3GPP TSG RAN WG1 Meeting #105e R1-xxxxxx

**e-Meeting, May 10th – 27th, 2021**

Agenda Item: 8.4.2

Source: Moderator (OPPO)

Title: summary of discussion/approval of reply LS for R1-2104230

Document for: Discussion and Decision

# Introduction

In this meeting, RAN1 received an LS (R1-2104230) [1] from RAN2 and the following questions are raised by RAN2, seeking for answers from RAN1.

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| **1)** RAN2 respectfully requests RAN1 to prioritize the TA pre-compensation work on: (i) whether and/or what parameters to broadcast for TA pre-compensation, and (ii) when broadcasted, how often the broadcasted parameters are expected to change over time. **2)** RAN2 respectfully requests RAN1 to provide input on: (i) how UE determines UE-gNB RTT, and (ii) what additional information needs to be broadcasted other than that for TA pre-compensation, if any.**3)** RAN2 respectfully requests RAN1 to provide input on the exact content and frequency of UE reporting of information about the UE specific TA pre-compensation at least for uplink scheduling adaptation. |

As per chairman assignment, i.e.

[105-e-NR-NTN-05] Email discussion/approval for [R1-2104230](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2104230.zip) from May 21 to May 26 - Hao (OPPO)

This document contains the summary of the discussion from company’s views and strives for achieving agreement on the reply to the RAN2’s LS.

# Discussions

In this section, we discuss the possible answers to the RAN2’s answers.

## Answers to Q1

The first questions asked by RAN2 are the following

1. whether and/or what parameters to broadcast for TA pre-compensation,
2. when broadcasted, how often the broadcasted parameters are expected to change over time.

For Q1(i), so far RAN1 has made the following agreements

Agreement:

The Timing Advance applied by an NR NTN UE in RRC\_IDLE/INACTIVE and RRC\_CONNECTED is given by:

$$T\_{TA}=\left(N\_{TA}+N\_{TA,UE-specific}+N\_{TA,common}+N\_{TA,offset}\right)×T\_{c}$$

Where:

* $N\_{TA}$ is defined as 0 for PRACH and updated based on TA Command field in msg2/msgB and MAC CE TA command.
	+ FFS: details of NTA update/accumulation.
* $N\_{TA,UE-specific}$  is UE self-estimated TA to pre-compensate for the service link delay.
* $N\_{TA,common}$ is network-controlled common TA, and may include any timing offset considered necessary by the network.
* $N\_{TA,common}$ with value of 0 is supported.
	+ FFS:  details of signaling including granularity.
* $N\_{TA,offset}$ is a fixed offset used to calculate the timing advance.

Note-1: Definition of $N\_{TA}$ is different from that in RAN1#103-e agreement.

Note-2: UE might not assume that the RTT between UE and gNB is equal to the calculated TA for Msg1/Msg A.

Note-3: $N\_{TA,common}$ is the common timing offset X as agreed in RAN1 #103-e.

Agreement:

Support serving-satellite ephemeris broadcast based on one or more of the following:

* Set 1: Satellite position and velocity state vectors:
	+ position X,Y,Z in ECEF (m)
	+ velocity VX,VY,VZ in ECEF (m/s)
* Set 2: At least the following parameters in orbital parameter ephemeris format:
	+ Semi-major axis α [m]
	+ Eccentricity e
	+ Argument of periapsis ω [rad]
	+ Longitude of ascending node Ω [rad]
	+ Inclination i [rad]
	+ Mean anomaly M [rad] at epoch time to
* FFS: Whether pre-provisioned ephemeris based on orbital elements can be used as reference. Thereby, only delta corrections can be broadcast in order to reduce the overhead
* FFS: The field size for each parameter
* FFS: The impact on signaling due to the required accuracy of serving-satellite ephemeris
* FFS: Whether down-selection is needed or both sets are supported

Based on the latest RAN1 agreements, RAN1 has agreed that at least the following parameters are to be broadcasted for TA pre-compensation

* Serving satellite ephemeris
* Common TA

Additional possible parameters are still in RAN1 discussion. Therefore, RAN1 may provide the answer to RAN2 with this information.

**Moderator proposal:**

Capture the above RAN1 agreements in the reply LS and indicate to RAN2 that at least the following parameters are to be broadcasted for TA pre-compensation

* Serving satellite ephemeris
* Common TA

Additional possible parameters are still under discussion in RAN1, and RAN1 will share the updated parameters with RAN2 once new agreement is achieved.

