse GNSS coordinates, whether to define fixed accuracy such as 2km or the accuracy is configurable.  Proposal 28: When UE needs to report UE location for TA report purpose, UE acquires location information to report if GNSS location information is not available. | Xiaomi |
| [4]R2-2200347 | Proposal 6. In connected mode, reporting UE location information as TA report is not supported. | Huawei, HiSilicon |
| [6]R2-2200520 | Proposal 3: Either UE specific TA information or UE location be reported to NW for TA compensation and no need for both in parallel. | China Telecom |
| [13]R2-2201007 | Proposal 4: RAN2 to confirm the working assumption that, the UE location information can be reported in connected mode if the AS security is established and the NTN specific user consent is stored in the gNB.  Proposal 5: For TA reporting purposes in connected mode, the network can configure the UE to send either the UE specific TA pre-compensation or the UE location information if the AS security is established and the NTN specific user consent is stored in the gNB.  Proposal 6: There is no need to report UE location and the UE specific TA information in parallel.  Proposal 13: For UE location information update, reuse the same TA change threshold which is defined for UE-specific TA pre-compensation reporting.  Proposal 14: For UE location information update, 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 |
| [14]R2-2201034 | Proposal 5: In case UE location information can be reported to network, RRCReconfiguration message is used to configure UE to report either the UE location or the UE specific TA information for the purpose of TA reporting in connected mode. | Samsung Research America |
| [15]R2-2201164 | Proposal 7: In case UE location information can be reported to network, a UE may be configured to report either the UE location or the UE specific TA information for the purpose of TA reporting in connected mode. | InterDigital |
| [16]R2-2201193 | Proposal 4: It is up to network whether TA reporting can be configured in parallel with location reporting (i.e., no specification restriction). | NEC Telecom MODUS Ltd. |
| [17]R2-2201324 | Proposal 3: For pre-compensation information report purpose, discussion of UE location report is deprioritized in this release. | ZTE Corporation, Sanechips |
| [19]R2-2201630 | Proposal 10 If the information about UE specific TA pre-compensation in connected mode is the UE position, then the event triggered report of information about the UE specific TA pre-compensation can be the same as in Proposal 6 and Proposal 7 but the reported quantity can be the UE location. | Ericsson |

Companies hold different views on whether to support reporting UE location information for TA reporting purpose. In [2] and [13], it is suggested that if the gNB has NTN specific user consent to obtain UE location, the UE location information can be reported for TA reporting purposes in connected mode. While in [4] and [17], it is proposed not to support UE location-based TA reporting.

**Question 11: Do companies agree to support UE reporting location information for TA reporting purpose in connected mode?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| Nokia | Yes | It is RAN2 agreement that NW can configure UE to report UE location information for TA purpose if the UE location can be reported to NW.   |  | | --- | | RAN2-115 Agreement:  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 |   According to SA3 response, it addressed RAN2 concern on whether the UE location can be reported. i.e. the UE location information can be reported in connected mode if the NTN specific user consent is stored in the gNB. Hence, we think RAN2 should follow previous agreement and confirm the support of UE location reporting for TA purpose. |
| ZTE | No | Since SA3 has not confirmed that user consent for NTN will be available for this release, it is premature to qgree on location information report. Especially we already have TA report which can fulfil the same requirement. |
| OPPO | No | We think using UE specific TA pre-compensation for TA reporting purpose is sufficient in Rel-17. We need to make sure NTN can work in this release and should not introduce too many optimizations which are simply duplicated functions and not essential to have. |
| Thales | No | We prefer to stick to one solution which is the UE to report UE specific TA pre-compensation |
| Xiaomi | Yes | Agree with Nokia’s comment, the agreement we made before only has one pre-condition, which is SA3 sees no issue of reporting location in connected mode. Given SA3 sees no issue on this, we should not overturn the agreement. |
| MediaTek | No | Agree with ZTE |
| Qualcomm | Yes | But we think it is not fair to link location report to TA. Location reporting is for other various purposes like handover, SMTC configurations. Location update may be less frequent than TA update. |
| Apple | No | We do not want a multiplicity of solutions for the same problem. In some jurisdictions user consent is required and may not be available, so UE specific TA is needed anyways. |
| Sequans | No | It doesn't seem needed as TA report is required anyway. So we would also prefer to keep it simple. |
| Lenovo, Motorola Mobility | No | SA3’s LS has emphasized the necessity of user consent for location reporting so it is not always available. We should focus on solutions not relying on UE location reporting. |
| Ericsson | Yes | Agree with Nokia and Xiaomi.  The UE location reporting does NOT fulfil the same purpose as the UE specific TA report. UE location can be used to predict future changes to the full TA, and thus decrease the amount of TA reporting. Further, it has other benefits for the management of resources (decide tracking area, decide which country, decide which neighbours to measure etc.).  SA3 have not confirmed that there is any privacy issues for reporting UE location after security is enabled, even they have provided many LSs.  RAN2 can specify this beneficial feature and make it NW configurable to send the report in this release, if SA3 later identify issues – that can be handled by NW not requesting the location. |
| ASUSTeK | Yes | Agree with Nokia. |
| Intel | No | Location reporting can be supported as SA3 is already working on user consent, but for TA reporting purpose in connected mode location reporting is not so necessary. |
| vivo | No | According to SA3 LS, SA3 has not yet studied how this user consent handling can be used specifically for the NTN case. With the lack of support from SA3 at this late stage, our view is that the whole feature of UE location information reporting is not supported in R17 NTN. |
| Samsung | Yes | We don’t see any problem with our previous agreement given user consent. |
| Huawei, HiSilicon | Yes | We think both TA and location information can be supported in specs. But only one can be chosen by gNB during configuration. |
| CATT | No |  |
| NEC | No | TA report is sufficient in this Release. |

