3GPP TSG-RAN WG2 Meeting #115e draftR2-2108897

Online, 16th - 27th August, 2021

**Agenda item: 8.10.2.1**

**Source: CATT**

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

**Document for: Discussion and Decision**

# 1 Introduction

This document will continue to discuss companies’ views regarding the RACH aspects in 3rd round:

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

Final scope: Continue the discussion on p1 and p2 from [R2-2108897](file:///C%3A/Data/3GPP/RAN2/Inbox/R2-2108897.zip)

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

  List of proposals for agreement (if any)

  List of proposals for further discussion

Final deadline (for companies' feedback): Thursday 2021-08-26 1000 UTC

Updated deadline (for rapporteur's summary in R2-2108901): Thursday 2021-08-26 1500 UTC

Proposals marked "for agreement" in R2-2108901 not challenged Friday 2021-08-27 0300 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue online during the CB session).

Status: Ongoing

# 2 Discussion

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

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

Further at RAN2#114 the following was agreed

Agreement:

1. If enabled by the network, the UE reports information about UE specific TA pre-compensation at the random access procedure (MSGA/MSG3 or MSG5) using a MAC CE. Actual content is FFS and also depends on further RAN1 input (we can revise this whole agreement if RAN1 come to a different conclusion in terms of what needs to be conveyed to the NW)

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

Agreements:

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

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

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| **Agreements via email - from offline 106:**1.     The content of UE specific TA pre-compensation reported in RA procedure using MAC CE is UE specific TA (this can be revisited after receiving RAN1 response).2.     Reporting on the information about UE specific pre-compensation in connected mode is supported, FFS via RRC signalling or MAC CE3.     Event-triggers for reporting on the information about UE specific TA in connected mode is supported. FFS on the details. Confirmation by RAN1 is also needed4.     If configured, the UE shall report information of the UE specific TA pre-compensation to the target cell during the random access. FFS if a new indication in RRC reconfiguration with sync is needed or not (besides the SIB indication carried in HO command on whether TA report is enabled/disabled in the target cell).5.    Information about UE specific TA pre-compensation is not reported in RA procedures triggered due to “Request for Other SI” |

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

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| **Agreements via email - from offline 106 second round:**1.     The event-triggers for reporting information about UE specific TA are based on TA values (confirmation from RAN1 is needed)2.     A TA offset threshold can be used for event-triggered reporting, at least the offset threshold can be between current information about UE specific TA and the last successfully reported information about UE specific TA3.     The event-triggers for reporting information about UE specific TA based on time threshold is not supported in NTN.4.     No new indication in RRC reconfiguration with sync is needed to configure the UE to report information about UE specific TA in handover procedure (besides the SIB indication carried in HO command on whether TA report is enabled/disabled in the target cell). |

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

In online discussion, some companies show the concern on the proposal 1 as below.

Proposal 1: The content of UE specific TA reported in connected mode is UE specific TA pre-compensation (13/17), FFS the UE position (3/17).

Nokia suggests keeping both options: if the UE location cannot be reported the UE sends the UE specific TA-pre-compensation value. Sony agrees, Ericsson, Intel as well.

In the online discussion regarding LCS, the following agreement is obtained:

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| If accepted by SA3, if the gNB has user consent to obtain UE location in NTN, reporting of finer location information/full GNSS coordinates in RRC\_CONNECTED can be supported after AS security is enabled |

Whether the UE location information can be reported in connected mode is based on the reply of SA3. Thus, the rapporteur lists the discussion under two work assumptions:

* Work assumption 1: the UE location information can be reported in connected mode
* Work assumption 2: the UE location information cannot be reported in connected mode

Therefore, the rapporteur suggests discussing the following question:

