3GPP TSG RAN WG1 Meeting #106e R1-xxxxxx

**e-Meeting, August 16th – 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 RAN1#105-e 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. |

In RAN1#105-e meeting, we have responded to RAN2 with a reply LS R1-2106341, where we provided our answer to Q2

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| **RAN2 Q2**: 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.**RAN1 answer**: In RAN1#105-e meeting, RAN1 reached the following agreement on UE-gNB RTT determination, which is used to delay the starts of ra-ResponseWindow and msgB-ResponseWindow. The UE-gNB RTT is estimated according to the UE's TA and K\_mac. RAN2 may take this information into account for future discussion. Agreement:The starts of ra-ResponseWindow and msgB-ResponseWindow are delayed by an estimate of UE-gNB RTT. * The estimate of UE-gNB RTT is equal to the sum of UE’s TA and K\_mac.

Note 1: The UE’s TA is based on the RAN1#104bis-e agreement on Timing Advance applied by an NR NTN UE given by  $N\_{TA}=\left(N\_{TA}+N\_{TA, UE-specific}+N\_{TA,common}+N\_{TA,offset}\right)×T\_{c}$$T\_{TA}=\left(N\_{TA}+N\_{TA, UE-specific}+N\_{TA,common}+N\_{TA,offset}\right)×T\_{c}$. The estimate of gNB-satellite RTT is equal to the sum of $N\_{TA,common}×T\_{c}$ and K\_mac.  How to treat $N\_{TA}$ and $N\_{TA,offset}$ can be further discussed.Note 2: According to the RAN1#104bis-e agreement: When UE is not provided by network with a K\_mac value, UE assumes K\_mac = 0.Note 3: The accuracy of the estimated UE-gNB RTT with respect to the true UE-gNB RTT can be further discussed.Note 4: Other options of determining the estimate of UE-gNB RTT can be further discussed. |

In this document, we continue discussing whether RAN1 can provide answers to the rest of the questions.

# 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

Agreement:

Specifications should support delivery of ephemeris information using both ephemeris formats, i.e., state vectors and orbital elements.

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:**

For RAN2 question (i): 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

For RAN2’s question (ii): no answer can be given in the reply LS.

**Company’s view**

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| Company name | Comments and views |
| Lenovo/MM | We are generally fine with the draft LS. Meanwhile, we prefer “common TA” to be replaced by “common TA related parameteres” as we are still discussing whether to signal common TA, common TA drift rate, common TA drift rate variation in agenda 8.4.2. Or alternatively, we can wait for the discussion result of 8.4.2.There is also “how often the broadcasted parameters are expected to change over time” in Q1, and we think further discussion on this aspect is necessary. And it may contain two aspects: How often the parameter is changed in SI information and how often the UE needs to acquire the new parameter? |
| LG | We are also generally ok with draft LS. As commented by Lenovo, how the UE determines/estimates a common TA is still under discussion in 8.4.2. Thus, we could hold the LS till the end of this RAN1 meeting. |
| Nokia, Nokia Shanghai Bell | As stated by Lenovo, there are still discussions related to how the information is provided for the UE to derive the Common TA. Actually, RAN1 is waiting for a LS response from SA1 and SA3 on this matter – related to our question on providing the NTN-GW/gNB position for allowing easy method for the UE to calculate the feeder link delay. Since this method has not been precluded, our preference would be replace “Common TA” with “information that may be used to derive/calculate the Common TA”. |

## Answers to Q3

Wait until RAN1 agreement, no answer at the moment to be provided to RAN2.

**Company’s view**

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| Company name | Comments and views |
| Lenovo/MM | We may wait for the discussion result on 8.4.1. |
| LG | Ok with FL’s assessment. |
| Nokia, Nokia Shanghai Bell | OK to wait for RAN1 agreement. One option could be to provide response to Q2 right away to allow RAN2 to take the information into account during this meeting, while we are still waiting for response to settle for Q3. |

# References

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

R1-2106341 Reply LS on TA pre-compensation RAN1, OPPO

R1-2107706 Discussion on RAN2 LS on TA Pre-compensation, Apple