If UE reporting location information for TA reporting purpose in connected mode can be agreed, the next issue is how to define the trigger condition for that. Based on companies’ input, the following options are proposed:

* Option 1: Reuse the TA-based trigger condition, i.e. when TA change between current UE-estimated TA and the last successfully reported TA (corresponding to the last successfully reported UE location) is larger than the network configured threshold. [2] [13]
* Option 1a: Reuse the TA-based trigger condition, where separate thresholds ThUp and ThDown are used. [19]
* Option 2: Introduce location-based trigger condition, i.e. when the distance change between current UE location and the last successfully reported UE location is larger than network configured threshold. [3]

**Question 12: If reporting UE location information for TA reporting purpose in connected mode can be agreed, which is the preferred option for the trigger condition?**

* **Option 1: Reuse the TA-based trigger condition**
* **Option 2: Introduce location-based trigger condition**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Nokia | Option1 with modification | The UE movement distance (UE location change) doesn’t mean the TA change since the trajectory of UE movement is unknown. The TA change threshold should be used in both mechanisms, whether the UE’s TA or UE location information is used to perform that update shouldn’t matter. So, we prefer to reuse the same TA change threshold which is defined for UE-specific TA pre-compensation reporting.  For otpion1, to be more accurate, we propose to modify it as:  **Option 1: Reuse the TA Change threshold.** |
| ZTE | Option 1 | If it is agreed, then the same triggering event can be considered to avoid additional specs impact. |
| OPPO | Option 1 | It is simple, although we don’t support reporting UE location information for TA reporting purpose. |
| Thales | - | See our response to question 11 |
| Xiaomi | Option 2 | it is not valid to use TA-based trigger condition for location report. If we reuse TA-based trigger condition, since the TA is between UE and satellite, UE needs to take into consider both UE movement and satellite movement, location report will be triggered very frequently. However, if we use location/distance change of UE itself, UE may only need to occasionally report location information given that UE moves quite slowly compared with satellite, it is the very reason that we introduce location report for TA pre-compensation purpose. |
| MediaTek | - | See our response to Q11 |
| Qualcomm | Option 2 | See our response in Q11. |
| Apple | Option 1 | We do not support UE location reporting for TA purposes |
| Lenovo, Motorola Mobility | Option 1 |  |
| Ericsson | Option 1a | When the NW has the UE location, it can always keep the UE-specific-Koffset updated in the UE, and if using [current-Koffset – T\_TA ] with two separate thresholds ThUp and ThDown there will be no TA reports triggered unless the NW stops updating the UE-specific-Koffset or if the UE have moved long enough from the location last reported (note that the UE do not need to know of any “last successfully reported UE location”). |
| vivo | None | As mentioned in Q11, we think UE location information reporting mechanism should not be supported in R17 NTN. |
| Samsung | Option 1 | Agree with Nokia |
| Huawei, HiSilicon | Option 1 | No need for another trigger. |
| CATT | Option 1 |  |
| NEC | Option 1 |  |

If UE reporting location information for TA reporting purpose in connected mode can be agreed, another issue RAN2 should address is whether UE can be configured to report both the UE location and the UE specific TA information for the purpose of TA reporting in connected mode. In [6] [13] [14] and [15], it is proposed that a UE may be configured to report either the UE location or the UE specific TA information, and there is no need to report both at the same time. While in [16], it is suggested not to introduce such specification restriction.