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| **Question 1: Work assumption 1: the UE location information can be reported in connected mode.****Which option of information about UE specific TA in connected mode do you prefer, under the Work assumption 1?****Option 1. TA pre-compensation value (for the details of the TA value, confirmation from RAN1 is needed); Option 2. UE location information(confirmation from RAN1 is needed);**  |
| **Company** | **Option1/2** | **Comment**  |
| Nokia | Option 2 | If UE location information can be reported to NW, it is common understanding that NW can accurately determine the scheduling offset for the UE. (e.g. based on UE’s location and satellite ephemeris data, NW can estimate the UE’s UE-gNB RTT (i.e. UE-specific TA). This is same as what UE can do before UE’s initial access to decide offset for RAR timer start.). **Obviously**, reporting the location has the advantage that TA change due to satellite movement can be tracked by the gNB thus save Uu interface signalling/overhead since it is not needed to report more report of UE specific TA. So, we think it is reasonable to reuse UE’s location information to estimate UE-specific TA if it can be reported to NW anyway (e.g. for cell id mapping etc.).Furthermore, there are two concerns in the email discussion and online discussion:**# Concern 1. UE location may not be updated fast and at the right time for UL scheduling.**In our view, to fulfil the motivation of report TA information (e.g. reduce UL scheduling latency), the coarse UE location reported to NW TA estimation is sufficient. The change of UE position (for example, 2km) will have very tiny latency difference (e.g. less than 0.005ms according to R1 contribution R1-2107292).  So, the event-based UE location reporting (as agreed in RAN2 LCS discussion) is sufficient for TA estimation to facilitate UL scheduling at the right time.**# Concern 2. UE report UE location info via RRC (in UL) may not suitable since it is not as fast as MAC CE (in DL) to update K\_offset.**In our view, any changes to K\_offset would basically be to optimize for the distance between UE and satellite. The K\_offset update depends on not only UE's location but also satellite's position. This means even the UE is stationary, the K\_offset should be updated when the satellite is moving (e.g. at 7.5km per second). Compared with the satellite's movement, the K\_offset update caused by UE's movement (e.g. 3km per hour) is a very rare case. Furthermore, we think the K\_offset should not change very often even it is associated to the satellite movement over the UE (e.g. depending on unit of K\_offset and NW implementation), to save the Uu interface overhead. So, we would claim that UE reporting of coarse UE location would not cause a problem if it is provided over RRC. RRC is much faster than what is needed for K\_offset update. And added benefit from using RRC for location update is that it is kept within the ciphering and is thereby protected. |
| ZTE | Option 1 | This is for scheduling adaption where efficiency is critical, we are worried by the additional delay and specs work needed to reuse location information for scheduling adaption.If location information is agreed to be reported in connected mode, then it can only be carried in RRC message which means DU cannot decode this information. Thus this reported information will first transfer to CU, after decoding CU should first translate the location info to TA value and delivers back the information to DU, thus additional delay will be introduced, which might not be able to fulfil RAN1’s requirement. Especially considering the TA reference point may located in satellite, in which case the grant station need to decode the RRC message, translate the location info and send it back to satellite.Also this solution will require additional work in RAN3 as well, in order to support interaction between CU and DU.  |
| OPPO | Option 1 | The intentions between UE location report and TA reporting are different. TA reporting is for NW scheduling, i.e., the configuration of Koffset. Regardless of the Work assumption 1 about UE location information, the solution assisted for NW scheduling should be aligned, i.e., report TA pre-compensation value. |
| Apple | Option 1 | TA reporting if for helping with network scheduling. There is no need of a discussion of UE location report in this regards. Additionally the TA report also needs to be limited in the number of times it has to be reported by the UE. The existing mechanism is self correcting. And obviously, we need RAN1 to first confirm this before RAN2 starts jumping to conclusions. |
