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. |

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 |

## 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.
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| 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. |

## 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. |

# 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