**Question 13: If reporting UE location information for TA reporting purpose in connected mode can be agreed, which is the preferred option?**

* **Option 1: UE can be configured to report both the UE location and the UE specific TA information, or either one**
* **Option 2: UE can be configured to only report either the UE location or the UE specific TA information**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Company** | **Option** | **Additional comments** | | |
| Nokia | Option 2 | There is no need to report both the UE specific pre-compensation and the UE location information to NW in parallel since they are derived from the same inputs.  For example, if the UE reports the UE location to NW, NW can estimate the UE-specific TA based on UE’s location and serving satellite’s ephemeris data. It is not necessary to report the UE-specific TA which is same as the one estimated by NW since UE also uses the same information (UE’s location and serving satellite’s ephemeris data) for its TA estimation. | | |
| ZTE | Option 2 if it is for event triggered location report and event triggered TA report. | My understanding is that the proposal asks whether event triggered location report and event triggered TA report can be configured simultaneously. And we tend to feel that only one information is needed for event triggered report.  But it shall be possible for NW to configure event triggered TA report with other location report, e.g., location report in MDT since they serve different purpose. Also NW can based on it’s implementation to decide whether make use of the received location information for scheduling adjustment purpose. | | |
| OPPO | Option 2 | No need to report both at the same time, although we don’t support reporting UE location information for TA reporting purpose. | | |
| Thales | - | | | See our response to question 11 |
| Xiaomi | Option 2 |  | | |
| MediaTek | - | See our response to Q11 | | |
| Qualcomm | Option 2 | But network should be able to provide concurrent location and TA report configurations. It is just which one to report when both are triggered. | | |
| Apple | Option 2 | But the question is moot for us since we do not think UE location should be reported for this purpose | | |
| Lenovo, Motorola Mobility | None | The pre-condition of this question depends on conclusion of Q11 and we do not support location reporting for this. | | |
| Ericsson | Option 1 | This is a NW configuration issue, no need to limit one or the other type of configuration. | | |
| ASUSTeK | Option 2 |  | | |
| vivo | None | |  | |
| Samsung | Option 2 | Either one is enough. | | |
| Huawei, HiSilicon | Option 2 | No need to report two kinds of information for one purpose. | | |
| CATT | Option 2 |  | | |
| NEC | Option 1 | As argued in [16], applications requiring location report may have different requirements compared to the TA report:   * More precision so more signalling load * Triggers that could be either periodic reporting or location triggers (i.e. UE is in range of specified location)   Therefore, we are concerned that location reporting triggers may serve an entirely different purpose and not suitably replace TA reporting and we think both should be available in parallel, subject to NW implementation. | | |

For other detailed proposals related to location information reporting, no summary is given here. Rapporteur assumes that they can be further discussed after RAN2 formally agrees to support location information reporting.

**SIB broadcasting for NTN parameters**

In [12], it is proposed to include the ephemeris, K\_mac, common TA and cell-specific Koffset in the new SIB. In [7], it is proposed to broadcast the network enable/disable TA report via SIB1. Rapporteur assumes all NTN specific parameters are broadcasted in the new SIB.

**Question 14: On how to broadcast following NTN specific parameters, e.g. ephemeris, K\_mac, common TA, cell-specific Koffset, network enable/disable TA report, etc., which is the preferred option?**

* **Option 1: in SIB1**
* **Option 2: in the new NTN-specific SIB**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Nokia | Option 2 |  |
| ZTE | Option 2 | But we think this shall be discussed in SI in CP session. |
| OPPO | Option 2 |  |
| Thales | Option 2 | If option 2 is agreed, we suggest to discuss whether this new SIB should be considered as a Minimum SI (MSI) |
| Xiaomi | Option 2 |  |
| MediaTek | Option 2 |  |
| Qualcomm | Option 2 |  |
| Apple | Option 2 | There is more detailed discussion in the 102 discussion and we prefer to discuss it there. |
| Sequans | Option 2 |  |
| Lenovo, Motorola Mobility | Option 2 |  |
| Ericsson | None | We think this shall be discussed in the control plane session. |
| ASUSTeK | Option 2 |  |
| Intel | Option 2 | This question is also discussed in offline-102. |
| vivo | Option 2 | RAN1 has agreed that ephemeris and the common TA shall be broadcast in the same SIB. Considering that the size of ephemeris information can be rather large, it is reasonable to define a new SIB. Under this case, it is better to put all NTN specific parameters in the new SIB. |
| Samsung | Option 2 |  |
| Huawei, HiSilicon | Option 2 |  |
| CATT | Option 2 |  |
| NEC | Option 2 |  |

## 2.2 UE-specific K\_offset

In the last RAN1 meetings, RAN1 discussed how to configure UE-specific K\_offset, and has reached the following agreements.