| Ericsson | Option 2 | We agree with Nokia. We would like to add that RAN1 have decided at RAN1#104e: Agreement:An NTN UE in RRC\_CONNECTED state is required to support UE specific TA calculation based at least on its GNSS-acquired position and the serving satellite ephemeris.FFS: Operation of closed loop and open loop TA controlAgreement:For TA update in RRC\_CONNECTED state, combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops shall be supported for NTN.FFS: Details of the combination of open and closed loop TA controlThus, the UE always need to have a UE location that is sufficiently accurate for the autonomous TA estimation, and that location can be reported and will be sufficient for the gNB estimation of the UE specific TA estimation. Further, this autonomous TA estimation in connected mode means that there must be a report of the TA (or UE location) to enable gNB to optimize the used Koffset, as the gNB can not detect if the UE have changed the TA autonomously. Thus, for Nokia’s analysis of the concerns, we would like to add:**# Concern 1. UE location may not be updated fast and at the right time for UL scheduling.**The UE uses the UE location to do autonomous TA updates during the connection, this UE location can always be reported (even if only coarse location is reported). We further agree with Nokia.**# Concern 2. UE report UE location info via RRC (in UL) may not suitable since it is not as fast as MAC CE (in DL) to update K\_offset.**We agree with Nokia. **# Concern 3. There is no need for TA/location report after the initial report during RA procedure.**This is incorrect, RAN1 have decided the UE must support autonomous TA estimation based on the GNSS location. The changes in TA are not possible to detect for the gNB, but gNB can estimate them if UE location is reported (and UEs move slow relative the satellite movement).  |
| Nokia2 |  | To address ZTE, OPPO and Apple’s comments, please see some of our response. @ZTE: Thank ZTE for providing the technical reason for the discussion.We don’t think there will have additional delay if location information is used for UL scheduling optimization, even in CU-DU architecture. Instead, we believe Uu interface signalling/overhead saving is the key aspects that companies may need to consider, especially for NTN which will cover larger area than TN. First of all, for CU-DU architecture, there is no agreement that DU cannot use UE’s location information to estimate TA, even the location info is received in CU. If DU has the location information, DU can estimate TA itself thus no delay at all. How to optimize CU-DU message is another topic. Furthermore, in Rel-17, the feature scope in WID is transparent payload, which means both CU and DU are in ground and satellite is an analogue RF repeater. We don’t understand why TA or location information should be sent back to satellite and there is no such interface between gNB and satellite, right? Secondly, (to reduce UL scheduling latency) the UE location update is a rare case which has very limited message exchange between CU and DU. As we explained previously, the change of UE position (for example, 2km) will have very tiny latency difference (e.g. less than 0.005ms according to R1 contribution R1-2107292). Compared with the satellite's movement (e.g. 7.5km per second), UE can be regarded as almost stationary. The main contribution for UE-gNB RTT (i.e. UE-specific TA) change is caused by the satellite movement instead of UE movement. This means UE’s location change report is a very rare case. In most cases, only one UE location report is enough for TA estimation to facilitate the UL scheduling (since scheduling granularity is 1 slot).Thirdly, compared to F1 interface update for location or TA information exchange, we believe Uu interface signalling saving and overhead reduction is the more important aspects.@OPPO, @AppleWe wonder why UE need the UE-specific TA reporting in addition to the UE location reporting. Is there any benefit to report duplicate information for the same purpose with the waste of Uu signalling ?  |
| Samsung | Option 2 for RRC, option 1 for MAC | We think for RRC connected UE, either option1 or option2 can work for TA adjustment and Koffset configuration. We also think option2 would be anyway needed for mobility support, then to avoid having two different mechanisms for the same purpose, we would like to rely on option2. However, if it is reported via MAC CE, then location information may be too big and possibly variable, so in the case we think option1 would be better.  |
| NEC | Option 1 | We prefer to have an efficient and quick scheme for MAC scheduler to get the information directly. Also, we prefer to reuse the same procedure as in the RACH procedure.We also agree with ZTE that in CU-DU architecture UE location report in RRC message may lead to further delay. |
| MediaTek | Option 1 | We think that a uniform solution across RA procedure and Connected mode is preferable. It will reduce specification effort and reduce UE and network implementation complexity. MAC CE is already agreed for RA scenario, we can easily re-use it for the Connected mode scenario. |
| Qualcomm | Option 2 | This question is tricky for the proponent of UE specific TA report.When we talk about UE location, it is UE location in RRC in connected mode. In this case, question should beIn addition to UE location report, do we need to support UE specific TA report?Answer: Yes, if network does not configure UE location reporting sufficiently to detect fast changing UE’s position. Updating UE location via RRC could be very slow.Also Yes, if network does not configure UE location reporting or does not have user consent. |