**Company’s view of 1st round**

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| Company name | Comments and views |
| APT | Agree. But if we check RAN2’s discussion in the last meeting, then they already used these RAN1 agreements for discussions.  |
| Apple | We could hold the LS till the end of this RAN1 meeting to see if more relevant agreements are made.  |
| CATT | Agree with apple’s view. Let’s wait for the end of this meeting. |
| LG | Agree with Apple’s view. |
| Samsung | Agree with Apple’s view, waiting for the end of this meeting. |
| Nokia, Nokia Shanghai Bell | Agree with Apple view. We better wait for end of meeting and provide updated agreements. However, we should be aware that RAN2 people are also capable of reading minutes of RAN1 meetings, so preferably the information provided in LS response should add on top of existing agreements. |
| Moderator quick summary | Yes, we can wait until the end of the meeting to check if new agreements are available.  |
| ZTE | Agree, we need to hold the reply for this LS, at least for this question. The reply with more concrete is benefical for RAN2’s decision  |
| Ericsson | Agree with Moderator’s proposal and also with Apple’s view that we should capture any relevant agreements made during this meeting in the reply LS. |

For Q1(ii), RAN1 has not yet achieved agreement on the periodicity that the parameters have to be broadcasted. Thus, we cannot provide answers to RAN2.

**Moderator’s suggestion:**

1. Indicate to RAN2 that RAN1 has not reached agreement on the periodicity of the broadcasted parameters for TA pre-compensation.
2. Make the feature lead of AI 8.4.2 aware that RAN2 is waiting for RAN1’s answer on this topic.

**Company’s view of 1st round**

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| Company name | Comments and views |
| APT | Agree. However, we already have possible candidates and their periodicity in some t-docs, e.g., * Ephemeris: 60s
* Common TA: 80ms
* Common TA drift rate: 1s
* Common TA drift rate variation: 6s

Numbers may need to check whether it shall be calculated by CP/2 or Te, and whether considering the worst-case delay variation of 93 or ~~40~~ µs/sec. |
| Apple | We do not need to explicitly mention the second point.  |
| CATT | So far no need this reply.  |
| LG | Agree. For the second bullet, we share the view with Apple. |
| Qualcomm | Agree |
| Samsung | No need to mention |
| Nokia, Nokia Shanghai Bell | When drafting the response it is crucial that we highlight that the update rates would be the largest allowed periodicity, and to support faster synchronization to a cell, these periodicities could be lower. Further, in terms of the TA and TA drift rate for the ephemeris, it should be highlighted that other and alternative solutions may not need such high update rates (for instance broadcasting the GW location). So this should either be included to complete the picture, or the response should be delayed until RAN1 has the complete information. Agree with Apple on the second point. |
| Moderator quick summary | Apple, LG, QC, Samsung think that we don’t reply to RAN2 for this question. APT proposes to reply with possible candiadate values* Ephemeris: 60s
* Common TA: 80ms
* Common TA drift rate: 1s
* Common TA drift rate variation: 6s

Nok proposes that the informed update rate should include a range, e.g. from the lowest periodicity to the highest periodicity. Network can select an appropriate value according the deployment needs. Moreover, the periodcity range also depends on the solution to be employment at least considering with and without GW location broadcasting, respectively.  |
| ZTE | Agree with previous companies, that this Q should be delayed for replying. We can wait for the agreement including granularity. Then, both RAN1 and RAN2 can further check the proper frequency for update and configuration of periodicity. |
| Ericsson | We agree with 1) while 2) can be assumed known by FL already.We should agree on solutions for common TA before providing numbers on the periodicity to RAN2.We should distinguish different periodicities:* Broadcast periodicity (how often parameters are broadcast)
* Broadcast update periodicity (how often broadcast parameters are updated)
* UE update periodicity (how often UE has to reacquire the parameters)

We could ask RAN2 for clarification on which of these they are asking for. |

## Answers to Q2

The next questions asked by RAN2 are the following

1. how UE determines UE-gNB RTT
2. what additional information needs to be broadcasted other than that for TA pre-compensation, if any.

For Q2(i and ii), there are 4 companies have provided their contribution to the questions.

Huawei: ***Observation 2:*** *UE-gNB RTT can be determined by* $N\_{TA,common}$*,* $N\_{TA,UE-specific}$ and *Kmac*.

OPPO: Regarding the Q2, there seems to be a common understanding among RAN1 group that when the DL/UL timing is aligned at gNB side, the UE can directly derive the gNB-UE RTT from the TA used for PRACH transmission. On the other hand, when the DL/UL timing is not aligned at gNB side, additional offset may be broadcasted to the UE, and the gNB-UE RTT can be derived from the TA used for PRACH transmission and the broadcasted offset.

ZTE: ***Proposal 2:*** *Capturing following information in the reply LS to RAN2 w.r.t Q2:*

*From RAN1’s perspective, the following information can be considered as reference for UE to determine the UE-gNB RTT information:*

* *Pre-compensated TA including common TA and UE-specific TA for service link*
* *UE-specific K\_offset*

LG: In order to cover gNB-UE RTT in timing relationship enhancement in NTN, RAN1 agrees to introduce K\_offset in the initial access and it can be updated after initial access. This value may be larger than actual gNB-UE RTT.