RAN1#106e:

|  |
| --- |
| Agreement:   * The UE-specific K\_offset can be provided and updated by network with MAC CE. |

RAN1#107e:

|  |
| --- |
| **Agreement**  For determining UE specific K\_offset   * Option 2: MAC CE provides a differential UE specific K\_offset value. The full UE specific K\_offset value equals the cell specific K\_offset value minus the differential UE specific K\_offset value.   + FFS: whether/how to resolve ambiguity of which cell-specific K\_offset value to use during the SIB modification period   **Agreement**  The value range of the differential UE specific K\_offset provided in MAC CE is 0 – 63 ms. |

Based on the agreements above, MAC CE is used for UE-specific K\_offset configuration. It should be RAN2 to design the new K\_offset MAC CE.

Relevant proposals on the UE specific Koffset MAC CE are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [2]R2-2200243 | Proposal 9: The size of K\_offset MAC CE is fixed to 1 byte. | OPPO |
| [19]R2-2201630 | Proposal 11 RAN2 to discuss the UE specific Koffset MAC CE name and whether it uses an LCID or eLCID. | Ericsson |

It is stated in [2] that since RAN1 has agreed that the value range of the differential UE specific K\_offset provided in MAC CE is 0 – 63 ms, with 1ms step size, 6 bits are needed for the UE specific K\_offset configuration. Therefore, it is proposed that the size of new K\_offset MAC CE can be fixed to 1 byte.

**Question 15: Do companies agree that the size of MAC CE for UE-specific K\_offset is fixed to 1 byte?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| Nokia | Yes |  |
| ZTE | Yes |  |
| OPPO | Yes |  |
| Thales | Yes |  |
| Xiaomi | Yes |  |
| MediaTek | Yes |  |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| Sequans | Yes |  |
| Lenovo, Motorola Mobility | Yes |  |
| Ericsson | Yes | We would like to reformulate it to say one octet (to align with other fixed size MAC CEs, and avoid the historical cases where byte could mean 4 or 8 or 16 bits etc.):  **The MAC CE for UE-specific K\_offset has a fixed size of a single octet.** |
| ASUSTeK | Yes |  |
| Intel | Yes |  |
| vivo |  | The specific granularity of the UE-specific K\_offset may need further RAN1 input (e.g. slot vs. millisecond). |
| Samsung | Yes |  |
| Huawei, HiSilicon | Yes |  |
| CATT | Yes |  |
| NEC | Yes |  |

**Question 16: Which is the preferred option for the LCID to be used for UE-specific K\_offset MAC CE?**

* **Option 1: use a LCID**
* **Option 2: use an eLCID**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Nokia | Option 2 | The UE-specific K\_offset is DL MAC CE, the coverage issue may not as critical as UL. To save the limited reserved LCID, we prefer to use an eLCID. |
| OPPO | Option1/2 | No strong view. |
| Xiaomi | Option 2 |  |
| MediaTek | Option 1/2 | No strong view |
| Qualcomm | Option 1 | As payload is just 1 byte and header probably should not be 2 bytes. |
| Apple | Option 2 |  |
| Lenovo, Motorola Mobility | Option 1/2 | No strong view |
| Ericsson | Option 2 | Considering there are only 12 reserved LCIDs left, and this is not sent very often, it is sufficient to use the eLCID. |
| ASUSTeK | Option1 or 2 | No strong view. |
| Intel | Option 2 |  |
| vivo | Option 2 | Considering that NTN itself is an optional feature, it is better to use eLCID (with 1 byte). |
| Huawei, HiSilicon | Option 2 | LCID is limited. We should use eLCID for this. |
| CATT | Option 2 |  |
| NEC | Option 2 | We agree with Nokia. |
|  |  |  |

## 2.3 UL synchronisation

In previous RAN1 meetings, RAN1 discussed validity time for NTN assistance information (i.e. serving satellite ephemeris data or common TA parameters), and has agreed to introduce an epoch time together with a validity timer for NTN assistance information, where the validity timer indicates the maximum time during which the UE can apply the satellite ephemeris and common TA for TA pre-compensation without re-acquiring new NTN assistance information. UE starts or restarts the validity timer at the epoch time of the NTN assistance information, and the UE assumes that it has lost uplink synchronization if the validity timer expires.