| Intel | Option 2 | We prefer that UE position is reported as network can determine UE TA and gets additional information that also may be helpful for other purposes. |
| China Telecom | Option 1 | We are discussing the report of UE specific TA. Option 1 is obviously the straightforward way to go. Location information report has more usage such as HO. However, under the work assumption 1, we think the location information can reduce the frequency of UE specific TA update for the reason that NW can also calculate the UE specific TA by location information. Thus, we suggest the following proposal for work assumption 1:**Proposal: TA pre-compensation value is reported for UE specific TA in connected mode when the location information can not be reused for NW scheduling.**  |
| vivo | Option 1 | We don’t see the reason why we cannot leave whether to configure UE specific TA reporting and/or UE location reporting to NW configuration for RRC\_CONNECTED mode. When UE specific TA reporting is configured, the UE runs related procedure in MAC; when location reporting is configured, the UE runs related procedure in RRC; when both are configured, the UE runs related procedures in both MAC and RRC in parallel. We don’t see any problem to go with this way, nor any necessity to couple these two procedures — All up to the NW configuration. To this end, we think the alternative proposal suggested by the chair during online is a feasible way forward:New proposal: In connected mode the network can request the UE to send either the TA precompensation value and/or the UE location"  |
| Huawei, HiSilicon | Option 1 | The UE location reporting discussed in LCS offline is to support CGI mapping and verify whether the PLMN selection crosses the borderline. It will not be very frequent. In contrast, TA information reporting is a continuous practice. Therefore, it is inappropriate to “reuse” the location reporting.MAC CE can be used which is similar to reporting during RACH and complied with legacy way to handle TA. |
| CATT | Option 1 | We prefer to stick option 1 since it is not clear that UE location information can be reported in connected mode. TA pre-compensation value is good enough to help gNB scheduling.BTW, the trigger condition of reporting TA is different from the trigger condition of reporting UE position. When the UE position is changed above the offset threshold, but it doesn't mean that the TA for scheduling is changed. Imagine that, UE moves around a circle which has the same TA value but its position may change a lot. So the trigger condition of report UE position still needs TA. So why not report TA pre-compensation value directly?@Qualcomm, we didn't get confirm from SA3 that UE position can be reported to gNB yet. So work assumption is put here to show the dependence relationship. |
| ETRI | Option 1 | For TA pre-compensation, it is sufficient to report TA pre-compensation value. We do not know why the UE position is considered for the content of UE specific TA(only 3/17 supported it). UE position reporting is agreed for LCS.  |
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| **Question 2: Work assumption 2: the UE location information cannot be reported in connected mode,** **Do you agree that the information about UE specific TA in connected mode is TA pre-compensation value (for the details of the TA value, confirmation from RAN1 is needed), under the work assumption 2?** |
| **Company** | **Yes/No** | **Comment**  |
| Nokia | Yes with comment | If it is not possible to report UE location information, we agree the content of UE specific TA information should be TA pre-compensation value.However, similar to what agreed in RACH procedure, we think whether UE report the information about UE specific TA in connected mode should be NW configurable. It is FFS how to configure or enable the reporting (e.g. reuse reporting flag for RACH procedure or not).  |
| ZTE | Yes | If there are no user consent received, than UE is not requested to report location, thus we prefer to report UE TA which is not subject to user consent. |
| OPPO | Yes |  |
| Apple | Yes |  |
| Ericsson | Yes with comment | Agree with Nokia.  |
| Samsung | Yes |  |
| NEC | Yes |  |
| MediaTek | Yes | TA pre-compensation value and location information are the only two options on the table, so if location information is not possible, TA pre-compensation will be reported. |
| Qualcomm | Yes | Note this this assumption 2 may not be because specification does not allow. It may be because gNB has no user consent for some UEs or gNB does not configure UE to report UE location. |
| Intel | Yes |  |
| China Telecom | Yes | In this case, only one option on the table.  |
| vivo | Yes | See also our comments to Q1. |
| Huawei, HiSilicon | Yes |  |
| CATT | Yes |  |
| ETRI | Yes |  |
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[Summary]