Based on company’s contributions, it seems that there are different opinions about the UE-gNB RTT determination. Below are different options:

UE-gNB RTT is derived from

Option 1: Pre-compensated TA and UE-specific K\_offset

Option 2:$N\_{TA,common}$*,* $N\_{TA,UE-specific}$ and *Kmac*

Option 3: Pre-compensated TA and *Kmac*

Option 4: Cell-specific K\_offset or updated K\_offset after initial access

**Moderator proposal**: please provide your views on which option can correctly determine the UE-gNB RTT.

**Company’s view of 1st round**

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| Company name | Comments and views |
| APT | R1-2105668 InterDigital’s proposal is missing because they submitted their proposal in 8.4.2.* Proposal-1: support to introduce an additional parameter to indicate feeder link RTT separately from the common TA.

UE-gNB RTT might be used for initial access, e.g., the start of the RAR window. In this case, UE-specific K\_offset does not exist yet, and the cell-specific K\_offset in SI is the worst-case assumption that ignores UE-satellite RTT calculated by the UE. Finally, Kmac still needs some discussion whether it is cell-specific or UE-specific.APT proposes to separate this discussion into two cases1. RP at the gNB: the TA used for PRACH transmission.
2. Others: Pre-compensated TA (UE-satellite RTT) + **new offset (satellite-gNB RTT) via SI.**

Common TA needs symbol-level accuracy, but this new offset only needs slot-level accuracy. |
| Apple | We support Option 2, but it still needs agreements (probably in 8.4.1) on the usage of Kmac in determining UE-gNB RTT.  |
| CATT | AI 8.4.1 discussion is on-going, just wait it. |
| LG | As commented in the email, we think option 2 and 4 can be utilized for UE-gNB RTT determination. We also fine to wait for the further agreement in AI 8.4.1. |
| Qualcomm | Note that UE-gNB RTT is at least agreed by RAN2 to be used as the time duration between PRACH transmission and RA-response window start. In RAN1, we have not agreed to ensure UE knows exactly UE-gNB RTT. Both common offset and Kmac can be larger than feeder link RTD. As a result, we should make it celar to RAN2 the following:1. RAN1 has not determined to enable UE acquire exact UE-gNB RTT.
2. Based on the existing agreement, UE can estimate UE-gNB RTT by UE specific TA +Kmac; or if Kmac is not signalled, UE can estimate UE-gNB RTT by UE specific TA+common offse. Both of the above two will lead to an estimate larger than or equal to UE-gNB RTT.
 |
| Samsung | Before reaching the agreement in RAN1, we don’t need to include this in the LS, while this is being discussed in AI 8.4.1. We think Option 4 can be used. |
| Nokia, Nokia Shanghai Bell | To a large extend we agree with Qualcomm on this matter. At present we do not have any means to make an accurate estimate of the gNB-UE RTT. Once more, we would like to highlight that for the case where the gNB provides the *referenceTimeInfo-r16*, it would really simple for the UE to calculate the **exact** gNB-UE RTT, irrespective of the provide ephemeris information. Further, it should be noted that it is crucial that the UE estimates the accurate RTT, since over- or under-estimating the value would cause the RA response window to be placed at the wrong location in time and could create error cases for the RA monitoring. |
| Moderator suggestion | AI 8.4.1 proposal 2 is still under discussion. Wait until 8.4.1 progress by the end of this meeting.  |
| ZTE | Share same views with moderator. |
| Ericsson | Ue should derive UE-gNB RTT according to Option2/Option 3, i.e., pre-compensated TA + Kmac (assuming “pre-compensated TA” means UE-specific TA + common TA). |

## Answers to Q3

RAN1 has not reached any concrete agreements on the UE TA reporting and this topic is under discussion in AI 8.4.2 issue #8. Thus, we can wait for the RAN1 progress before sending any answers to RAN2.

**Moderator proposal:**

1. Wait for the RAN1 discussion progress under AI 8.4.1 issue#1. If no decision in RAN1#105-e meeting, indicate to RAN2 that answer to Q3 is not yet available.
2. Make feature lead of AI 8.4.1 aware that RAN2 is waiting for RAN1’s input on this topic.

**Company’s view of 1st round**

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| Company name | Comments and views |
| APT | Agree |
| Apple | We do not need to explicitly mention the second point. |
| CATT | No need it. TA reporting is unclear so far. |
| LG | Agree. For the second bullet, we share the view with Apple. |
| Qualcomm | Agree |
| Samsung | No need to mention. |
| Nokia, Nokia Shanghai Bell | Agree to point #1. No need to address or explicitly mention point #2. |
| Moderator suggestion | Wait until the end of the RAN1 meeting.  |
| ZTE | We need to wait for the concrete agreement. |
| Ericsson | We agree with 1) while 2) can be assumed known by FL already. |

# References

R1-2104230 LS on TA pre-compensation RAN2, OPPO

R1-2104775 Discussion on LS on TA pre-compensation OPPO

[R1-2105198](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105198.zip) Discussion on LS on TA pre-compensation ZTE

[R1-2105481](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105481.zip) Draft reply LS on TA pre-compensation LG Electronics

[R1-2105931](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_105%5CDocs%5CR1-2105931.zip) Discussion on TA pre-compensation Huawei, HiSilicon