Relevant proposals on UL synchronisation recovery are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [2]R2-2200243 | Proposal 10: UE may re-acquire new NTN assistance information before the validity timer expires, if the UE is provided with common search space including searchSpaceSIB1 and searchSpaceOtherSystemInformation on the active BWP. The exact time for the UE to re-acquire new NTN assistance information is up to UE implementation.  Proposal 11: Upon expiry of the validity timer, the UE should flush all HARQ buffers and release all resource configuration including PUCCH, SRS, CG, SPS, etc.  Proposal 12: Upon expiry of the validity timer, UE needs to firstly acquire the serving satellite ephemeris data and common TA parameters from SIB, and then trigger a RACH to recover UL synchronization.  Proposal 13: If the UE is not configured with searchSpaceSIB1 or searchSpaceOtherSystemInformation on the active BWP, the UE should switch to initialDownlinkBWP to acquire the serving satellite ephemeris data and common TA parameters. | OPPO |
| [19]R2-2201630 | Proposal 12 If the UL synchronization timer expires, the UE stop all uplink transmissions and triggers RLF.  Proposal 13 If the UE fails to acquire an accurate UE location to be used in the calculation of the full TA, the UE stop all uplink transmissions and trigger RLF. | Ericsson |

In summary, the following options for UL synchronisation recovery due to validity time expiry are brought by companies:

* Option 1: Upon expiry of the validity timer, UE flushes all HARQ buffers and release all resource configuration, and UE needs to firstly acquire the serving satellite ephemeris data and common TA parameters from SIB, before trigger a RACH to recover UL synchronization. [2]
* Option 2: If the UL synchronization timer expires, the UE stop all uplink transmissions and triggers RLF. [19]

For option 1, it is stated in [2] that similar to the legacy UL out of synchronization caused by the expiry of TAT, UL out of synchronization caused by the expiry of validity timer leads to the infeasible UL transmission. Therefore, a straight way to recovery UL synchronization is to firstly acquire the serving satellite ephemeris data and common TA parameters from SIB, and then trigger a RACH.

For option 2, it is stated in [2] that if the UE fails to reacquire synchronisation before this validity timer expires, all configured resources needs to be dropped and the higher layers need to be informed of the event, that is to trigger an RLF.

**Question 17: Regarding how the UE recovers from UL synchronization failure due to the validity timer expiry, which is the preferred option?**

* Option 1: UE flushes all HARQ buffers and releases all resource configuration, re-acquires the SIB and triggers RACH procedure to recover from UL synchronization loss failure.
* Option 2: UE triggers RLF.

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Nokia | Option 1 | Option1 is simple and straightforward. It has less impact to specification. When the validity timer expires, it is only the UL synchronization that is unavailable, but the DL synchronization is kept. The UE should stay in RRC CONNECTED mode and re-acquire new assistance information from SIB for UL sync, which is similar to the maintenance of uplink time alignment timer (TAT) when UL synchronization status is “non-synchronised”.  For Option 2, when the UE trigger RLF, the UE should perform cell reselection and the whole RRC Reestablishment procedure again to achieve UL synchronization which will have unnecessary signalling and power consumption. |
| ZTE | Option1 is preferred but we can wait for IoT NTN | Option 1 is preferred since UE can reestablish TA by initiating RACH procedure which can be completed within 3steps if there are CFRA resource available while for RLF UE will always need to initiate reestablishment procedure which will introduce additional RRC processing delay since UE needs to transmit RRCReestablishmentRequest message. However, considering there are already some discussion in IoT NTN, we can wait for their outcome and reuse their solution. |
| OPPO | Option 1 | Share the same view as Nokia. RRC re-establishment is too heavy for recovering UL synchronization loss which can be well handled by a RACH procedure. |
| Thales | Option 1 |  |
| Xiaomi | Option 1 & Option 2 | Option 1 and option 2 are not mutual exclusive. Option 1 is the behaviour when UL sync is lost. Option 2 is the behaviour when SIB can not be acquired. They address different timing. Thus, both of them should be adopted. |
| MediaTek | FFS | Needs some more discussion |
| Qualcomm | FFS | For NR UE, acquisition of SIB (i.e., ephemeris) is not big deal, it may be just a very short interruption like short physical layer problem which can be recovered soon and continue RRC connection. For this, there is no need to break the RRC connection. |
| Apple | Option 1 |  |
| Sequans | Option 1 | May need further discussion, but the principle seems ok and indeed more optimized than triggering RLF. |
| Lenovo, Motorola Mobility | FFS | The behaviours in Option 1 seems necessary but we think it requires further discussion. |
| Ericsson | Option 2 | After the validity timer expires, there is no possibility for the UE to send anything in the UL, not even random access. Therefore, this is different from the TAT expiry case.  Option 1 and 2 are very similar in our view.  In option 1 and 2 the UE is very aware of when the validity timer will expire and must try reacquiring the SIB before the validity timer expires. When validity timer expires; option 2 triggers RLF immediately while in option 1 the UE partly drops the configured resources and try reacquiring SIB before a new timer expires and the RLF is triggered.  We think Option 2 is simpler as no new timer is needed and still the UE shall have plenty of time before the expiry of validity timer to reacquire the SIB.  Note that when RLF is triggered, cell search is most likely very quick as the UE knows what to expect and the value tag has most likely not changed. |
| ASUSTeK | Option 1 | However, further discussion may be needed. |
| Intel | Option 1 |  |
| vivo | Option 1 | According to RAN1 agreements, UE assumes that it has lost uplink synchronization if the validity timer expires. At least from the view of UL synchronization, the validity timer and the TAT timer has nearly the same function. Thus, it is logical that UE flushes all HARQ buffers and release all resource configure upon the validity timer expiry. |
| Samsung | FFS | Validity time expiry may imply either acquiring SI is not triggered or it’s triggered but UE is not able to successfully read SI due to poor radio link quality. |
| Huawei, HiSilicon | Option 1 with comments | Option 1 is preferred if it is the same as legacy behaviour without further enhancement. |
| CATT | FFS | It needs further discussion. |
| NEC | Option 1 |  |