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

Since the content of information about UE specific TA is not decided, thus the rapporteur suggests discussing the following question based on the content of information about UE specific TA.

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| **Question 3: If the reported content of information about UE specific TA is TA pre-compensation value, do you agree using MAC CE to report TA pre-compensation value?** |
| **Company** | **Yes/No** | **Comment**  |
| Nokia | Yes | Reusing the method in RACH for simplicity.  |
| ZTE | Yes | MAC CE is more efficient. And for connected mode report, security issue needs to be confirmed by SA3.  |
| OPPO | No | We prefer to use RRC signalling since it is secured. |
| Apple | No | We prefer RRC. Based on our RAN1 input, this value even for the most dynamic of cases LEO at 500Km with highly mobile UE would need to be updated only once every 10-20s. Anything other than that is not needed. RAN1 would need to first confirm these values before we design signaling for the mechanism needed for reporting UE specific TA pre-compensation value.  |
| Ericsson | No | Repeated MAC CEs can be detected by unwanted parties and used to accurately estimate the UE position.  |
| Samsung | Yes |  |
| NEC | Yes | We prefer to reuse the sane procedure as in RACH. |
| MediaTek | Yes | See our comment for Q1 above. |
| Qualcomm | Yes | Given the TA report itself should be blurry (in granularity of 1 slot). |
| Intel | Yes | We share the view that TA MAC CE reporting could be reused as baseline. |
| China Telecom | Yes | Reuse RA procedure. |
| vivo | Yes | A unified procedure is preferred.  |
| Huawei, HiSilicon | Yes | It’s better to be aligned with the TA report for initial access. |
| CATT | Yes | Reuse RA procedure. |
| ETRI | Yes | We prefer to reuse the RA procedure. |
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| **Question 4: If the reported content of information about UE specific TA is UE location information, which option do you prefer to use in connected mode?****Option 1. RRC signalling; Option 2. MAC CE** |
| **Company** | **Option 1/2** | **Comment**  |
| Nokia | Option 1 | See our response to Q1.If UE location should be reported, RRC is the preference since it can provide integrity protection and encryption on UE location information |
| ZTE | Option 1 |  Position information can only be carried in RRC due to security concern. |
| OPPO |  | We prefer that the reported content of information about UE specific TA is TA pre-compensation value. |
| Apple | None | We don’t think this discussion is relevant for pre-compensation. |
| Ericsson | Option 1 |  |
| Samsung | Option1 |  |
| NEC | Option 1 | UE location information would need RRC for security. |
| MediaTek | Option 1 | We don’t support this option (reporting UE location information), but if it will be supported, to our knowledge, location information is generally reported using RRC signalling rather than MAC CE. |
| Qualcomm | Option 2 | TA report is to update the TA fast. UE location is reported in RRC signaling, so, no need to report TA in RRC. |
| Intel | Option 1 |  |
| China Telecom | Option 1 | With the encryption of RRC signalling, high resolution of location information is allowed. |
| vivo | / | See our comments to Q1. |
| Huawei, HiSilicon | Option 1 | The UE location report will occupy large signalling overhead, and requires security. In this regard, RRC signalling is more suitable. |
| CATT | Option 1 | UE position should be carried on RRC signalling because of security concern. |
| ETRI | - | The content of UE specific TA is TA pre-compensation value. |
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[Summary]

## 2.3 LS to RAN1

The following agreements at RAN2 #115-e are related with RAN1 which should be confirmed by RAN1 proposed by companies:

Agreements:

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

1.     The content of UE specific TA pre-compensation reported in RA procedure using MAC CE is UE specific TA (this can be revisited after receiving RAN1 response).