The issue on UL out of synchronization caused by unavailable UE location for TA pre-compensation is raised in [19]. It is stated that when the UE fails to acquire the GNSS fix for the UE location to be used in the full TA calculation, the UE must refrain from making any UL transmissions, and trigger RLF.

However, rapporteur understands this issue may be only valid for IoT NTN where IoT devices could not acquire the GNSS fix during RRC connected mode and not so relevant for NR NTN. Companies can also share views here.

**Question 18: Do companies agree that the UE should stop all uplink transmissions and trigger RLF if the UE fails to acquire an accurate UE location to be used in the calculation of the full TA?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| Nokia | No | We agree with rapporteur the case is more relevant to IoT NTN where simultaneous usage of GNSS and NTN NB-IoT/eMTC is not assumed. For NR NTN, it is UE’s implementation to make sure the GNSS is valid. There is no need to have specification impact. |
| ZTE | No |  |
| OPPO | No | Share the same view as Nokia. |
| Thales | No |  |
| Xiaomi | No | Only for IOT-NTN |
| MediaTek | FFS | Needs more discussion |
| Qualcomm | FFS | But as per Question it says “UE fails to acquire UE location”. It is not clear why? Generally we agree NR UEs should be able to maintain the GNSS validity during connected mode. |
| Apple | Yes | In some scenarios the UE may be unable to acquire GNSS (e.g., indoor location). |
| Sequans | FFS |  |
| Lenovo, Motorola Mobility | No |  |
| Ericsson | Yes | This applies to both NR NTN and IoT NTN, a UE may have NTN coverage without having GNSS coverage as they have different properties (different constellations and frequency bands).  Without accurate UE location, the UE cannot accurately calculate the full TA and shall therefore stop all UL transmissions.  As the UE implementation may improve the accuracy of an old GNSS fix by many methods, it is better left to the UE implementation to detect a location accuracy that is not accurate enough. This shall be a rare event, but if it happens UE must stop all UL transmissions in order to not create excess interference. |
| ASUSTeK | FFS | Share the view with Nokia. |
| Intel | No |  |
| vivo | NO |  |
| Samsung | FFS | We are not sure whether UE fails to acquire an accurate UE location is a practical scenario to be considered in NTN. |
| Huawei, HiSilicon | No |  |
| CATT | No |  |
| NEC | No | We agree with Nokia. |

Other detailed proposals in [2] can be further discussed after RAN2 makes conclusion on question 17.

## 2.4 Handling of contention resolution timer

The issue of restarting ra-ContentionResolutionTimer with RTT offset was discussed offline in RAN2#116e meeting but has made no conclusion.

Relevant proposals on handling of contention resolution timer are listed below:

|  |  |  |
| --- | --- | --- |
| Tdoc No. | Relevant Proposals | Source |
| [2]R2-2200243 | Proposal 14: The UE stops ra-ContentionResolutionTimer once receiving PDCCH which schedules Msg3 retransmission and then starts ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT. | OPPO |
| [3]R2-2200270 | Proposal 9: Ignore the expiry of ra-ContentionResolutionTimer during the delay of the restart of the ra-ContentionResolutionTimer by UE-gNB RTT. | Xiaomi |
| [4]R2-2200347 | Proposal 3: UE should stop ra-ContentionResolutionTimer once having received PDCCH which schedules Msg3 retransmission and then start ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT. | Huawei, HiSilicon |
| [10]R2-2200747 | Proposal 1: RAN2 discuss which of the following options is adopted for the concerned issue:   * Option 1: UE stops ra-ContentionResolutionTimer upon receiving PDCCH indicating Msg3 retransmission and then starts ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT. * Option 2: If ra-ContentionResolutionTimer expires during the UE-gNB RTT after Msg3 retransmission, the UE does not consider the Contention Resolution not successful. | ASUSTeK |
| [13]R2-2201007 | Proposal 1: Blind scheduling for MSG3 retransmission should be possible for NTN.  Proposal 2: To handle the case Contention Resolution timer expired during UE-gNB RTT to wait for the next Contention Resolution timer restart, the UE should only consider the Contention Resolution failure if the timer expires and there is no MSG3 has been transmitted after the start of the ra-ContentionResolutionTimer.  Proposal 3: To avoid unintended Contention Resolution failure declaration, RAN2 could take the proposed text into account . | Nokia, Nokia Shanghai Bell |

In summary, following two options are proposed by companies:

* Option 1: UE stops ra-ContentionResolutionTimer upon receiving PDCCH for Msg3 retransmission and start the timer after Msg3 retransmission plus UE-gNB RTT. [2] [4]
* Option 2: If ra-ContentionResolutionTimer expires during the UE-gNB RTT after Msg3 retransmission, the UE does not consider the Contention Resolution not successful. [3] [13]

For option 1, the ra-ContentionResolutionTimer would not unexpectedly expire in the case of Msg3 retransmission with this solution. Another benefit brought by this solution is power saving since the UE could reduce PDCCH monitoring. The main concern of the opponent is that blind scheduling of Msg3 retransmissions would not be possible.

For option 2, blind scheduling for MSG3 retransmission should be possible for NTN with this solution [3] [13], which may reduce the RACH delay. Howerever, it is argued in [2] that RAN2 has agreed to delay the start of ra-ContentionResolutionTimer by the UE-gNB RTT, during this UE-gNB RTT, UE is not required to monitor PDCCH, which means blind scheduling of Msg3 retransmissions is not expected from UE. This logic should apply for both the first Msg3 retransmissions and the subsequent Msg3 retransmissions, otherwise (i.e. if blind scheduling for subsequent Msg3 retransmissions is expected), UE should restart ra-ContentionResolutionTimer immediately after each Msg3 retransmission rather than waiting for a UE-gNB RTT.

**Question 19: Regarding the issue of ra-ContentionResolutionTimer, which is the preferred option?**

* **Option 1: UE stops ra-ContentionResolutionTimer upon receiving PDCCH indicating Msg3 retransmission and then starts ra-ContentionResolutionTimer after the end of the Msg3 retransmission plus UE-gNB RTT.**
* **Option 2: If ra-ContentionResolutionTimer expires during the UE-gNB RTT after Msg3 retransmission, the UE does not consider the Contention Resolution not successful.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Additional comments** |
| Nokia | Option 2 | Option 1 disables a legacy function (i.e. blind Msg3 retransmission scheduling) which is supported in both LTE and NR from the original release.  From NW point of view, the blind Msg3 retransmission scheduling is one typical strategy for Msg3 coverage enhancement, the function will be even more beneficial in NTN due to wide coverage of NTN cells.  we see no motivation to introduce one issue (disable the legacy function) in order to solve the other issue (declare unintended Contention Resolution failure). Hence Option1 is not acceptable.  Option 2 can solve the issue in a clean way without negative impact. |
| ZTE | Option 2 | Agree with Nokia. |
| OPPO | Option 1 | As RAN2 has agreed to delay the start of ra-ContentionResolutionTimer by the UE-gNB RTT, during this UE-gNB RTT, UE is not required to monitor PDCCH, which means blind scheduling of Msg3 retransmissions is not expected from UE. This logic should apply for both the first Msg3 retransmissions and the subsequent Msg3 retransmissions, otherwise (i.e. if blind scheduling for subsequent Msg3 retransmissions is expected), UE should restart ra-ContentionResolutionTimer immediately after each Msg3 retransmission rather than waiting for a UE-gNB RTT. |
| Xiaomi | Simply ignore this event | Ignore the expiry of ra-ContentionResolutionTimer during the delay of the restart of the ra-ContentionResolutionTimer by UE-gNB RTT. |
| MediaTek | Option 1 |  |
| Qualcomm | Option 1 |  |
| Apple | Option 2 |  |
| Lenovo, Motorola Mobility | Option 1 |  |
| Ericsson | Option 1 | We do not see the need to support blind retransmissions for Msg3 after a first retransmission. |
| ASUSTeK | Option 1 | As analysis in our Tdoc [10], both options could solve the issue with trade-off. We prefer for option 1 since it is supported by most companies in last discussion. |
| Intel | Option 1 |  |
| vivo | Option 2 | For the NTN scenario, blind retransmission is much possible. Option 2 can avoid UE missing the possible blind retransmission of msg3, which is preferable. |
| Huawei, HiSilicon | Option 1 |  |
| CATT | Option 1 |  |
| NEC | Option 1 | Since the UE is not required to monitor PDCCH for a period of UE-gNB RTT after sending retransmission following a retransmission grant on the PDCCH, we prefer to stop the contention resolution timer in the meantime and save UE battery. |