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| 1. Reporting on the information about UE specific pre-compensation(Typo, should be TA) in connected mode is supported, FFS via RRC signalling or MAC CE2. The event-triggers for reporting information about UE specific TA are based on TA values (confirmation from RAN1 is needed)3. A TA offset threshold can be used for event-triggered reporting, at least the offset threshold can be between current information about UE specific TA and the last successfully reported information about UE specific TA |

Thus, the rapporteur suggests discussing the following question

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| **Question 5: Do you agree that an LS should be sent to RAN1 for confirming the following agreements at RAN2 #115-e including the agreement in 3rd round?**1. UE specific TA reporting during RACH procedure is enabled/disabled by SI (FFS for RACH in connected mode)
2. The content of UE specific TA pre-compensation reported in RA procedure using MAC CE is UE specific TA (this can be revisited after receiving RAN1 response).
3. The event-triggers for reporting information about UE specific TA are based on TA values (confirmation from RAN1 is needed)
4. A TA offset threshold can be used for event-triggered reporting, at least the offset threshold can be between current information about UE specific TA and the last successfully reported information about UE specific TA
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| **Company** | **Yes/No** | **Comment**  |
| Nokia | No | For item 2/3/4, we think there are being discussed in RAN1 according to RAN2’s request in LS R2-2104376. RAN2 can wait for RAN1’s response first. |
| ZTE | No this meeting | RAN1 has decide to send an LS after this meeting to answer the remaining issues RAN2 asked before and include a list agreements relevant to several issues under-discussion in RAN2. We might need to revisit several issues based on on RAN1 replied LS. It is pre-mature to send LS at this stage. |
| OPPO | Yes with comment | We are ok to involve the first three bullets. For the fourth bullet, in our understanding, we should conclude on the discussion before we inform RAN1 about this. Or is it the intention to send another subsequent LS after RAN2 agrees to more options for the offset threshold? |
| Apple | No | We prefer to wait for RAN1 to send the LS response before we send more LSes asking similar things.  |
| Ericsson | No | Agree with Nokia, ZTE and Apple.  |
| Samsung | No | We agree with Nokia and ZTE. |
| NEC | No | Wait for next meeting. |
| MediaTek | Yes, but | If companies prefer, we are OK to postpone the LS until more progress is made. If it is sent, it is better to include all previous agreements on this topic excluding the “no impact” agreements (not supported, no new indication needed etc.) |
| Qualcomm | Yes | Ok with LS as it anyway seems to inform RAN2 agreements that are dependent on RAN1. |
| Intel | See comments | We are ok waiting for RAN1’s response before sending additional questions as current agreements do not see critical for RAN1 progress.  |
| vivo | No | Share above companies’ view to await RAN1 response first.  |
| Huawei, HiSilicon | No | Same view with ZTE. |
| CATT | Yes | There is some progress at this meeting on TA reporting, e.g. the content of information about UE specific TA in RACH procedure, the event-triggered method to trigger TA reporting in connected mode. We can send an LS to RAN1 to inform RAN2’s progress on TA reporting for aligning the conclusion. |
| ETRI | No | Not this meeting. We think it is premature to send LS. |
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# 3 Conclusions

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

*Proposals for easy agreements:*

*Proposals for further discussion:*

# 4 List of referenced documents

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

[2] R2-2108882 [offline 106] RACH aspects CATT discussion Rel-17 NR\_NTN\_solutions-Core

[3] R2-2108897 [offline 106] RACH aspects - second round CATT discussion Rel-17 NR\_NTN\_solutions-Core

# Contact information

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