# 3. Conclusion

Based on the discussion we make the following proposals:

To be added…

# 4. References

1. R2-2200214 Discussion on remaining issues on TA reporting Intel Corporation discussion Rel-17 NR\_NTN\_solutions-Core
2. R2-2200243 Discussion on RACH and TA report in NTN OPPO discussion Rel-17 NR\_NTN\_solutions-Core
3. R2-2200270 Remaining issues related to TA report Xiaomi discussion Rel-17
4. R2-2200347 Remaining issues about RACH and TA reporting Huawei, HiSilicon discussion Rel-17 NR\_NTN\_solutions-Core
5. R2-2200377 Discussion on UE specific TA reporting vivo discussion
6. R2-2200520 Consideration of TA report remaining issues of NTN China Telecom discussion Rel-17 NR\_NTN\_solutions-Core
7. R2-2200627 TA report procedure Spreadtrum Communications discussion Rel-17
8. R2-2200688 The Left Issues on UE-specific TA information reporting in NTN CATT discussion Rel-17 NR\_NTN\_solutions-Core
9. R2-2200746 Discussion on TA report during RA procedure ASUSTeK discussion Rel-17 NR\_NTN\_solutions-Core
10. R2-2200747 Discussion on issue of restarting contention resolution timer ASUSTeK discussion Rel-17 NR\_NTN\_solutions-Core
11. R2-2200764 Further discussion on TA reporting in NTN Lenovo, Motorola Mobility discussion Rel-17
12. R2-2200876 Considerations on RACH aspects CMCC discussion Rel-17 NR\_NTN\_solutions-Core
13. R2-2201007 Discussion on RACH open issues and TA reporting aspects Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_NTN\_solutions-Core
14. R2-2201034 Further considerations on TA reporting Samsung Research America discussion NR\_NTN\_solutions-Core
15. R2-2201164 UE-specific TA reporting and other RACH aspects InterDigital discussion Rel-17 NR\_NTN\_solutions-Core
16. R2-2201193 Remaining issues on TA Report NEC Telecom MODUS Ltd. discussion
17. R2-2201324 Consideration on remaining issues of RACH aspects ZTE Corporation, Sanechips discussion Rel-17
18. R2-2201363 Discussion on RACH and TA report aspects LG Electronics Inc. discussion NR\_NTN\_solutions-Core
19. R2-2201630 Reporting information about UE specific TA pre-compensation in NTNs Ericsson discussion
20. S3-214349, Reply LS on NTN specific User Consent

# 5. Contact information

|  |  |
| --- | --- |
| Company | Delegate contact |
| COMPANY\_NAME | NAME ([email@address.com](mailto:email@address.com)) |
| OPPO | Haitao Li (lihaitao@oppo.com) |
| MediaTek | Abhishek Roy (abhishek.roy@mediatek.com) |
| Sequans | Olivier Marco (omarco@sequans.com) |
| Lenovo, Motorola Mobility | Min Xu (xumin13@lenovo.com) |
| Ericsson | robert dot s dot karlsson AT ericsson dot com |
| ASUSTeK | Erica Huang (Erica\_Huang@asus.com) |
| CATT | Xiangdong Zhang(zhangxiangdong@catt.cn) |
| NEC | Maxime Grau (maxime.grau@emea.nec.com) |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |