3GPP TSG-RAN WG1 Meeting #108-e R1- 220xxxx

e-Meeting, February 21th – March 3rd, 2022

Agenda Item: 8.4.2

Source: Moderator (Thales)

Title: FL Summary #2: Maintenance on UL time and frequency synchronization for NR NTN

Document for: Discussion

# Introduction

This feature lead summary document captures the remaining/maintenance issues related to UL time and frequency synchronization in NR NTN. It contains a summary of the contributions under 8.4.2 at TSG-RAN WG1 #108-e. together with identified remaining key open issues and recommends topics/questions to be handled via email discussions.

A total of 21 TDocs have been identified for discussion in [108-e-R17-NR-NTN-02]: please see the Appendix for the details, with all the observations and proposals.

Identified topics and issues are listed within the table of content below.

|  |
| --- |
| Please note the following checkpoints for agreements:[108-e-R17-NR-NTN-02] Email discussion for maintenance on UL time and frequency synchronization – Mohamed (Thales)* 1st check point: February 25
* Final check point: March 3
 |

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# [Active] Topic#1 NTA at Initial access

The following Working assumption was made at RAN1#107-e:

|  |
| --- |
| Working assumption:When TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:* Option 1: $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.

Where, $T\_{A}$ is the TAC field in msg2/msgB |

This working assumption is to be revisited in current meeting.

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| THALES | Proposal 3: Confirm the following working assumption made at RAN1#107-e:When TAC ($T\_{A}$) in msg2/msgB is received. UE receives the first adjustment and $N\_{TA}$ is updated as:$N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$. Where. $T\_{A}$ is the TAC field in msg2/msgB |
| CATT | 1. Confirm working assumption:

When TAC ($T\_{A})$ in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as follows:$N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.  $where T\_{A} is the TAC field in msg2/msgB$.1. 5bit of TAC can be used to support the scope of $T\_{A}$ in the initial access considering different subcarrier intervals.
 |
| NTT DOCOMO, INC. | **Proposal 3:** Confirm the working assumption made in 107-e meeting: When TAC ($T\_{A})$ in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:$N\_{TA}=T\_{A}. 16.\frac{64}{2^{μ}} $ , where $T\_{A} $is the TAC field in msg2/msgB |
| Spreadtrum Communications | **Proposal 1:** Confirm the Working assumption on on TA update in RRC\_CONNECTED state:Working assumption:When TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:* Option 1: $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.

where, $T\_{A}$ is the TAC field in msg2/msgB |
| Apple | **Proposal 1:** Confirm the working assumption that when TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$, where $T\_{A}$ is the TAC field in msg2/msgB.  |
| CMCC | Proposal 2:Confirm the above working assumption. When TAC ($T\_{A})$ in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as follows:* $N\_{TA}=T\_{A}. 16.\frac{64}{2^{μ}}$

where,$ T\_{A}$ is the TAC field in msg2/msgB. |
| Samsung | **Proposal 1**: Confirm the following working assumption:When TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:* Option 1: $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$,

where, $T\_{A}$ is the TAC field in msg2/msgB. |
| Qualcomm  | **Proposal 1:** When TAC ($T\_{A})$ in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as follows:$N\_{TA}=−128. 16.\frac{64}{2^{μ}}+T\_{A}. 16.\frac{64}{2^{μ}} $ ,$where, T\_{A} is the TAC field in msg2/msgB$. |
| LG Electronics | Proposal 1. Confirm the following working assumption:Working assumption:When TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:* Option 1: $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.

where, $T\_{A}$ is the TAC field in msg2/msgB |

## Initial proposal and companies views’ collection for 1st round

The situation remains the same as in previous RAN1 meeting:

* The vast majority is supportive of option 1 and proposed to confirm the working assumption.
* [Qualcomm] proposed to support a negative old NTA value when $N\_{TA}$ is updated at the UE after receiving TAC (T\_A) in msg2/msgB is received. The reason given by Qualcomm is recopied hereafter:

|  |
| --- |
| **R1-2202138** – Qualcomm:During initial access, a PRACH transmission may arrive earlier than the start of a PRACH occasion. Without the support of TA commands of negative values (i.e., delays), subsequent UE UL transmissions can all have negative timing until a TA command with a negative timing advance is received during connected mode. According to RAN4 LS R1-2200869 [R1-2200869/R4-2120311], the transmit timing error requirements for FR1 are established for both PRACH transmission and the first transmission in a DRX cycle. The required timing accuracy is well within half of the CP. However, for FR2 or FR3, same accuracy requirement may lead to a timing error close to or larger than the CP. Further tightening of the requirement for PRACH transmission would mean unnecessarily tight requirement on GNSS accuracy. Hence, without further delay of the specification and to avoid different specification on the subject between FR1 and FR2, negative NTA values in Msg2/MsgB should be supported. |

Moderator view: As long as the UE initial transmission error does not exceed Te\_NTN specified by RAN4 (At FR1: 30% of CP in case of SCS of uplink signals is 30 kHz and only 18% of CP in case of 15 kHz) an over-estimation of Initial TA estimation is not a major issue, at least at FR1.

The Initial proposal 1 is made as follows:

**Initial Proposal 1:**

Confirm the following working assumption made at RAN1#107-e:

When TAC ($T\_{A}$) in msg2/msgB is received. UE receives the first adjustment and $N\_{TA}$ is updated as:

$N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.

Where. $T\_{A}$ is the TAC field in msg2/msgB

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | Support the proposal. |
| Ericsson | Support. |
| QC | In TN, initial transmission timing error requirement does not apply to PRACH. Although it’s RAN4’s responsibility to define timing requirement for PRACH, RAN1 should be careful not to extend the conclusion based on requirements in FR1 to FR2. For negligible impact on performance for 120 kHz, the initial transmission error will have to be less than 0.3 us. This would mean an overly tight requirement on GNSS and/or downlink synchronization that may seriously limit the NTN deployment. To ensure consistent specification for FR1 and beyond, we should allow negative N\_TA values. |
| Apple | Support the proposal. |
| ZTE | Support |
| NTT DOCOMO, INC. | Support the proposal. |
| Huawei, HiSilicon | Support |
| NEC | Support Initial Proposal 1.  |
| Panasonic | Agreed |
| Xiaomi | Support Initial Proposal 1. |
| Sony | Support. |
| Intel | Support |
| Baicells | Support |
| MediaTek | Support |
| CMCC | Support |
| Samsung | Support |
| CATT | Support |
| LG | Support |
| Lenovo | Support moderator’s proposal. |
| Thales | Support |

## Updated proposal and companies views’ collection for 2nd round

20 companies provided views during first round of email discussion. The vast majority is supportive of Initial proposal 1.

Based on the views expressed during first round, the following proposal is made. It should be discussed during a GTW session.

**Updated Proposal 1:**

Confirm the following working assumption made at RAN1#107-e:

When TAC ($T\_{A}$) in msg2/msgB is received. UE receives the first adjustment and $N\_{TA}$ is updated as:

$N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.

Where. $T\_{A}$ is the TAC field in msg2/msgB

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Moderator | The proposal is being discussed via the reflector for mail endorsement |
| LG | Support |
| Sony | Support the updated proposal. |
| Panasonic | Support |
| ZTE | Support |

# [Closed] Topic#2 Combination of open and closed loop TA control

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| MediaTek Inc. | **Proposal 3**: RAN4 can further discuss and conclude on combination of open and closed loop TA control in NTN. |
| CATT | 1. On the double-correction of close-loop TA and open-TA, implementation specific way can be used to resolve this issue.
 |
| Spreadtrum Communications | **Proposal 2:** The solution to resolve the issue on combination of open and closed loop TA control is up to the UE implementation to meet the RAN4 gradual timing adjustment requirement. |
| Nokia, Nokia Shanghai Bell | **Observation 1:** Operation of closed loop and open loop TA control in RRC connected state needs careful design to avoid instability due to erroneous calculation of the UE-specific TA value by the UE.**Observation 2:** If TAC is generated to fix a temporary deviation in the UE transmission timing, when UE updates their autonomous components on the timing advance formula, there may be an overcompensation of the timing advance, generating a similar deviation on the opposite direction (Figure 8).**Observation 3:** If TAC is generated to introduce an offset in UE timing due to gNB internal optimizations, the TAC should be applied regardless of UE accuracy for timing estimation. **Observation 4:** In order to guarantee TA update loop stability, two operation states for TAC update are needed.**Proposal 1:** The update rate that the UE applies for both the UE-specific TA and Common TA should be such that the applied TA fulfilles the RAN4 time synchronization requirements.**Proposal 2:** The Common TA should be calculated in a deterministic way and applied at the same time for all UEs.**Proposal 3:** For UE in RRC connected mode, in case closed loop TA control is used, open loop TA control should be applied only in a way that does not impact the stability and accuracy as provided by closed loop TA control.**Proposal 4:** The gNB should be able to use the closed-loop solution (Timing Advance Commands over DL MAC-CE) at any time. **Proposal 5:** The TAC should operate in two different states to allow both differential and absolute indication of the TAC updates.**Proposal 18:** RAN1 to send LS to RAN4 in order to clarify the additional aspects that would need to be considered related to the sudden jumps in the UE transmit timing due to UE reading updated information for the serving satellite ephemeris. |
| Apple | **Proposal 2:** For the double correction issue, RAN1 to wait for RAN4’s final decision before concluding the RAN1 discussion. * In case gradual timing adjustment requirement applies, RAN1 to define the reference timing when new GNSS position or new ephemeris parameters are applied.
 |
| Xiaomi | **Proposal 1:** The solution to resolve the issue on combination of open and closed loop TA control is up to the UE implementation to meet the RAN4’s requirements. |
| Samsung | **Proposal 2**: Each of the following options are supported based on the gNB configuration:* Closed-loop TA control
* Open-loop TA control
* Combination of open&closed-loop TA control
 |
| Baicells | **Observation 1:** Due to the large RTT in NTN, repeated TA adjustment may be a more prominent problem in NTN.**Proposal 1:** To ensure TA adjustment can handle both the large TAC latency and high speed UE movement, RAN1 shall wait for the RAN4’s requirement and determine whether RAN1 need additional measures to solve this issue. |
| NEC | **Proposal 2.** The combination of open and closed loop TA control is up to the UE implementation to meet the RAN4 gradual timing adjustment requirement. |

## Initial proposal and companies views’ collection for 1st round

The issue related to the combination of open and closed loop TA control and the possible “double-correction” was discussed in 9 contributions:

According to [MediaTek, Apple, Baicells ] RAN4 can further discuss. RAN1 will re-examine the issue after RAN4 reply.

For [CATT, Spreadtrum Communications, Xiaomi, NEC] the issue can be solved by UE implementation to meet the RAN4 gradual timing adjustment requirement.

[Nokia, Nokia Shanghai Bell] proposed for RAN1 to send LS to RAN4 in order to clarify the additional aspects that would need to be considered related to the sudden jumps in the UE transmit timing due to UE reading updated information for the serving satellite ephemeris

Moderator note: The Reply LS R1-2200870(R4-2120417) from RAN4 was already discussed at RAN1#107-e. The issue is still within the hands of RAN4. RAN1 to wait for RAN4’s final decision before concluding the RAN1 discussion.

**Initial Proposal 2:**

RAN1 to wait for RAN4’s final decision before concluding the RAN1 discussion on “double-correction” issue

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | According to the RAN4 reply to the LS [R1-2200870] originally sent by RAN1, RAN4 does not plan to provide further input to this. Therefore, we propose RAN1 to specify solutions to mitigate the “double correction” issue, such as the TAC operation in two different states to allow both differential and absolute indication of the TAC updates. Further, as outlined in our contribution there are additional aspects of sudden jumps in the UE applied TA whenever a UE updates its information related to serving satellite ephemeris and Common TA, and thereby abruptly cancels any systematic TA error that has accumulated in the system (which the gNB would have been tracking using regular TA commands). At the same time RAN1 sends an LS to RAN4 with the question to clarify whether there are additional aspects to be considered related to the sudden jumps in the UE transmit timing due to UE reading updated information for the serving satellite ephemeris.  |
| Ericsson | Fine to wait for final decision from RAN4. |
| QC | Agree with the Moderator. |
| Apple | We are fine with the proposal. Nokia’s suggestion of addressing this issue in RAN1 directly is also fine to us.  |
| ZTE | Support |
| NTT DOCOMO, INC. | Support. Re-examining the final decision of RAN4 is fine for us. |
| Huawei, HiSilicon | Support the FL proposal. |
| NEC | We are fine with this.  |
| Panasonic | OK |
| Xiaomi | Support Initial Proposal 2. |
| Sony | Support. |
| Intel | Based on RAN4 LS (R1-2200870) our understanding is that RAN4 will work to solve the issue of double correction by defining requirements. So, in our view there is no need to work on it in RAN1 unless RAN4 request RAN1 input. |
| Baicells | Support FL Initial Proposal 2. |
| MediaTek | Support |
| CMCC | Fine with the proposal. |
| Lockheed Martin | Agree |
| Interdigital | Ok |
| Samsung | OK |
| CATT | OK |
| LG | OK with proposal |
| Lenovo | If there will be a RAN4 reply, we are fine to wait for it. Otherwise, we prefer to define a reference time instance for TA MAC CE determination, so the “double correction” issue can be solved by UE with help of orbit propagation. |

## Updated proposal and companies views’ collection for 2nd round

Based on first round of email discussions, the moderator would recommend to not discuss the issue on “double-correction” before receiving the RAN4’s final LS Reply.

**FL Recommendation:**

RAN1 to wait for RAN4’s final decision before concluding the RAN1 discussion on “double-correction” issue

#  [Active] Topic#3 Maintenance on Serving satellite ephemeris format bit allocations

The following working assumption on serving satellite ephemeris format bit allocations was made at RAN1#106-bis-e meeting and confirmed at RAN1#107-e [1]:

|  |
| --- |
| **Agreement**Confirm the working assumption made at RAN1#106-bis-e on serving satellite ephemeris bit allocations for LEO/MEO/GEO based non-terrestrial access network:* Support serving satellite ephemeris format bit allocations for LEO/MEO/GEO based non-terrestrial access network:
	+ Position and velocity state vector ephemeris format is 17 bytes payload.
		- The field size for position (m) is 78 bits
			* Position range is driven by GEO : +/- 42 200 km
			* The quantization step is 1.3m for position
		- The field size for velocity (m/s) is 54 bits
			* Velocity range is driven by LEO@600 km: +/- 8000 m/s
			* The quantization step is 0.06 m/s for Velocity
	+ Orbital parameter ephemeris format 18 byte payload
		- Semi-major axis α (m) is 33 bits
			* Range: [6500, 43000]km
		- Eccentricity e is 19 bits
			* Range: ≤ 0.015
		- Argument of periapsis ω (rad) is 24 bits
			* Range: [0, 2π]
		- Longitude of ascending node (Ω rad) is 21 bits
			* Range: [0, 2π]
		- Inclination i (rad) is 20 bits
			* Range: [- π/2 , + π/2]
		- Mean anomaly M (rad) at epoch time to is 24 bits
			* Range: [0, 2π]
 |

## Companies’ contributions summary

Companies proposals regarding Topic#1 submitted to RAN1#108-e are collected in the following table:

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| Thales | **Observation 2.** When the network indicates ephemeris using Keplerian/orbital parameter format with the bit allocation agreed in RAN1#107-e. satellite position errors at the UE are high. An optimal quantization step is needed for Keplerian orbital parameters.**Observation 3.** An optimal bit allocation in 21 bytes (instead of the 18 bytes as agreed in RAN#107-e) improves significantly the Satellite position and velocity prediction at the UE.Proposal 1:Modify bit allocations for orbital parameters ephemeris format as follows:* Orbital parameters are indicated in 21 bytes payload:
	+ - Semi-major axis α (m) is 33 bits
			* Range: [6500. 43000]km
			* The quantization step is 4.2 $×10^{−3}$m
		- Eccentricity e is 20 bits
			* Range: ≤ 0.015
			* The quantization step is 1.4 $×10^{−8}$
		- Argument of periapsis ω (rad) is 28 bits
			* Range: [0. 2π]
			* The quantization step is 2.3 $×10^{−8}$ rad
		- Longitude of ascending node (Ω rad) is 28 bits
			* Range: [0. 2π]
			* The quantization step is 2.3 $×10^{−8}$ rad
		- Inclination i (rad) is 27 bits
			* Range: [- π/2 . + π/2]
			* The quantization step is 2.3 $×10^{−8}$ rad
		- Mean anomaly M (rad) at epoch time to is 28 bits
			* Range: [0. 2π]
			* The quantization step is 2.3 $×10^{−8}$ rad
 |

## Initial proposal and companies views’ collection for 1st round

Moderator note: Based on the simulation provided by Thales in [R1-2201011], the quantization step used for Keplerian/orbital parameter format with the bit allocation agreed in RAN1#107-e is non-optimal.

For Keplerian/orbital parameter format, an optimal bit allocation in 21 bytes (instead of the 18 bytes as agreed in RAN#107-e) improves significantly the satellite position and velocity prediction at the UE.

Hopefully we can converge on this issue in first week of the meeting. Indeed, an agreement on this topic is also needed for LS reply to RAN2 (R1-2200875 LS on NTN-specific SIB) and to update RRC parameters list.

The initial proposal is made as follows:

**Initial Proposal 3**

Modify bit allocations for orbital parameters ephemeris format as follows:

* **Orbital parameters are indicated in 21 bytes payload:**
	+ - **Semi-major axis α (m) is 33 bits**
			* **Range: [6500. 43000]km**
			* **The quantization step is 4.2** $×10^{−3}$**m**
		- **Eccentricity e is 20 bits**
			* **Range: ≤ 0.015**
			* **The quantization step is 1.4** $×10^{−8}$
		- **Argument of periapsis ω (rad) is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Longitude of ascending node (Ω rad) is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Inclination i (rad) is 27 bits**
			* **Range: [- π/2 . + π/2]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Mean anomaly M (rad) at epoch time to is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**

Companies are encouraged to provide inputs within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | OK |
| Ericsson | OK |
| QC | OK |
| Apple | We are fine with the proposal. |
| ZTE | OK. |
| NTT DOCOMO, INC. | OK |
| Huawei, HiSilicon | The total number of bits in the proposal is larger compared to the agreement in RAN1#107-e. In general, we support to have some further study on the bit allocations for orbital parameters ephemeris format. According to the our evaluations in the RAN1#107-e [R1-2110805], orbital parameters ephemeris designed for different orbital types (LEO,MEO and GEO) shows better performance considering the overhead compared to the unified design. |
| NEC | OK.  |
| Panasonic | Support |
| Xiaomi | Support Initial Proposal 3. |
| Intel | OK |
| Baicells | OK |
| MediaTek | Support |
| CMCC | OK |
| Lockheed Martin | Support |
| Samsung | OK |
| CATT | OK |
| LG | We can support the intention to reduce the UL timing error.  |
| Thales | Ok |

## Updated proposal and companies views’ collection for 2nd round

19 companies provided views during first round of email discussions. All companies are supportive of Initial Proposal 3. Huawei proposed to have some further study on the bit allocations for orbital parameters ephemeris format.

Moderator note: the optimal bit allocation in Initial Proposal 3 is not only beneficial for LEO scenario but more importantly it is essential in case of GEO for which the precision of orbit determination could be degraded because of limited number of GNSS satellite in view. For example in case of Keplerian/orbital parameter with bit allocation as agreed in RAN1#107 and PROPAGATION MODEL in UE : KEPLER, the Satellite position error at the UE (m) could be up to 184.8 m which is not acceptable.

Based on the views expressed during first round. Moderator view is to discuss this proposal in the upcoming GTW session. Hopefully we can converge on this issue in first week of the meeting. Indeed, an agreement on this topic is also needed for LS reply to RAN2 (R1-2200875 LS on NTN-specific SIB) and to update RRC parameters list:

**Updated Proposal 3**

Modify bit allocations for orbital parameters ephemeris format as follows:

* **Orbital parameters are indicated in 21 bytes payload:**
	+ - **Semi-major axis α (m) is 33 bits**
			* **Range: [6500. 43000]km**
			* **The quantization step is 4.2** $×10^{−3}$**m**
		- **Eccentricity e is 20 bits**
			* **Range: ≤ 0.015**
			* **The quantization step is 1.4** $×10^{−8}$
		- **Argument of periapsis ω (rad) is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Longitude of ascending node (Ω rad) is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Inclination i (rad) is 27 bits**
			* **Range: [- π/2 . + π/2]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Mean anomaly M (rad) at epoch time to is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**

Companies are encouraged to provide inputs within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Moderator | The proposal is being discussed via the reflector for mail endorsement |
| LG | We directly replied to the email thread with our views, but for the convenience, we share it as follows:**Updated Proposal 3a**Modify bit allocations for orbital parameters ephemeris format as follows:* **Orbital parameters are indicated in 21 bytes payload:**
	+ - **Semi-major axis α (m) is 33 bits**
			* **Range: from 6500 km to 43000 km**
			* **The quantization step is (43000000-6500000)/(233-1) m (Note: this is approximately 4.2**$×10^{−3}$ **m)**
		- **Eccentricity e is 20 bits**
			* **Range: ≤ 0.015**
			* **The quantization step is 0.015/(220-1) (Note: this is approximately 1.4** $×10^{−8})$
		- **Argument of periapsis ω (rad) is 28 bits**
			* **Range: from 0 to 2π**
			* **The quantization step is 2π/(228-1) rad (Note: this is approximately 2.3** $×10^{−8}$ **rad)**
		- **Longitude of ascending node ~~(~~Ω (rad) is 28 bits**
			* **Range: from 0 to 2π**
			* **The quantization step is 2π/(228-1) rad (Note: this is approximately 2.3** $×10^{−8}$ **rad)**
		- **Inclination i (rad) is 27 bits**
			* **Range: from - π/2  to + π/2**
			* **The quantization step is π/(227-1) rad (Note: this is approximately 2.3** $×10^{−8}$ **rad)**
		- **Mean anomaly M (rad) at epoch time to is 28 bits**
			* **Range: from 0 to 2π**
			* **The quantization step is 2π/(228-1) rad (Note: this is approximately 2.3** $×10^{−8}$ **rad)**
 |

# [Active] Topic#4 Ephemeris format for HAPS

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| NTT DOCOMO, INC. | **Observation 4:** The position and velocity state vector ephemeris format for HAPS scenario should be introduced with different bit allocations**Proposal 7:** The position and velocity state vector ephemeris format for HAPS is supported as the following.* Position and velocity state vector ephemeris format 12 bytes payload.
	+ The field size for position [m] is 54 bits
		- Position range is driven by HAPS: +/- 50 km
		- The quantization step is 0.38m for position
	+ The field size for velocity [m/s] is 42 bits
		- Velocity range is driven by HAPS: +/- 140 m/s
		- The quantization step is 0.017 m/s for Velocity
 |
| InterDigital, Inc. | **Proposal-1:** Ephemeris format is determined based on NTN scenario without indication.**Proposal-3:** State vector ephemeris format is supported for HAPS.**Proposal-2:** State vector is used for GEO/HAPS and orbital elements is used for LEO |
| Ericsson | **Observation 1** It is unclear if serving satellite ephemeris is needed for HAPS since the propagation delay and Doppler shift are similar or equivalent to those in a terrestrial network.**Observation 2** If serving satellite ephemeris is broadcast for a HAPS, the UE must be aware that the non-terrestrial node is a HAPS rather than a satellite since satellite orbit propagation models do not work for HAPS.[Proposal 5 If serving satellite ephemeris is broadcast for a HAPS, one of the existing serving satellite ephemeris formats can be used without modification.](#_Toc95768508)[Proposal 6 It can be left to UE implementation to detect that a non-terrestrial node is a HAPS.](#_Toc95768509) |
| ZTE | **Proposal 3:** Confirm that the agreed position and velocity state vector ephemeris format for LEO/MEO/GEO is also applied for HAPS/ATG. |

## Initial proposal and companies views’ collection for 1st round

Moderator note: The agreement on the satellite ephemeris format bit allocations for LEO/MEO/GEO was made in the last RAN1#107-e meeting. However RAN1#107-e agreement does not include serving satellite ephemeris information format for HAPS. Further discussion on Topic#4 is still needed.

NTT DOCOMO proposed a PV state vector based ephemeris format with an optimal bit allocation: 12 bytes payload instead of 17 bytes payload as agreed for LEO/GEO at RAN1#107-e.

Moderator view: An optimal payload for ephemeris format for HAPS may save 5 bytes compared to the bit allocation for PV state vector agreed in RAN1#107-e. However, as observed by Ericsson, the UE must be aware that the NTN is a HAPS. This may lead to further discussion on indicating a NTN-type flag to be indicated in SIB. But as already discussed in previous RAN1 meeting, an unified satellite ephemeris signalling is enough to make the system working, although it is not optimal and further optimization can be done in subsequent Release.

Moderator shares the same view as ZTE. The following Proposal is made:

**Initial Proposal 4:**

**Confirm that the agreed position and velocity state vector ephemeris format for LEO/MEO/GEO is also applied for HAPS/ATG**.

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | Agree with the basic principle, but it the intention that a specific set of UE features would be needed to support HAPS? Or would the intention rather be that HAPS can be used for addressing any UE supporting Rel-15 NR? |
| Ericsson | OK |
| QC | It’s unclear if PVT is always needed for HAPS/ATG. |
| Apple | Fine with the proposal |
| ZTE | Support, The indication of these parameters are optional for all scenarios based on the scheduling. |
| NTT DOCOMO, INC. | We support to apply the position and velocity format for HAPS. In addition, the current payload of 17 bytes leads to a very small quantization step for HAPS and a reduced payload for HAPS is preferred. |
| Huawei, HiSilicon | Both orbital and PVT based ephemeris can be applied for HAPS/ATG they can be transformed to each other. On the other hand, HAPS can also work without the need to support satellite ephemeris format. |
| NEC  | We are fine with this.  |
| Panasonic | Support |
| Intel | OK |
| MediaTek | Support |
| CMCC | OK. At least PV indication is needed for ATG.  |
| Lockheed Martin | Support |
| OPPO | We share similar view as QC, Nokia and Huawei that the PVT can be applied to HAPS, but we should not mandate the UE supporting TA compensation based on ephemeris, as in HAPS, this may not be a must.  |
| InterDigital | Support |
| Samsung | OK |
| CATT | OK |
| LG | Support.Furthermore, if initial proposal 4 is agreed, the RRC parameter names should be considered to change.(e.g., ServingSatelliteEphemerisStateVectorX 🡺 ~~ServingSatellite~~EphemerisStateVectorX) |
| Lenovo | Agree with the proposal. |

## Updated proposal and companies views’ collection for 2nd round

Large majority of companies is supportive of Initial Proposal 4. Some companies highlight that the PVT can be applied to HAPS, but we should not mandate the UE supporting.

Moderator shares the view that the enhancements for LEO are not necessarily required for HAPS scenarios when delay can be similar or equivalent values with those of terrestrial network. But in some deployment scenario, depending on the cell coverage area, r (maximum radius, the alpha (elevation) and d as seen in Figure below, timing compensation might be needed.



To Moderator, it make sense to confirm that the agreed position and velocity state vector ephemeris format for LEO/MEO/GEO is also applied for HAPS/ATG.

**Update Proposal 4:**

**Confirm that the agreed position and velocity state vector ephemeris format for LEO/MEO/GEO is also applied for HAPS/ATG**.

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Moderator | As per Chair guidance, the group may discuss if such proposal is neededAt least, RRC parameters list for NTN should be modified to implicitely support HAPS/ATG |
| LG | Support. Furthermore, if initial proposal 4 is agreed, the RRC parameter names should be considered to change.(e.g., ServingSatelliteEphemerisStateVectorX 🡺 ~~ServingSatellite~~EphemerisStateVectorX)By the way, according to the RAN4 discussion, ATG is not expected to be supported for Rel-17 NTN, and new WID for ATG will be held in Rel-18. Therefore, it should be considered when discussing this issue. |
| Lenovo | Support. |
| Panasonic | Support. However, during the GTW session, concerns were mentioned, that ephemeris data for HAPS may not be needed, and that the current agreement seems to mandate the use of PVT for HAPS. Hence, to address the concern we propose a small modification:**Update Proposal 4:****Confirm that the agreed position and velocity state vector ephemeris format for LEO/MEO/GEO is also applied for HAPS/ATG, if needed.** |
| ZTE | Support. Since the indication is optional, the case where PVT is not needed in HAPS/ATG is not excluded. |

# [Active] Topic#5 Validity duration for GEO

The following agreement was made at RAN1#107-e. And it is FFS whether additional NTN validity duration(s) is (are) needed for GEO NTN deployment.

|  |
| --- |
| AgreementNTN validity duration is configured per cell and indicated to the UE in X bits with:* + Value range { 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 120, 180, 240, Infinity}
	+ Unit is second
	+ FFS (to be resolved in current meeting): Additional values for GEO
 |

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| THALES | **Observation 4.** In Case of GEO based NTN. ntnUlSyncValidityDuration can be set to 15mn if the serving satellite ephemeris format is Keplerian-based with optimal bit allocation.Proposal 2NTN validity duration is indicated to the UE in 4 bits with:Value range { 5. 10. 15. 20. 25. 30. 35. 40. 45. 50. 55. 60. 120. 180. 240.900}Unit is second |
| MediaTek Inc. | **Proposal 2:** Add the GEO candidate values for UL validity timer: {300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800}.Validity timer duration is configured per cell and indicated to the UE in X=5 bits with:* Value range {5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 120, 180, 240, 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800}
* Unit is second
 |
| PANASONIC R&D Center Germany | **Proposal 1**: NTN validity duration is configured per cell and indicated to the UE in X bits with:* Value range {5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 120, 180, 240, Infinity}
* Unit is second
* Note: An infinite validity duration is subject to clause 5.2.2.2.1 in TS 38.331 on SIB validity setting it equal to a maximum of 3 hours.
 |
| NTT DOCOMO, INC. | **Proposal 5:** One additional large value other than “infinity” could be added on the value range of validity duration for GEO. |
| InterDigital, Inc. | **Proposal-4:** Support a larger value of validity timer for GEO scenario. |
| Apple | **Proposal 3:** An additional NTN validity duration value longer than 240 seconds is supported for GEO scenario.  |
| Ericsson | **Proposal 1** Add NTN validity duration values suitable for GEO, e.g., {900 s, 1800 s, 3600 s, 7200 s}. To limit the field size to 4 bits, other values could be removed, e.g., {25 s, 35 s, 45 s, 55 s} |
| CMCC | **Proposal 3:** ForNTN validity duration configuration, larger values than 240 seconds are needed for GEO scenario.**Proposal 4:** “Infinity” is not needed in the NTN validity duration value range for the case of GEO. |
| ZTE | **Proposal 1:** Additional validity duration value for GEO is not supported.  |

## Initial proposal and companies views’ collection for 1st round

Companies views within the contributions submitted to RAN1#108-e can be summarized as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Additional value (s) for GEO** | **X = # bits** | **Comment** |
| **Thales** | One additional value**:** 900 s | X = 4 bits | In Case of GEO based NTN. ntnUlSyncValidityDuration can be set to 15mn if the serving satellite ephemeris format is Keplerian-based with optimal bit allocation |
| **MediaTek** | {300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800} | X = 5 bits | MediaTek Observed that since the max Doppler shift is 0.93 ppm and 24 ppm for GEO and LEO respectively, the validation timer duration can be expected to be in the order of 30 (=~24 ppm/0.93 ppm) longer for GEO than for LEO. A validity timer duration of 30 seconds for LEO could be a reasonable target, so a reasonable target for GEO can be in the order of 900 seconds. The longer validity timer duration of 1800 seconds may be achievable depending on the UE complexity. |
| **PANASONIC** | Infinity = 3 hours.  | X = 4 bits | An infinite validity duration is subject to clause 5.2.2.2.1 in TS 38.331 on SIB validity setting it equal to a maximum of 3 hours. |
| **NTT DOCOMO** | One additional value. But not infinity | X = 4 bits | One additional large value other than “infinity” could be add |
| **InterDigital** | One additional value | X = 4 bits | support much larger value than 240s for GEO case or if validity timer is not configured, a UE may assume that satellite ephemeris/common TA related parameters are not change over time (or up to UE implementation). |
| **Apple** | One additional value**:** 600 s | X = 4 bits | An additional NTN validity duration value longer than 240 seconds is supported for GEO scenario: A possible candidate validity duration could be 600 seconds |
| **Ericsson** | {900 s, 1800 s, 3600 s, 7200 s} | X = 4 bits | larger validity duration values should be added e.g., {900 s, 1800 s, 3600 s, 7200 s}. Other values could be removed, e.g., {25 s, 35 s, 45 s, 55 s} |
| **CMCC** | One or more additional values But not infinity | X= 4 or 5 | larger values than 240 seconds are needed for GEO scenario. “Infinity” is not needed. |
| **ZTE** | No additional value | X = 0 | Additional validity duration value for GEO is not supported. The legacy SIB update procedure can be adopted for updating the ephemeris and common TA parameters. |

Moderator view: The determination of range/values for **ntnUlSyncValidityDuration** should take into account the timing error due to:

1. Serving-satellite position estimation error due to orbit propagation at NCC/gNB
2. Serving-satellite position estimation error due to orbit propagation at UE: RAN1 made a conclusion that orbit propagation model is left to implementation. Thus it is reasonable for the network to assume a simple orbit propagator model at the UE to determine the validity timer value range.
3. Quantization error linked to bit allocation for serving satellite ephemeris format
4. Common TA estimation error at the UE.

Most importantly, for GEO NTN based deployment we may need to consider a low quality Precision Orbit Determination (POD). Indeed. in case of GEO. although GNSS-based measurements can be also performed on-board to enhance the POD, the number of GNSS satellites in view can be limited in case of GEO (GPS satellites fly in medium Earth orbit at an altitude of approximately 20,200 km and Galileo at 23 222 km) and thereby the POD might be degraded. Therefore, a low quality POD is to be considered for GEO.

Hence a reasonable WF is to consider one additional value = 600 s (10mn, as proposed by Apple) or 900 s (15mn as proposed by Thales). Further, the network may not configure ntnUlSyncValidityDuration, update the Ephemeris data and common TA parameters periodically (e.g every 5mn) and the SIB update procedure(by incrementing ValueTag in SIB1) can be used to indicate that the content of **NTN SIBx** has changed.

Moderator Note: Hopefully we can converge on this issue in first week of the meeting. Indeed, an agreement on this topic is also needed for LS reply to RAN2 (R1-2200875 LS on NTN-specific SIB) and to update RRC parameters list.

Further discussions are needed to align companies views. The following proposal is made:

**Initial Proposal 5**

**Option 1** (APPLE, NTT DOCOMO, CMCC, InterDigital) : **Add one additional NTN validity duration value for GEO i.e. 600 s. X = 4 bits**

**Option 2** (Thales, NTT DOCOMO, CMCC, InterDigital) : **Add one additional NTN validity duration value for GEO i.e. 900 s. X = 4 bits**

**Option 3** (Panasonic): **Add one additional NTN validity duration value for GEO i.e. Infinity = 3 hours. X = 4 bits**

**Option 4** (Ericsson, CMCC): **Add additional NTN validity duration values for GEO e.g., {900 s, 1800 s, 3600 s, 7200 s}. X = 4 bits**

**Option 5** (MediaTek, CMCC, InterDigital) : **Add additional NTN validity duration values for GEO i.e. {300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800}. X = 5 bits.**

**Option 6** (ZTE): **No need to introduce additional validity duration values for GEO. Instead, ntnUlSyncValidityDuration is not indicated and the legacy SIB update procedure can be adopted for updating the ephemeris and common TA parameters. X = 0 bits.**

**Option 7** (Moderator):

* **Add one additional NTN validity duration value for GEO i.e. 900 s. X = 4 bits.**
* **The Network may not indicate ntnUlSyncValidityDuration. If it is not indicated, SIB update procedure (by incrementing ValueTag in SIB1) can be used to indicate that NTN SIB carrying the ephemeris and common TA parameters has changed.**

Companies are encouraged to provide views/preferred option (s) within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | OK to support one additional value for validity duration, which should be either 600 s or 900 s.No need to introduce ntnUlSyncValidityDuration. |
| Ericsson | Limiting the field size to X=4 bits is preferred. Also, it is desirable to have a single parameter range defined irrespective of LEO/MEO/GEO. |
| QC | Providing multiple very large validity duration has at most negligible benefit. We prefer to limit the field size to 4 bits. |
| Apple  | OK to support one additional value for validity duration for GEO. We are open on the exact value but may be not infinity.  |
| ZTE | We think legacy procedure can be adopted for ephemeris and common TA update in GEO. But we are also open for introducing only one additional large validity duration value for GEO, i.e., 900s. Since regarding the dedicated value for GEO (also for LEO), in our view, since the configured value from gNB should be applicable all UEs and the value should be determined based on the worst assumption of model used at UE side. Then, the smallest value can be considered each scenario. |
| NTT DOCOMO, INC. | We support one additional value with X=4 bits. We’re open to the value (not infinity). |
| Huawei, HiSilicon | Fine with the first bullet. The second bullet would require some discussion in RAN2. |
| NEC  | We are ok to add one additional NTN validity duration value for GEO. |
| Panasonic | The reason for us to provide option 3 was to compromise with companies supporting infinity. So given all contributions, we are fine with Option 7. |
| Xiaomi | Ok to add additional values for GEO and prefer to keep X=4bits. |
| Intel | Prefer Option 6 or Option 7. |
| Baicells | For GEO, “Infinity” can be indicated in a implicit way (by GEO satellite’s ephemeris information, for example, or by not indicating ntnUlSyncValidityDuration). Therefore Additional validity duration value for GEO is not needed. Option6 is fine.Option7 is also OK to us. |
| MediaTek | Prefer Option 2 “Add one additional NTN validity duration value for GEO i.e. 900 s. X = 4 bits”We think based on simulations of GEO satellite parameters using ephemeris and common TA parameters that a reasonable target is 900 seconds for GEO. Up to 1800 seconds could be considered if needed. As proposed by Thales in 8.4.2, to keep the size of indication to 4 bits, one value of 900 seconds could be added Value range {5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 120, 180, 240, 900}. With reference point at eNB, we observed with simulations that it is needed to use the Common TA Drift Rate and Common TA Drift Rate variation for GEO networks for longer validity timer value of 900 seconds (or 1800 s). The Doppler shift in GEO necessicate accurate UE prediction over long time using the common TA parameters.Note that there is a factor ~25 = 24 ppm/0.93 ppm between LEO and GEO. With 30 seconds considered to be a reasonable target for LEO using common TA, common TA drift, and common TA drift variation , then 900 seconds ~25\*30 is consistent for GEO. Note that the common TA parameters are not configured if reference point is at the satellite. |
| CMCC | We are open to additional NTN validity duration value other than infinity for GEO, and we are fine with X = 4 bits. |
| Lockheed Martin | Support Option 7. |
| OPPO | We agree with MTK’s suggestion.  |
| InterDigital | We are ok with either option 1 or 2 (also open for another value). We shouldn’t be listed as supporting company for the option 6. |
| Samsung | OK with MTK’s proposal above.  |
| CATT | Agree with MTK’s suggestion. |
| LG | Support: Option 1, 2, and 4.Not support: Option 3, 5, 6, and 7.We prefer to support larger value than 240 second for GEO using the same bit width (i.e., 4 bits), and we don't prefer to support implicit indication. |
| Lenovo | Fine to support one additional value for GEO. |

## Updated proposal and companies views’ collection for 2nd round

Based on first round of email discussions, the majority is supportive of adding one additional value for Validity duration which is limiting the field size to X=4 bits.

This additional value for validity duration could be 900 s which is acceptable to many companies

The proposal is updated as follows:

**Updated Proposal 5**

* **Add one additional NTN validity duration value for GEO i.e. 900 s. X = 4 bits.**
* **The Network may not indicate ntnUlSyncValidityDuration.**
	+ **Note: If it is not indicated, SIB update procedure (by incrementing ValueTag in SIB1) can be used to indicate that NTN SIB carrying the ephemeris and common TA parameters has changed.**

Companies are encouraged to provide views/preferred option (s) within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Moderator | First bullet was agreed at GTW held on Feb 24thCompanies are encouraged to comment on second bullet + Note. |
| LG | Regarding the second bullet, we think further discussions should be needed. |
| Lenovo | Our understanding is that if it is for GEO, there is no necessity to update the ephemeris and common TA parameters. And it is for NGEO, the update by SIB is too frequent. So our preference is that the parameter can be not indicated, and if it is not indicated, it is for GEO, and the ephemeris and common TA is always effective, and the timing error is corrected by TA command as in legacy release. |
| Sony | Further discussion on second bullet. We think network should always indicate **ntnUlSyncValidityDuration** |
| OPPO | We think that if the validity duration is not configured, RAN1 should discuss whether the UE assumes an infinite duration or the UE shall fall back to SIB update procedure for ephemeris and common TA reading. From our viewpoint, it might be risky to simply assume an infinite duration. Thus, we believe that the note case is a safe choice. We support the proposal 5 including the note.  |
| Panasonic | Support. We do not have a concern regarding the second bullet. |
| ZTE | In GEO, the validity duration can be as long as 900 s. The legacy SIB update procedure is able to handle this case. Therefore, fallback to legacy SIB update procedure when validity duration is not indicated can be supported. But anyway, RAN2 is still discussing the design of NTN SIB. Whether the legacy SIB update procedure can be used may be determined by RAN2. |

#  [Active] Topic#6 UE behaviour w.r.t Validity timer expiry

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| MediaTek Inc | **Observation 1:** UE’s behaviour needs to be specified when UL synchronization is lost, due to expiry of the UL validity timer**.****Observation 2:** Before expiry of UL validity timer, the connected UE can read the NTN-specific SIBx to re-acquire new assistance information.**Proposal 1:** RAN2 can discuss on how to acquire new or additional assistance information if new or additional assistance information (i.e. serving satellite ephemeris data or Common TA parameters) is not available within the associated validity duration. **Observation 3**: There is no limitation in NR NTN for UE to re-acquire the NTN-specific SIB when UL synchronization is lost.**Observation 4:** On NTN cell access when paged, a UE may need to read the NTN-specific SIB within a typical time in the order of a second. It may not be necessary to re-acquire SIB-1 or SIB-2 assuming these SIBs have not changed within the current system information notification period. |
| Nokia, Nokia Shanghai Bell | **Observation 5:** Even if the UE has obtained new serving satellite ephemeris and Common TA related parameters prior to the time of the validity timer expiring, the UE may lose synchronization if the current validity timer expires before the Epoch time of the new serving satellite ephemeris and Common TA.**Observation 6:** The network is not able to know whether the validity timer has expired at the UE side or is about to expire soon. This may lead to situations where the UE is not able to fulfil the requirements associated to the scheduling commands (PUCCH and PUSCH transmissions).**Observation 7:** RAN1 and RAN2 have different understandings of the applicability of the validity timer/validity duration.**Observation 8:** Is seems that RAN1 and RAN2 have different understandings of UE actions prior to the validity timer expiry.**Observation 9:** There may be periods with uncertainty related to UE’s UL synchronization status if the UE is allowed to read serving satellite ephemeris and Common TA related parameters after the expiry of the validity timer**Proposal 6:** If a UE has obtained new serving satellite ephemeris and Common TA related parameters prior to the time of the validity timer expiring, the UE is allowed to maintain its UL synchronization until the new Epoch time is reached. For this, the time interval from the expiration of the validity timer until the new Epoch time must not be larger than the new validity duration. In this case, * The UE restarts the validity timer before the new Epoch time, or,
* The UE suspends the timer during this period such that it does not expire.

**Proposal 7:** The UE shall at any time be able to guarantee that is has a valid UL synchronization.**Proposal 8:** In case the validity timer is about to expire, the UE informs the gNB that it will lose synchronization soon.**Proposal 9:** Upon receiving a signal from the UE that the UE’s validity timer will expire soon, the gNB either  * Stops scheduling the UE in the uplink and broadcast ephemeris information and Common TA as planned via SIB.
* Provides UE-specific assistance signal including ephemeris information of the satellite, the relevant associated Common TA parameters.

**Proposal 10:** After having received UE-specific synchronization information or after having read the SIB again while having earlier informed the gNB on an oncoming validity timer expiration, the UE indicates to the gNB that it has maintained or re-established UL synchronization and that it has reset the validity timer.**Proposal 11:** To reduce the signalling overhead for UE reporting, UE only informs gNB to maintain the validity timer status when there is potential UL or DL data transmission. **Proposal 12:** Inform RAN2 that the validity duration is only intended to be applicable for serving satellite ephemeris and common TA related parameters.**Proposal 13:** Inform RAN2 that under normal operation, a UE is expected to have read new and updated serving satellite ephemeris information prior to the expiry of the validity timer. |

## Initial proposal and companies views’ collection for 1st round

Moderator note: UE behaviour w.r.t Validity timer expiry was discussed in RAN1#106-e and #106-bis-e meetings:

* **RAN1#106-e**: FFS: Associated UE behaviour if the UE does not read the ephemeris within the validity duration.
* **RAN1#106-bis-e**:

Agreement:

The UE assumes that it has lost uplink synchronization if new or additional assistance information (i.e. serving satellite ephemeris data or Common TA parameters) is not available within the associated validity duration.

* FFS: details on how to acquire new or additional assistance information

Moderator notes: w.r.t topic#6,

* Figure 3 below shows the normal operation 🡪 the connected UE can read the NTN-specific SIBx to re-acquire new assistance information: MediaTek: **Observation 2.** Nokia: **Proposal 7, Proposal 13.**
* Figure 1: New assistance information is not available before expiry of the UL validity timer 🡪UL synchronization is lost 🡪 There is no limitation in NR NTN for UE to re-acquire the NTN-specific SIB : MediaTek: **Observation 3**
* Figure 2: Shows the case where new assistance information is available but not within the associated validity duration 🡪 the UE may lose synchronization if the current validity timer expires before the Epoch time of the new serving satellite ephemeris and Common TA: Nokia: **Observation 5**. **Proposal 6.**



Figure 1 Case 1: New assistance information is not available before expiry of the UL validity timer



Figure 2 Case 2: New assistance information is available but not within the associated validity duration



Figure 3 Case 3: New assistance information is available before expiry of the UL validity timer

* Other proposal from Nokia (Proposal 12 and Proposal 13) can be considered in the discussions on RAN2 LS on NTN-specific SIB.

Moderator view: The UE can always re-acquire new assistance information (read the NTN-specific SI) before expiry of UL validity timer (Case 3 which is the normal mode of operation). But if not, there could be 2 cases:

* Case 1: New assistance information is not available before expiry of the UL validity timer. Uplink sync is lost and the UE needs to wait next SI period: Periodicity of SIx window assigned to NTN SIBx (given in # radio frames: 8, 16, 32, 64, 128, 256, 512) should be configured to small value to reduce the access latency.
* Case 2: raised by Nokia, new assistance information is available but not within the associated validity duration. As workaround: Moderator shares the same view as proposed by Nokia (proposal 6 from Nokia) or the group can revise the agreement on Epoch time as follows:

|  |
| --- |
| * Otherwise, when indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end start of the SI window during which the SI message is transmitted.
 |

**Initial Proposal 6**

**Option 1 (Nokia, Nokia Shanghai Bell):**

**If a UE has obtained new serving satellite ephemeris and Common TA related parameters prior to the time of the validity timer expiring, the UE is allowed to maintain its UL synchronization until the new Epoch time is reached. For this, the time interval from the expiration of the validity timer until the new Epoch time must not be larger than the new validity duration. In this case,**

* **The UE restarts the validity timer before the new Epoch time, or,**
* **The UE suspends the timer during this period such that it does not expire.**

**Option 2 (Moderator):**

**Revise the agreement on Epoch time made at RAN1#107e as follows:**

**When assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is indicated in NTN SIB, Epoch time is implicitly known as the end start of the SI window Carrying the NTN SIB.**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | The Moderator’s understanding of the problem raised by Nokia (Observation 5, Proposal 6) and as depicted in Figure 2 is correct. We believe that adopting Option 1 fully solves the problem.In case of the alternative Option 2, the Epoch time would be always at an earlier time (start of SI window) than the time instant where the assistance information is provided in NTN SIB, having thus the drawback that when actually applied by the UE this information would be already outdated; i.e. this would practically shorten the effective duration of the validity timer. |
| Ericsson | We prefer Option 1 in principle. It is beneficial to allow epoch time indicated in the future, which can be signaled with explicit SFN+subframe number or implicitly known as the end of the SI window. This allows the UE to "predict" satellite position (or common TA) both in the forward direction (after the epoch time) and backward direction (before the epoch time), which improves prediction accuracy.For Option 1 it is unclear at what point the UE should stop using the old assistance information and start using the new assistance information. To clarify this, we propose the following:1. The assistance information is valid when |t-tepoch| < validity duration (i.e., both before and after the epoch time).
2. If the UE has acquired new assistance information and also has old assistance information that is still valid, it should for transmission at time t use the (valid) assistance information with an epoch time closest to t.
 |
| QC | We don’t see any problem and see no need of the change. |
| Apple | We are fine with either option. For Option 2, the SIB window length (e.g., 160 ms) may be short comparing with validity duration (e.g., at least 5 seconds). Hence, the shorten of effective duration of the validity timer may not be significant.  |
| ZTE | We do not see the spec impact. In NR, UE can receive updated SIB in RRC\_CONNECTED mode. Therefore, UE can always re-acquire new assistance information and it is up to UE implementation to avoid the loss of synchronization. The case 1 and case 2 are low frequency cases, which can be handled by reusing legacy procedure for UL synchronization loss.  |
| NTT DOCOMO, INC. | We think the cases mentioned in Figure1/2 can be resolved by implementation. UE should have the ability to avoid it from happening, which means that UE should know when the timer will expire, and when the next epoch time is. Hence, before timer expiry, UE should be able to realize that it should read NTN-SIB again. |
| Huawei, HiSilicon | Support option 1, UE will know the scheduling of NTN SIB and the remaining validity during before the next available NTN SIB. Therefore, it can be solved by UE implementation to update the UL synchronization before the validity timer expires. At the gNB side, the scheduling of NTN SIB should have a relative small periodicity compared to the configured validity duration.  |
| NEC  | We slightly prefer to allow the UE to maintain the UL synchronization with suspending the timer until the new Epoch time is reached. The UE restarts the validity timer before the new Epoch time may result in misalignment between the UE and NW. If the Epoch time is implicitly known as the start of the SI window carrying the NTN SIB, does this mean the UE shall start/restart the timer before it receives the updated NTN SI? Or the UE starts/restarts the timer when it receives the updated NTN SI, which will short the actual validate duration of the NTN parameters at the UE side.  |
| Panasonic | In our understanding, the issue occurs when the indicated epoch time lies in the future of the SIB transmission timing. We prefer Option 1, since it solves the issue. Clarify that the newly acquired assistance information is valid even before the indicated epoch time.Option 2 solves the issue only partially when the epoch time is implicitly indicated by the end of SI window, but does not solve the issue when the epoch time is explicitly indicated.  |
| Xiaomi | We are fine with either option.Both of the explicit indication and implicit indication can indicate a time instant in the past, and as Apple pointed, the shorten of effective duration of the validity timer may not be significant. For the explicit indication, as all the UEs could have the same epoch time, it is easier for the gNB to avoid such ‘error’ case that the epoch of new assistant information is later than the expire time of the old assistant information. |
| Sony | Option 1. Network can broadcast new ephemeris and common TA related parameters prior to validity timer expiry. A UE knowing that its validity timer will soon expire can read the SIBx and restart its validity timer before the new Epoch time. |
| Intel | Either option 1 or option 2 is fine. |
| Baicells | We are fine with the **RAN1#106-bis-e** Agreement: The UE assumes that it has lost uplink synchronization if new or additional assistance information (i.e. serving satellite ephemeris data or Common TA parameters) is not available within the associated validity duration.If any other shorter timer is needed for the UE to trigger SIB reading, it is up to UE implementation. We share same view of ZTE: UE can always re-acquire new assistance information and it is up to UE implementation to avoid the loss of synchronization.  |
| MediaTek | It is not clear what is the issue and the need for either Option 1 or Option 2. It could be clarified that Epoch time is always in the past when UE reads the SIB. This avoids ambiguity when SFN wraps round, for example epoch time is indicated by SFN=1023, and UE read SIB at SFN=2 or later. Then, is the epoch time in future at SFN=1023, or in the past in the previous SFN=1023.New Proposal: The Epoch time t\_epoch if indicated explicitly by a SFN and subframe number is in the past when UE reads the SIB at time t, where t\_epoch < t |
| CMCC | We share the same view of ZTE. UE can always re-acquire new assistance information and it is up to UE implementation to avoid the loss of synchronization. |
| Lockheed Martin | Open to both, but option 2 appears to be a simpler solution. |
| OPPO | From our viewpoint, when the UE reads the new ephemeris and common TA, the UE cannot immediately execute the new ephemeris and common TA estimation until the next epoch time arrives. Thus, there will be a gap time between the validity time expiry and the next epoch time, where the UE is out of sync. But we think that option 1 is quite artifical, as the validity timer is expired and the UE cannot actually use the newly read ephemeris before the next epoch time. Thus, even the UE claims that he is still in sync, the TA estimation is already quite biased. On the other hand, option 2 can allow UE to execute ephemeris and common TA estimation immediately after the UE reads the new SIB. Thus, the gap time is very much reduced, and the UE is in quite safe situation to use the ephemeris and common TA because the epoch time in the past. For this reason, we support option 2.  |
| CATT | Support option 2.  |
| LG | We are not sure this issue is necessary to discuss. In our view, it seems to be possible to solve with network implementation. That is, the network may appropriately set the validity duration value so that the UE may operate as shown in Figure 3. |
| Lenovo | We think option 2 is more reasonable. For Option 1, during the time interval from the expiration of the validity timer to the new epoch time, we think UL synchronization is lost. |

## Updated proposal and companies views’ collection for 2nd round

It seems that more discussion is needed on this issue as the views expressed during first round are diverse as can show the table below:

|  |  |  |
| --- | --- | --- |
|  |  | Other options/comment |
| Nokia, Nokia Shanghai Bell | Option 1 |  |
| Ericsson  | Option 1(in principle) | * The assistance information is valid when |t-tepoch| < validity duration (i.e., both before and after the epoch time).
* If the UE has acquired new assistance information and also has old assistance information that is still valid, it should for transmission at time t use the (valid) assistance information with an epoch time closest to t.
 |
| QC |  | No need of the change. |
| Apple | Option 1 or Option 2 |  |
| ZTE |  | We do not see the spec impact |
| NTT DOCOMO |  | the cases mentioned in Figure1/2 can be resolved by implementation |
| Huawei, HiSilicon | Option 1 |  |
| NEC | Option 1 |  |
| Panasonic | Option 1 |  |
| Xiaomi | Option 1 or Option 2 |  |
| Sony | Option 1 |  |
| Intel | Option 1 or Option 2 |  |
| Baicells |  | it is up to UE implementation to avoid the loss of synchronization |
| MediaTek |  | New Proposal: The Epoch time t\_epoch if indicated explicitly by a SFN and subframe number is in the past when UE reads the SIB at time t, where t\_epoch < t |
| CMCC |  | it is up to UE implementation to avoid the loss of synchronization |
| Lockheed Martin | Option 1 or Option 2 | option 2 appears to be a simpler solution |
| OPPO | Option 2 |  |
| CATT | Option 2 |  |
| LG |  | it seems to be possible to solve with network implementation |
| Lenovo | Option 2 |  |

Moderator view: Option 1 can solve the issue. To this option, we may just need to add a note to clarify that the UE shall always apply new assistance information when acquired prior to the time of the validity timer expiring. Because it is a fresh data that will provide more accurate satellite PV and Common delay.

Proposal from MediaTek (option 4 below) is related to another issue that need to be discussed.

From Moderator perspective more discussions on this issue is needed. The proposal is updated as follows:

**Updated Proposal 6**

**Companies are encouraged to comment on all the options below:**

**Option 1 (Nokia, Nokia Shanghai Bell):**

**If a UE has obtained new serving satellite ephemeris and Common TA related parameters prior to the time of the validity timer expiring, the UE is allowed to maintain its UL synchronization until the new Epoch time is reached. For this, the time interval from the expiration of the validity timer until the new Epoch time must not be larger than the new validity duration. In this case,**

* **The UE restarts the validity timer before the new Epoch time, or,**
* **The UE suspends the timer during this period such that it does not expire.**

**Note : UE shall always apply new assistance information obtained within uplink sync validity duration**

**Option 2 (Ericsson):**

* **The assistance information is valid when |t-tepoch| < validity duration (i.e., both before and after the epoch time).**
* **If the UE has acquired new assistance information and also has old assistance information that is still valid, it should for transmission at time t use the (valid) assistance information with an epoch time closest to t.**

**Option 3:**

* **The UE shall re-acquire new assistance information before expiry of UL validity timer**

**Option 4 (MediaTek**)**:**

**The Epoch time t\_epoch if indicated explicitly by a SFN and subframe number is in the past when UE reads the SIB at time t, where t\_epoch < t**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| LG | As commented above, it seems to be possible to solve with network implementation. That is, the network may appropriately set the validity duration value so that the UE may operate as shown in Figure 3. |
| Lenovo | Suppose there are t1 and t2, and t1-t\_epoch=t\_epoch -t2, we are not sure about whether the satellite position accuracy for t1 and t2 are same. Our understanding is that depends on the orbit modeling, accuracy at t1 may be more accurate than t2. If this is the case, we prefer option 3 and option 4. |
| Sony | Option 1. We think MediaTek’s point needs consideration as a separate issue – how to avoid the ambiguity in SFN interpretation at the boundary. This arises in all cases if epoch time is indicated via SFN. |
| OPPO | We don’t understand why the option 2 is changed. We support the original option 2, I.e. **Option 2 (Moderator):** **Revise the agreement on Epoch time made at RAN1#107e as follows:****When assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is indicated in NTN SIB, Epoch time is implicitly known as the end start of the SI window Carrying the NTN SIB.**If the epoch time is in future compared with the received updated ephemeris data and common TA, we are questioning whether the UE can simply use these data before the epoch time and claiming in sync. To us, this is quite artificial. To solve this problem, to set an earlier epoch time can allow the UE to immediately use the updated ephemeris and common TA.  |
| Panasonic | As commented earlier, we prefer Option 1, since it solves the issue. Clarify that the newly acquired assistance information is valid even before the indicated epoch time, by changing the note in Option 1 to "**Note : UE shall always apply new assistance information obtained within uplink sync validity duration** **even before the indicated epoch time.**" |
| ZTE | We support option 3.For option 1 and option 2, setting the validity duration as |t - t\_epoch1| < delta\_t is equal to setting the validity duration as 0< t - t\_epoch2 < 2\*delta\_t, where t\_epoch2 = t\_epoch1 - delta\_t. Therefore, indicating the future epoch time will not significantly increase the validity duration.For option 4, we think it is more of an implementation issue. Hence, option 3 is more preferred. |

#  [Closed] Topic#7 Unit of Common TA parameters

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| NTT DOCOMO, INC. | **Observation 3:** Based on the indicated common TA parameters and the agreed one-way propagation time formular, the calculated common TA at UE side could be absolute TA value which is not in unit of Tc directly.**Proposal 4:** Revise the TA equation as TTA = (NTA+NTA,offset+ NTA,adjUE)\*Tc + TTA,adjcommon, where TTA,adjcommon equals 2∙$Delay\_{common}\left(t\right)$. |

## Initial proposal and companies views’ collection for 1st round

NTT DOCOMO made the following observation: Based on the indicated common TA parameters and the agreed one-way propagation time formula, the calculated common TA at UE side could be absolute TA value which is not in unit of Tc directly.

Then NTT DOCOMO proposed to revise the TA equation as TTA = (NTA+NTA,offset+ NTA,adjUE)\*Tc + TTA,adjcommon, where TTA,adjcommon equals 2∙$Delay\_{common}\left(t\right)$.

Moderator view: Range, granularity and bits allocation for Higher-layer parameters TACommon, TACommonDrift, TACommonDriftVariation were agreed in previous RAN1 meeting. These parameters are given in unit of: μs for Common TA, μs⁄s for TACommonDrift and μs⁄s^2 for TACommonDriftVariation.

The interpretation/definition of these parameters is clear by considering the formula/agreement on $Delay\_{common} $ made at previous RAN1 meeting:

$$Delay\_{common}\left(t\right)= D\_{Common }\left(t\_{epocℎ}\right)+ DCommonDrift× \left(t−t\_{epocℎ}\right)+DCommonDriftVariation× \left(t−t\_{epocℎ}\right)^{2} $$

The unit of $Delay\_{common}$ is of course in μs.

Then, $N\_{TA, common}$ is derived by the UE based on $Delay\_{common}\left(t\right)$. It is not yet specified how the UE derives $N\_{TA, common}$ (will be discussed under topic#12) but obviously whatever the method used $Delay\_{common}\left(t\right) $should be divided Tc.

From moderator perspective: No revision of TA equation is needed. Alternatively, the Common TA related parameters can be indicated in absolute value (similar to TAC in MAC CE), thereby, the group may revise the unit of Common TA parameters if deemed necessary.

**Initial Proposal 7:**

**Companies are encouraged to comment on all the below WFs:**

**WF 1: Revise the unit of Common TA parameters: to be divided by Tc.**

**WF 2: (**NTT DOCOMO)**: Revise the TA equation as TTA = (NTA+NTA,offset+ NTA,adjUE)\*Tc + TTA,adjcommon, where TTA,adjcommon equals 2∙**$Delay\_{common}\left(t\right)$**.**

**WF 3: No revision is deemed necessary.**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | Support WF3 – no revision is seen needed. |
| Ericsson | WF3 |
| QC | WF3 |
| Apple | WF3. With the existing agreement, N\_{TA, common} is derived by the UE based on Delay\_{common}(t). The unit transition from μs to Tc is expected here.  |
| ZTE | We prefer WF 3. The calculated common TA can be round to the unit of Tc anyway. |
| NTT DOCOMO, INC. | WF2 or WF1 is preferred. For WF3, common TA is described as NTA,common\*Tc , which could lead to misunderstanding that common TA is in the unit of Tc. Meanwhile, the agreement of $Delay\_{common}$ is not captured. Thus, a clarification would be better. |
| Huawei, HiSilicon | We support WF3. |
| NEC | We support to go for WF3.  |
| Panasonic | The problem is an apparent mismatch of the units of $Delay\_{common}\left(t\right)$ and NTA+NTA,offset+ NTA,adjUE . But according to Topic#12 CRs/TPs for 3GPP TS 38.213, we have *NTA,adjcommon is derived by the UE based on Delaycommon(t) to pre-compensate the two-way transmission delay between the uplink time reference point and the satellite.*”. Hence, we think this is not really a problem and it is already sufficiently addressed.We support WF3.  |
| Xiaomi | WF3 |
| Sony | Support WF2.  |
| Intel | WF3 |
| Baicells | WF3 |
| MediaTek | WF3 – No revision is deemed necessary. |
| CMCC | WF3 |
| Lockheed Martin | WF3 |
| InterDigital | WF3 |
| Samsung | WF3 |
| CATT | WF3 |
| LG | Support WF3. |
| Lenovo | We prefer WF3. |

## Updated proposal and companies views’ collection for 2nd round

Based on the views expressed during the first round, the large majority is supportive of WF3- No revision is deemed necessary.

**FL Recommendation:**

**Regarding issue/topic#7, no revision is deemed necessary.**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| LG | Support |
| Panasonic | Support |
|  |  |

#  [Closed] Topic#8 Revision of Epoch time agreement

The following agreement was made at RAN1#107-e:

|  |
| --- |
| **Agreement*** When explicitly provided through SIB, Epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is the starting time of a DL sub-frame, indicated by a SFN and a sub-frame number signaled together with the assistance information.
* Otherwise, when indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the SI message is transmitted.
* When provided through dedicated signaling, epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is the starting time of a DL sub-frame, indicated by a SFN and a sub-frame number.
 |

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| CATT | 1. Correct the description on the implicit epoch time as following:

Otherwise, when not indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the SI message is transmitted. |

## Initial proposal and companies views’ collection for 1st round

Moderator note: Based on CATT proposal, the second bullet of RAN1#107-e agreement on Epoch time needs to be clarified.

Initial Proposal 8 is made as follows:

**Initial Proposal 8**

**Modify second bullet of RAN1#107-e agreement on Epoch time as follows:**

* **Revision 1: Otherwise, when not indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the NTN SIB SI message is transmitted.**
* **Revision 2: When assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is indicated in NTN SIB, Epoch time is implicitly known as the end of the SI window Carrying the NTN SIB.**
* **Revision 3 (depending on topic#6 conclusion): When assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is indicated in NTN SIB, Epoch time is implicitly known as the start of the SI window Carrying the NTN SIB.**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | Revision 1 would potentially need a revision such that it reads:**Revision 1a: Otherwise, when Epoch time is not explicitly indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the NTN SIB SI message is transmitted.**Following this, Revisions 2 and 3 would not be needed. |
| Ericsson | Revision 1: Ok. Revision 1a from Nokia is also fine.In revision 2 and 3, the condition is missing that epoch time is not indicated (corresponding to “when not indicated in SIB” in Revision 1). |
| QC | Agree with Ericsson |
| Apple | We think Revision 1a proposed by Nokia is better. Or, we may make it clear that the SIB is NTN-specific SIB, based on RAN2 agreements. Revision 1a’: Otherwise, when epoch time is not explicitly indicated in NTN-specific SIB, epoch time of assistance information (i.e., Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the NTN-specific SIB is transmitted. Also, we may determine Topic 8 after Topic 6 is addressed since they are correlated.  |
| ZTE | We are fine with revision 1a proposed by Nokia. |
| NTT DOCOMO, INC. | Revision 1a from Nokia is fine. |
| Huawei, HiSilicon | Revision 1 is okay. We think this is more like a clarification. |
| NEC  | We are fine with Nokia’s Revision 1.  |
| Panasonic | We support Revision 1. This issue seems to be a problem with language. If epoch time is not signaled, our understanding is that UE derives epoch time from the SI-window. Postpone the decision until resolving topic #6, i.e., start or end of the SI window. |
| Baicells | CATT’s proposal and Nokia Revision 1a are both fine. |
| MediaTek | Revision 1: Ok. Revision 1a from Nokia is also fine /clearer. |
| CMCC | We are fine with Revision 1a from Nokia |
| Lockheed Martin | Revision 1 or 1a. |
| Samsung | Revision 1 is ok. |
| CATT | We think the revision is needed. Revision 1 or 1a is fine for us. |
| LG | Nokia’s proposal (Revision 1a) is fine and we think this issue can be discussed in topic #6. |
| Lenovo | We think Nokia’s revision 1a is more clear. We prefer to conclude this after discussion on topic#6. |

## Updated proposal and companies views’ collection for 2nd round

Many companies share the view that the Nokia’s revision 1a is more clearer. The Proposal 8 is updated as follows:

**Updated Proposal 8**

**Modify second bullet of RAN1#107-e agreement on Epoch time as follows:**

**Otherwise, when Epoch time is not explicitly indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the NTN-specific SIB SI message is transmitted.**

The following agreement was made at the GTW session held Feb 24th

**Agreement**

Modify second bullet of RAN1#107-e agreement on Epoch time as follows:

Otherwise, when Epoch time is not explicitly indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the NTN-specific SIB SI message is transmitted.

# [Closed] Topic#9 Support of Common TA third order derivative

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| NTT DOCOMO, INC. | **Observation 1:** With the validity duration of 10 seconds, Common TA, Common TA drift rate and Common TA drift rate variation are enough for LEO-600km for FR1. Common TA third order derivative is needed LEO-600km for FR2.**Observation 2:** Different combinations of common TA parameters are needed for different NTN types and UE capability on NTN type. For example,1. LEO: Common TA, Common TA drift rate and Common TA drift rate variation are necessary for moderate validity duration and FR1.
2. GEO: Common TA is enough due to its feature of stationary location to earth
3. HAPS: Common TA (and Common TA drift rate optionally) may be needed

**Proposal 1:** Common TA third order derivative is optionally supported based on the validity duration and carrier frequency.**Proposal 2:** Based on NTN type and UE capability on NTN type, UE assumes that following combination of common TA parameters are included at least in SIB message:1. LEO: Common TA, Common TA drift rate and Common TA drift rate variation in mandatory, and Common TA third order derivative optionally based on carrier frequency.
2. GEO: Common TA in mandatory
3. HAPS: Common TA in mandatory, Common TA drift rate optionally
 |

## Initial proposal and companies views’ collection for 1st round

Support of a third order derivative (TACommonThirdOrder) was discussed in last RAN1 meetings. Based on previous discussions on this topic, few companies do not see the need of Common TA third order derivation support. Even optionally by the network.

Within its contribution submitted to RAN1#108-e, NTT DOCOMO proposed to re-discuss this issue and proposed that TACommonThirdOrder may be optionally supported.

The Initial Proposal 9 is made as follows:

**Initial Proposal 9 (NTT DOCOMO)**

**Common TA third order derivative is optionally supported based on the validity duration and carrier frequency**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | We do not see the need to provide the Common TA third order derivative, and also do not see how the aging of the Common TA should depend on the carrier frequency. As shown in our contributions in previous meetings, it is sufficient to provide the TA drift rate and optionally TA drift rate variation, in order for the UE to track the satellite movement. If needed, the UE can also estimate the third order derivative from reading multiple SIB messages. |
| Ericsson | We support the proposal since it can significantly increase the validity time of the common TA parameters, as shown in many contributions to previous meetings. |
| QC | Ok with the proposal. To be clear, we suggest the following change: **Common TA third order derivative is optionally ~~supported~~ signaled based on the validity duration and carrier frequency.** |
| ZTE | Since the network can work without Common TA third order derivative, no need to re-discuss this issue with consideration on limited time. |
| NTT DOCOMO, INC. | Support. Common TA third order derivative is needed in some cases with the increase of validity duration, especially in FR2. |
| Huawei, HiSilicon | We don’t see a strong need of common TA third order derivative. With the closed loop TA mechanism, the validity duration is relative long with the current agreed parameters.  |
| NEC  | We are fine with this.  |
| Panasonic | RAN1 should double-check if the largest adopted validity duration can be handled with second-order approximation as currently envisaged. If found not sufficient, we support the third order derivative. |
| Intel | We are fine with this proposal |
| MediaTek | Support. This proposal allows longer UE prediction time |
| CMCC | We are fine with the proposal. |
| Lockheed Martin | Not opposed but too early to consider FR2. |
| InterDigital | Ok with the proposal |
| CATT | We don’t think this proposal is needed. In previous meeting, we have spent much time for the optimization of common TA estimation, now in this CR stage, no need to re-open this discussion. |
| LG | We prefer to not support. |
| Lenovo | We are fine to support the third order derivative optionally. |

## Updated proposal and companies views’ collection for 2nd round

w.r.t support of Common TA third order derivative, the views are diverse. But many companies don’t see a strong need of common TA third order derivative.

**FL Recommendation:**

**No need to re-discuss this issue with consideration on limited time**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| LG | OK. |
| Panasonic | Agreed |
|  |  |

# [Closed] Topic#10 BWP switching in TS 38.213

## Companies’ contributions summary

|  |  |
| --- | --- |
| **Companies** | **Proposals** |
| LG Electronics | Proposal 2. The common TA ($N\_{TA,common}$) and the UE specific TA ($N\_{TA,UE−specific}$) should be considered in addition to the TA command value in BWP switching for NR NTN UE. |

## Initial proposal and companies views’ collection for 1st round

Issue on BWP switching in TS 38.213 was raised by LG. The issue description is recopied hereafter:

|  |
| --- |
| R1- 2202286- LG Electronics:In TS 38.213 [2], the legacy NR UE can change the UL timing based on the TA command value during BWP switching. If a UE changes an active UL BWP between a time of a timing advance command reception and a time of applying a corresponding adjustment for the uplink transmission timing, the UE determines the timing advance command value based on the SCS of the new active UL BWP. If the UE changes an active UL BWP after applying an adjustment for the uplink transmission timing, the UE assumes a same absolute timing advance command value before and after the active UL BWP change.For the NR NTN UE, however, the UL timing is calculated together, including common TA ($N\_{TA,common}$) and/or UE specific TA ($N\_{TA,UE−specific}$) in addition to the TA command value. Therefore, when the NR NTN UE switches its BWP, it is reasonable to consider not only TA command value but also common TA and/or UE specific TA. |

Based on the above, the Initial Proposal 10 is made as follows:

**Initial Proposal 10 (LGE)**

**The common TA (**$N\_{TA,common}$**) and the UE specific TA (**$N\_{TA,UE−specific}$**) should be considered in addition to the TA command value in BWP switching for NR NTN UE.**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | In general our understanding is that the NTN related UE autonomous timing advance operations for both service link and feeder link should be compensated for all operations – also for the BWP switching. However, we do not see any specific need for addressing the compensation here, as it would be covered in the general description for the timing advance operations. |
| Ericsson | We don't understand what is it about common TA and UE-specific TA that should be considered specifically when switching BWP. Our understanding is that the issue with the TA command is that its interpretation (the step size) depends on the SCS, which needs to be taken into account if the UE switches UL BWP between receiving a TAC and applying it. But for common/UE-specific TA, we are not sure if there is an issue. |
| ZTE | The common TA and UE specific TA are autonomously adjusted by UE. Hence, UE is able to determine the proper values to apply in BWP switching and there is no need for specification. |
| NTT DOCOMO, INC. | As aforementioned text in 38.213 states, UE determines the timing advance command value based on the SCS of the new active UL BWP, but for common TA/UE-specific TA, there’s no such SCS-related issue and no need to be considered in BWP switching. |
| Huawei, HiSilicon | We are not sure there is an issue. |
| NEC | We do not see any need to address/ clarify this.  |
| Panasonic | We agree. |
| Baicells | The common TA and UE specific TA is independent of SCS. Their unit μs. Therefore there is no ambiguity for them during BWP switching. |
| MediaTek | The need for this enhancement is not clear, not sure there is an issue |
| Lockheed Martin | Disagree; N\_TA is a concern at BWP switch due to possible SCS change, but N\_TAcommon and N\_TAUEspecific are only scaled by Tc |
| OPPO | Would be good to see a TP. |
| CATT | No need |
| LG | As mentioned in our contribution, when the NR NTN UE switches its BWP, it is reasonable to consider not only TA command value but also common TA and/or UE specific TA. The text proposal can be up to specification editor. |
| Lenovo | We don’t think uplink TA should be impacted by BWP switching. |

## Updated proposal and companies views’ collection for 2nd round

Given the views expressed during first round it seems many companies share the view that there is no need to consider common TA/UE-specific TA in BWP switching.

From Moderator’s perspective it is recommended that the proponent to offline discuss with other companies to make progress.

**FL Recommendation:**

**On Issue/Topic#10, proponent is encouraged to have offline discussions with other companies.**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| LG | OK. |
| Panasonic | OK. |
|  |  |

#  [Active] Topic#11 CRs/TPs for 3GPP TS 38.211

Original CR can be found in [R1-2112921 CR 38.211 NR\_NTN\_solutions-Core](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Docs/R1-2112921.zip).

## Companies’ contributions summary

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| **Companies** | **Proposals** |
| MediaTek Inc. | **Proposal 4**: Agree Pseudo CR to TS 38.211 Section 4.3.1 to update Figure 4.1.1-1: Uplink-downlink timing relation with $N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}$. |
| OPPO | **Proposal 1: Adopt TP#1.** ------------------------------------ TP#1 TS 38.211 (in bleu)----------------------------------------------4.3.1 Frames and subframesDownlink, uplink, and sidelink transmissions are organized into frames with duration, each consisting of ten subframes of duration. The number of consecutive OFDM symbols per subframe is N\_"symb" ^("subframe" ,μ)=N\_"symb" ^"slot" N\_"slot" ^("subframe" ,μ). Each frame is divided into two equally-sized half-frames of five subframes each with half-frame 0 consisting of subframes 0 – 4 and half-frame 1 consisting of subframes 5 – 9.There is one set of frames in the uplink and one set of frames in the downlink on a carrier. Uplink frame number for transmission from the UE shall start T\_"TA" =(N\_"TA" +N\_"TA,offset" +N\_"TA,adj" ^"common" +N\_"TA,adj" ^"UE" ) T\_"c" before the start of the corresponding downlink frame at the UE where - N\_"TA" and N\_"TA,offset" are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where N\_"TA" =0 shall be used;- N\_"TA,adj" ^"common" is derived from the higher-layer parameters TACommon, TACommonDrift, and TACommonDriftVariation if configured, otherwise N\_"TA,adj" ^"common" =0; a UE may determine the one-way propagation time $Delay\_{common}$used for N\_"TA,adj" ^"common" calculation as follows:$Delay\_{common}\left(t\right)= D\_{Common }\left(t\_{epocℎ}\right)+ DCommonDrift× \left(t−t\_{epocℎ}\right)+DCommonDriftVariation× \left(t−t\_{epocℎ}\right)^{2} $, where, $D\_{Common }$, $DCommonDrift$, and $DCommonDriftVariation$, are provided by TACommon, TACommonDrift, and TACommonDriftVariation, respectively; and $Delay\_{common}\left(t\right) $ is the distance between the satellite and the uplink time synchronization reference point divided by the speed of light. The reference point is where DL and UL are frame aligned with an offset given by $N\_{TA,offset}$;- N\_"TA,adj" ^"UE" is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise N\_"TA,adj" ^"UE" =0.-------------------------------- end of TP#1------------------------------------------------------------------**Proposal 2: Adopt TP#2.** ------------------------------------ TP#2 TS 38.211 (in bleu)-----------------------------------------------4.3.1 Frames and subframesDownlink, uplink, and sidelink transmissions are organized into frames with duration, each consisting of ten subframes of duration. The number of consecutive OFDM symbols per subframe is N\_"symb" ^("subframe" ,μ)=N\_"symb" ^"slot" N\_"slot" ^("subframe" ,μ). Each frame is divided into two equally-sized half-frames of five subframes each with half-frame 0 consisting of subframes 0 – 4 and half-frame 1 consisting of subframes 5 – 9.There is one set of frames in the uplink and one set of frames in the downlink on a carrier. Uplink frame number for transmission from the UE shall start T\_"TA" =(N\_"TA" +N\_"TA,offset" +N\_"TA,adj" ^"common" +N\_"TA,adj" ^"UE" ) T\_"c" before the start of the corresponding downlink frame at the UE where - N\_"TA" and N\_"TA,offset" are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where N\_"TA" =0 shall be used;- N\_"TA,adj" ^"common" is derived from the higher-layer parameters TACommon, TACommonDrift, and TACommonDriftVariation if configured, otherwise N\_"TA,adj" ^"common" =0; - N\_"TA,adj" ^"UE" is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise N\_"TA,adj" ^"UE" =0.The provided highe layer parameters TACommon, TACommonDrift,TACommonDriftVariation and satellite-ephemeris-related parameters are with reference to an epoch time at a reference point. A UE may assume the epoch time as the start of a subframe n of a SFN m, if m and n are provided; otherwise, the UE may assume the epoch time as the end of a SI window in which the parameters are provided. The reference point is where DL and UL are frame aligned with an offset given by N\_(TA,offset).-------------------------------- end of TP#2------------------------------------------------------------------- |
| CATT | 1. Adopt the two following CRs on timing relationship and parameter descriptions:

**Updated CR 38.211:**

|  |
| --- |
| Uplink frame number  for transmission from the UE shall start $$T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$$before the start of the corresponding downlink frame at the UE where - - $N\_{TA}$ , $N\_{TA,offset}$ ,$ N\_{TA,adj}^{common}$ and $N\_{TA,adj}^{UE}$ are given by clause 4.2 of [5, TS 38.213]. |

 |
| Sony | **Proposal 1:** The agreed equation of $Delay\_{common}\left(t\right) $and epoch time $t\_{epoch}$ definition in RAN1 107-e should be captured in specification.**Proposal 2:** Following the text proposal can be considered for TS38.211 specification:>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted >>>>>>>>>>>>>>>>>>>>>>>>>>>>Uplink frame number  for transmission from the UE shall start $T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$ before the start of the corresponding downlink frame at the UE where- $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from two times one-way propagation time $Delay\_{common}\left(t\right)$ which is calculated from TAInfo-r17 if configured. If TAInfo-r17 is not configured, $N\_{TA,adj}^{common}=0$;* the $Delay\_{common}$ used for $N\_{TA,adj}^{common}$ is calculated as follows:

$$Delay\_{common}\left(t\right)= D\_{Common }\left(t\_{epoch}\right)+ DCommonDrift× \left(t−t\_{epoch}\right)+DCommonDriftVariation× \left(t−t\_{epoch}\right)^{2} $$Where:* $D\_{Common }=\frac{taCommon−r17}{2}$, $DCommonDrift=\frac{taCommonDrift−r17}{2}$ and $DCommonDriftVariation=\frac{taCommonDriftVariant−r17}{2}$
* $t\_{epoch}$ is derived as follows:
	+ EpochTime-r17 when configured through [SIB] or [dedicated signaling].
	+ otherwise, when indicated in [SIB (other than SIB1)], epoch time of assistance information is implicitly known as the end of the SI window during which the SI message is transmitted.

- $N\_{TA,adj}^{UE}$ is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted >>>>>>>>>>>>>>>>>>>>>>>>>>>> |
| Ericsson | [Proposal 2 Adopt the following TP for 3GPP TS 38.211:](#_Toc95768505) --------------------------------- Start of TP for 3GPP TS 38.211 ---------------------------------4.3.1 Frames and subframes<Unchanged Text Omitted>Uplink frame number  for transmission from the UE shall start $T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$ before the start of the corresponding downlink frame at the UE where- $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* if configured, otherwise $N\_{TA,adj}^{common}=0$;- $N\_{TA,adj}^{UE}$ is computed by the UE to pre-compensate for the two-way delay between the UE and the serving satellite, based on UE position and serving satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.--------------------------------- End of TP for 3GPP TS 38.211 ----------------------------------[Proposal 4 Adopt the following TP for 3GPP TS 38.211:](#_Toc95768507) ---------------------------------- Start of TP for 3GPP TS 38.211 ----------------------------------4.3.1 Frames and subframes<Unchanged Text Omitted>Uplink frame number  for transmission from the UE shall start $T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$ before the start of the corresponding downlink frame at the UE where- $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* as specified in [5, TS 38.213] if configured, otherwise $N\_{TA,adj}^{common}=0$;- $N\_{TA,adj}^{UE}$ is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.---------------------------------- End of TP for 3GPP TS 38.211 ----------------------------------- |

## Initial proposal and companies views’ collection for 1st round

Regarding CRs/TPs for 3GPP TS 38.211, based on the companies contributions recopied in section 11.1 Initial proposal 11 is made hereafter.

Let’s work as group to provide an appropriate wording for this TP:

**Initial proposal 11**

**Adopt the following TP for 3GPP TS 38.211:**

|  |
| --- |
| ---------------------------------- Start of TP for 3GPP TS 38.211 ----------------------------------**3.1 Frames and subframes**<Unchanged Text Omitted>Uplink frame number  for transmission from the UE shall start $$T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$$before the start of the corresponding downlink frame at the UE where - $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* as specified in [5, TS 38.213] if configured, otherwise $N\_{TA,adj}^{common}=0$;- $N\_{TA,adj}^{UE}$ is computed by the UE to pre-compensate for the two-way delay between the UE and the serving satellite, based on UE position and serving satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.Figure 4.3.1-1: Uplink-downlink timing relation.---------------------------------- End of TP for 3GPP TS 38.211 ----------------------------------- |

Companies are encouraged to provide views and comments within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | We support the intention of initial proposal 11. |
| Ericsson | Support. |
| Apple  | We are fine with the proposal.  |
| ZTE | We suggest following revisions on the TP:- $N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* ~~as specified in [5, TS 38.213]~~ if configured, otherwise $N\_{TA,adj}^{common}=0$;- $N\_{TA,adj}^{UE}$ is computed by the UE ~~to pre-compensate for the two-way delay between the UE and the serving satellite~~, based on UE position and serving satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.For common TA, as replied by 38.211 spec editor in RAN1#107e email discussion, the only difference between current description in 38.211 and the agreements “$N\_{TA, common}$ is derived by the UE based on $Delay\_{common}\left(t\right)$” is calculation of the intermediate variable $Delay\_{common}\left(t\right)$. But since how to derive the common TA through intermediate variable $Delay\_{common}\left(t\right)$ is left to UE implementation anyway, we prefer to just keep current simple description and avoid the introduction of additional unneeded intermediate concepts.For UE specific TA, there is no need to specify the purpose of calculation, which is not aligned with the style of specification. Moreover, no agreement clearly stated that the UE specific TA is to pre-compensate the **two-way** delay. Hence, we prefer to remove the description about the purpose and keep a simple specification. |
| NTT DOCOMO, INC. | Support. |
| Huawei, HiSilicon | Agree with the proposal. |
| NEC | OK.  |
| Panasonic | We support this TP. |
| Xiaomi | Support Initial proposal 11 |
| Sony | We are fine with this initial proposal if Topic#12 is agreed for clarification how to calculate the Delay\_common. |
| Intel | OK |
| MediaTek | Support |
| CMCC | We are OK with the proposal. ZTE’s revision is also fine. |
| OPPO | We support initial proposal 11. |
| Samsung | Support |
| CATT | Support  |
| Thales | Support |
| LG | We think that the specific comment regarding UE specific TA can be added in TS 38.213. On the other hands, after TS 38.331 for Rel-17 NTN is published, it can be considered to modify the “satellite-ephemeris-related higher-layers parameters” to the correct parameter name. |
| Lenovo | We prefer the sentence “to pre-compensate for the two-way delay between the UE and the serving satellite” to be deleted to avoid description of the purpose. We can define the formula as suggested by OPPO in TS38.211 or elsewhere. |

## Updated proposal and companies views’ collection for 2nd round

Companies [Nokia, Nokia Shanghai Bell, Ericsson, Apple, NTT DOCOMO, Huawei, HiSilicon, NEC, Panasonic, Xiaomi, Sony, Intel, MediaTek, CMCC, OPPO, Samsung, CATT, Thales] are supportive of the TP/proposal 11.

Regarding the comment of ZTE about $Delay\_{common}\left(t\right)$, from moderator perspective, the main intention of capturing calculation of this intermediate variable is to clearly capture in the specs how the UE interprete/use the indicated high layer common TA parameters.

According to LG the specific comment regarding UE specific TA can be added in TS 38.213.

Lenovo prefers to remove the sentence “to pre-compensate for the two-way delay between the UE and the serving satellite” to avoid description of the purpose.

From Moderator perspective, the sentences highlighted by ZTE, LGE and Lenovo can be removed and captured in the TS 38.213.

Based on the above, the TP for 3GPP TS 38.211 is updated as follows:

**Updated proposal 11**

**Adopt the following TP for 3GPP TS 38.211:**

|  |
| --- |
| ---------------------------------- Start of TP for 3GPP TS 38.211 ----------------------------------**3.1 Frames and subframes**<Unchanged Text Omitted>Uplink frame number  for transmission from the UE shall start $$T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$$before the start of the corresponding downlink frame at the UE where - $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* as specified in [5, TS 38.213] if configured, otherwise $N\_{TA,adj}^{common}=0$;- $N\_{TA,adj}^{UE}$ is computed by the UE to pre-compensate for the two-way delay between the UE and the serving satellite based on UE position and serving satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.Figure 4.3.1-1: Uplink-downlink timing relation.---------------------------------- End of TP for 3GPP TS 38.211 ----------------------------------- |

Companies are encouraged to provide views and comments within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Moderator | The proposal is being discussed via the reflector for mail endorsement |
| LG | Agree.On the other hands, after TS 38.331 for Rel-17 NTN is published, it can be considered to modify the “satellite-ephemeris-related higher-layers parameters” to the correct parameter name. |
| Lenovo | Support. |
| Sony | We agree with it if calculation of $Delay\_{common}\left(t\right)$ is specified in TS38.213. |
| OPPO | We have a different opinion on the removed sentence. We think the spec should give a clear definition of the parameter thus I would not interpret it as a purpose but rather a definition. If the definition is not given, how shall we expect to implement this specification. $N\_{TA,adj}^{UE}$ is a two way delay between the UE and the serving satellite, derived ~~computed~~ by the UE to pre-compensate for the two-way delay between the UE and the serving satellite based on UE position and serving satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$. |
| ZTE | Support. We think specification should focus on what UE should do instead of the purpose. There is no need to introduce new terminology just to describe the purpose. |

# [Active] Topic#12 CRs/TPs for 3GPP TS 38.213

The original CR can be found in [R1-2112934](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_107-e/Docs/R1-2112934.zip).

## Companies’ contributions summary

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| --- | --- |
| **Companies** | **Proposals** |
| CATT | Updated CR 38.213 with added wording in red color:

|  |
| --- |
| **4.2 Transmission timing adjustments**UE periodically reads SIB message to acquire assisted information including satellite ephemeris and commonTA parameter, and timing advance is adjusted according to UE GNSS position information and assistance information indicated by the network. The network broadcast the validity duration for assistance information by high-level parameter ntnUlSyncValidityDuration in the SIB message. The UE assumes that it has lost uplink synchronization if serving satellite ephemeris and Common TA parameter are not available within the associated validity duration.A UE can be provided a value $N\_{TA,offset}$ of a timing advance offset for a serving cell by n-TimingAdvanceOffset for the serving cell. If the UE is not provided n-TimingAdvanceOffset for a serving cell, the UE determines a default value $N\_{TA,offset}$ of the timing advance offset for the serving cell as described in [10, TS 38.133]. If a UE is configured with two UL carriers for a serving cell, a same timing advance offset value $N\_{TA,offset}$ applies to both carriers. Upon reception of a timing advance command for a TAG, the UE adjusts uplink timing for PUSCH/SRS/PUCCH transmission on all the serving cells in the TAG based on a value $N\_{TA,offset}$ that the UE expects to be same for all the serving cells in the TAG and based on the received timing advance command where the uplink timing for PUSCH/SRS/PUCCH transmissions is the same for all the serving cells in the TAG. For a band with synchronous contiguous intra-band EN-DC in a band combination with non-applicable maximum transmit timing difference requirements as described in Note 1 of Table 7.5.3-1 of [10, TS 38.133], if the UE indicates ul-TimingAlignmentEUTRA-NR as 'required' and uplink transmission timing based on timing adjustment indication for a TAG from MCG and a TAG from SCG are determined to be different by the UE, the UE adjusts the transmission timing for PUSCH/SRS/PUCCH transmission on all serving cells part of the band with the synchronous contiguous intra-band EN-DC based on timing adjustment indication for a TAG from a serving cell in MCG in the band. The UE is not expected to transmit a PUSCH/SRS/PUCCH in one CG when the PUSCH/SRS/PUCCH is overlapping in time, even partially, with random access preamble transmitted in another CG.$N\_{TA,adj}^{common}$ is derived from the higher-layer parameters TACommon, TACommonDrift, and TACommonDriftVariation if configured, otherwise $N\_{TA,adj}^{common}=0$.$N\_{TA,adj}^{UE}$ is UE self-estimated TA to pre-compensate for the service link delay. And it is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}$ is updated automatically by UE based on orbit modelling.$N\_{TA}$ is Timing advance adjust value and updated based on TA Command field in msg2/msgB and MAC CE TA command. It is defined as 0 for PRACH.For a SCS of  kHz, the timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG in multiples of . The start timing of the random access preamble is described in [4, TS 38.211]. |

 |
| Ericsson | [Proposal 3 Adopt the following TP for 3GPP TS 38.213:](#_Toc95768506) --------------------------------- Start of TP for 3GPP TS 38.213 ----------------------------------4.2 Transmission timing adjustments<Unchanged Text Omitted>Using higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation*, if configured, the UE shall determine $N\_{TA,adj}^{common}$ to pre-compensate the two-way transmission delay between the satellite and the uplink time synchronization reference point as follows:The one-way transmission delay function $Delay\_{common}(t)$ gives the distance at time $t$ between the satellite and the uplink time synchronization reference point divided by the speed of light and is defined as$$Delay\_{common}\left(t\right)= DCommon+ DCommonDrift×\left(t−t\_{epocℎ}\right)+DCommonDriftVariation×\left(t−t\_{epocℎ}\right)^{2} $$where $t\_{epocℎ}$ is the epoch time of the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* and $DCommon=TACommon/2$, $DCommonDrift=TACommonDrift/2$ and $DCommonDriftVariation=TACommonDriftVariation/2$.For transmission of UL slot $n$, the UE shall determine the $N\_{TA,adj}^{common}$ that corresponds to the two-way transmission delay $\left⌊(Delay\_{common}\left(t\_{UL}\right)+Delay\_{common}\left(t\_{DL}\right))/T\_{c}\right⌋$, where* $t\_{DL}=t\_{ref}+Delay\_{common}\left(t\_{DL}\right)$
* $t\_{UL}=t\_{ref}−\left(N\_{TA}+N\_{TA,offset}\right)×T\_{C}− Delay\_{common}\left(t\_{UL}\right)$
* $t\_{ref}$ is the transmission time of the corresponding DL slot $n$ from the uplink time synchronization reference point.

---------------------------------- End of TP for 3GPP TS 38.213 --------------------------------- |

## Initial proposal and companies views’ collection for 1st round

Moderator view: the formula of $Delay\_{common}\left(t\right)$ agreed in previous RAN1 meeting is essential because it provides how the UE interpret/use the Common TA related parameters indicated by the Network. It is also used by the UE to compute/derive the $N\_{TA,adj}^{common}$. From this perspective, the agreement on $Delay\_{common}\left(t\right)$ made at previous RAN1 meeting should be captured in the specs. TS 38.213 is the right place for that. Nevertheless, how the UE derive the $N\_{TA,adj}^{common}$ from $Delay\_{common}\left(t\right)$ might be left the UE implementation and thereby, it is not needed to be captured in the specifications.

To the moderator understanding the procedure captured in the proposed TP by Ericsson and the definition of tref allows the UE implementation to determine the common delay using higher-layer parameters TACommon, TACommonDrift, and TACommonDriftVariation, if configured. As mentioned earlier, This (last paragraph in TP by Ericsson) may not be needed to be given by the spec.

I had an offline discussion with specs editors during RAN1#107e meeting. It could be useful to have in mind their feedback, recalled hereafter:

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| **Some feedback from 38.211 spec editor during the 107e email discussions**:I am not sure how to capture this in the 211/213 specs, maybe because I have not followed the detailed discussion during the meeting.First, the agreement says “the UE can”, not “the UE shall”. I interpret this as different algorithms can be used as long as the UE fulfills the requirements (“can” in specifications “indicates that something is possible”). Furthermore, as Aris points out, what does “$N\_{TA, common}$ is derived by the UE based on $Delay\_{common}\left(t\right)$” mean from a specification perspective? t\_epoch and “uplink time synchronization reference point” also needs to be defined if we are to capture this as mandatory text in 211 or 213. In 38.211 we currently have the text “$N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* if configured , otherwise $N\_{TA,adj}^{common}=0$” which I think decently well reflects the agreement. The agreements says that “$N\_{TA, common}$ is derived by the UE based on $Delay\_{common}\left(t\right)$” so the only difference between 38.211 and the agreements is calculation of the intermediate variable $Delay\_{common}\left(t\right)$, but since we anyway has not defined of to use that intermediate variable I don’t see much of a difference between 211 and the agreements.So far my assumption has been to cover any additional details/requirements needed in 38.133, e.g. in section 7.3 (but I have not checked this with the 133 editor). This would allow the UE to, based on the RRC parameters and whatever measurements that is implemented, compute N\_TA,common (for N\_TA,UE-specific, the agreements already says it is up to the implementation). Any algorithm would be allowed as long as it fulfills the requirements in 38.133. If the intention is to mandate a specific way of calculating N\_TA,common I think we need more decisions nailing down the details.**Some feedback from 38.213 spec editor during the 107e email discussions:**I’m unsure of what needs to be in 213 and how it can be captured.For example, I expected TACommon, TACommonDrift and TACommonDriftVariation to be in 211.Then, what does “$N\_{TA, common}$ is derived by the UE based on $Delay\_{common}\left(t\right)$” mean from a specification perspective?How is the derivation done? |

Let’s work as group to provide an appropriate wording for this TP.

By considering the TPs from CATT and Ericsson, the following proposal is made:

**Initial proposal 12**

**Adopt the following TP for 3GPP TS 38.213:**

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| --- |
| --------------------------------- Start of TP for 3GPP TS 38.213 ----------------------------------4.2 Transmission timing adjustments<Unchanged Text Omitted>A UE can be provided a value $N\_{TA,offset}$ of a timing advance offset for a serving cell by n-TimingAdvanceOffset for the serving cell. If the UE is not provided n-TimingAdvanceOffset for a serving cell, the UE determines a default value $N\_{TA,offset}$ of the timing advance offset for the serving cell as described in [10, TS 38.133]. If a UE is configured with two UL carriers for a serving cell, a same timing advance offset value $N\_{TA,offset}$ applies to both carriers. Upon reception of a timing advance command for a TAG, the UE adjusts uplink timing for PUSCH/SRS/PUCCH transmission on all the serving cells in the TAG based on a value $N\_{TA,offset}$ that the UE expects to be same for all the serving cells in the TAG and based on the received timing advance command where the uplink timing for PUSCH/SRS/PUCCH transmissions is the same for all the serving cells in the TAG. For a band with synchronous contiguous intra-band EN-DC in a band combination with non-applicable maximum transmit timing difference requirements as described in Note 1 of Table 7.5.3-1 of [10, TS 38.133], if the UE indicates ul-TimingAlignmentEUTRA-NR as 'required' and uplink transmission timing based on timing adjustment indication for a TAG from MCG and a TAG from SCG are determined to be different by the UE, the UE adjusts the transmission timing for PUSCH/SRS/PUCCH transmission on all serving cells part of the band with the synchronous contiguous intra-band EN-DC based on timing adjustment indication for a TAG from a serving cell in MCG in the band. The UE is not expected to transmit a PUSCH/SRS/PUCCH in one CG when the PUSCH/SRS/PUCCH is overlapping in time, even partially, with random access preamble transmitted in another CG.UE can be provided satellite position by higher layer ephemeris parameters indicated in NTN SIB in Keplerian or PV state vector format. Using satellite position and its own position the UE can calculate $N\_{TA,adj}^{UE}$ which is used to compensate the two-way transmission delay on the service link.Using indicated Higher-layer Common TA parameters, if configured, the UE can determine the one-way propagation time ( $Delay\_{common})$ used for $N\_{TA, common}$  calculation as follows:$$Delay\_{common}\left(t\right)= DCommon+ DCommonDrift×\left(t−t\_{epocℎ}\right)+DCommonDriftVariation×\left(t−t\_{epocℎ}\right)^{2} $$Where $t\_{epocℎ}$ is the epoch time of the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation*. And $DCommon=TACommon/2$, $DCommonDrift=TACommonDrift/2$ and $DCommonDriftVariation=TACommonDriftVariation/2$.This one-way transmission delay function $Delay\_{common}(t)$ gives the distance at time $t$ between the satellite and the uplink time synchronization reference point divided by the speed of light.DL and UL are frame aligned at the reference point with an offset given by $N\_{TA,offset}$.$N\_{TA,adj}^{common} $is derived by the UE based on $Delay\_{common}\left(t\right)$ to pre-compensate the two-way transmission delay between the uplink time reference point and the satellite.For a SCS of  kHz, the timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG in multiples of . The start timing of the random access preamble is described in [4, TS 38.211].---------------------------------- End of TP for 3GPP TS 38.213 --------------------------------- |

Companies are encouraged to provide views and comments within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | Agree with the intention of initial proposal 12. Since the current agreements does not relate to the “shall” terminology, we need to leave ways for the UE to perform the needed calculations. |
| Ericsson | * We share the moderator's view that the formula of $Delay\_{common}\left(t\right)$ is essential and should be captured in 38.213.
* We are ok with not explicitly specifying how the UE derives the $N\_{TA,adj}^{common}$ from $Delay\_{common}\left(t\right)$, as long as it is clear what the target offset at the reference point is. This is captured by the TP, in particular the sentence "DL and UL are frame aligned at the reference point with an offset given by $N\_{TA,offset}$", which should be clear enough.
* Since 38.213 is a normative specification, "can" should be avoided.

Based on the comments above (and some rewording to align wording and improve readability), we propose the following modifications to the TP: Using higher-layer ephemeris parameters for the serving satellite, if configured, the UE shall calculate $N\_{TA,adj}^{UE}$, using serving satellite position and its own position, to pre-compensate the two-way transmission delay on the service link.Using indicated higher-layer Common TA parameters, if configured, the UE shall determine the one-way propagation time ( $Delay\_{common})$ used for $\_{}$  $\_{}^{}$ calculation as follows:$$Delay\_{common}\left(t\right)= DCommon+ DCommonDrift×\left(t−t\_{epocℎ}\right)+DCommonDriftVariation×\left(t−t\_{epocℎ}\right)^{2} $$where $t\_{epocℎ}$ is the epoch time of the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation,* and $DCommon=TACommon/2$, $DCommonDrift=TACommonDrift/2$ and $DCommonDriftVariation=TACommonDriftVariation/2$.This one-way transmission delay function $Delay\_{common}(t)$ gives the distance at time $t$ between the satellite and the uplink time synchronization reference point divided by the speed of light.DL and UL are frame aligned at the uplink time synchronization reference point with an offset given by $N\_{TA,offset}$.The UE shall derive $N\_{TA,adj}^{common} $based on $Delay\_{common}\left(t\right)$ to pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the satellite. |
| Apple | We are fine with the proposal.  |
| ZTE | We do not support to adopt the TP. As replied by replied by the editors, the only difference between current description in 38.211 and the agreements “$N\_{TA, common}$ is derived by the UE based on $Delay\_{common}\left(t\right)$” is calculation of the intermediate variable $Delay\_{common}\left(t\right)$. However, how to derive the common TA through intermediate variable $Delay\_{common}\left(t\right)$ is left to UE implementation anyway. Therefore, the introduction of additional intermediate concepts like “one-way propagation delay” and “two-way transmission delay” is not needed and not aligned with the style of specification. We prefer current specification without revision. |
| NTT DOCOMO, INC. | We agree the $Delay\_{common}$ for common TA calculation to be captured in TS 38.213. The initial proposal 12 is generally fine for us.When $Delay\_{common} $is captured, it is better to clarify the unit of μs, and its relationship with estimated common TA $T\_{TA,adj}^{common}$. |
| Huawei, HiSilicon | We share similar views with ZTE that even the one-way propagation delay formula is captured in the specification. How the UE would actually determine the N\_TA,common based on this is still based on UE implementation.  |
| NEC  | We are generally fine with the proposal. |
| Panasonic | We generally agree. “NTN SIB” is a very casual usage. Will it be the official language? |
| Sony | Support the TP. |
| MediaTek | We are generally supportive of this TP. It is a useful clarification for the implementation, without specifying the method to determine the common delay from the common TA parameters which should be up to the UE implementation. The revisions from Ericsson are fine. |
| OPPO | In RAN1#107-e meeting, we agreed that the model of common TA should be known to UE, but the UE should be allowed to determine the common TA using different algorithm, I.e. UE implementation. Thus, Ericsson’s revision is too much restrictive to UE implementation, which does not follow the RAN1#107-e discussion outcome. For this reason, we support the initial proposal.  |
| Samsung | Fine with the TP |
| CATT | Share same view with ZTE, no need to restrict the implementation. |
| LG | We can modify it as follows:UE can be provided satellite ~~position~~ ephemeris information by higher layer ~~ephemeris~~ parameters indicated in NTN SIB. ~~in Keplerian or PV state vector format.~~ Using satellite ~~position~~ ephemeris information and its own position, the UE can calculate $N\_{TA,adj}^{UE}$ which is used to compensate the two-way transmission delay between the UE and the satellite. ~~on the service link.~~Using indicated ~~H~~ higher-layer Common TA parameters, if configured, the UE can determine the one-way propagation time ( $Delay\_{common})$ used for $N\_{TA, common}$  calculation as follows:$$Delay\_{common}\left(t\right)= DCommon\frac{TACommon}{2}+ DCommonDrift \frac{TACommonDrift}{2} ×\left(t−t\_{epocℎ}\right)+DCommonDriftVariation\frac{TACommonDriftVariation}{2}×\left(t−t\_{epocℎ}\right)^{2} $$~~W~~ where $t\_{epocℎ}$ is the epoch time of the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation*. ~~And~~ $DCommon=TACommon/2$~~,~~ $DCommonDrift=TACommonDrift/2$ ~~and~~ $DCommonDriftVariation=TACommonDriftVariation/2$~~.~~~~This one-way transmission delay function~~ $Delay\_{common}(t)$ ~~gives the distance at time~~ $t$ ~~between the satellite and the uplink time synchronization reference point divided by the speed of light.~~~~DL and UL are frame aligned at the reference point with an offset given by~~ $N\_{TA,offset}$~~.~~$N\_{TA,adj}^{common} $is derived by the UE based on $Delay\_{common}\left(t\right)$ to pre-compensate the two-way transmission delay between the uplink time reference point and the satellite. |
| Lenovo | Fine with this proposal. |

## Updated proposal and companies views’ collection for 2nd round

14 Companies supportive of Initial proposal 12: [Nokia, Nokia Shanghai Bell, Ericsson (with revision), Apple, NTT DOCOMO, NEC, Panasonic, Sony, MediaTek, OPPO, Samsung, LG, Thales, Lenovo]

[ZTE, Huawei, HiSilicon, CATT] do not support the proposal and share the view that even the one-way propagation delay formula is captured in the specification. How the UE would actually determine the N\_TA,common based on this is still based on UE implementation.

Moderator view: As already mentioned, the formula of $Delay\_{common}\left(t\right)$ agreed in previous RAN1 meeting is essential because it provides how the UE interpret/use the Common TA related parameters indicated by the Network. It is also used by the UE to compute/derive the N\_"TA,adj" ^"common" . From this perspective, the agreement on 〖Delay〗\_common (t) made at previous RAN1 meeting should be captured in the specs.

Based on the above and by considering the revisions from Ericsson and LGE, the Updated proposal 12 is made as follows:

**Updated proposal 12**

**Adopt the following TP for 3GPP TS 38.213:**

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| --- |
| --------------------------------- Start of TP for 3GPP TS 38.213 ----------------------------------4.2 Transmission timing adjustments<Unchanged Text Omitted>A UE can be provided a value $N\_{TA,offset}$ of a timing advance offset for a serving cell by n-TimingAdvanceOffset for the serving cell. If the UE is not provided n-TimingAdvanceOffset for a serving cell, the UE determines a default value $N\_{TA,offset}$ of the timing advance offset for the serving cell as described in [10, TS 38.133]. If a UE is configured with two UL carriers for a serving cell, a same timing advance offset value $N\_{TA,offset}$ applies to both carriers. Upon reception of a timing advance command for a TAG, the UE adjusts uplink timing for PUSCH/SRS/PUCCH transmission on all the serving cells in the TAG based on a value $N\_{TA,offset}$ that the UE expects to be same for all the serving cells in the TAG and based on the received timing advance command where the uplink timing for PUSCH/SRS/PUCCH transmissions is the same for all the serving cells in the TAG. For a band with synchronous contiguous intra-band EN-DC in a band combination with non-applicable maximum transmit timing difference requirements as described in Note 1 of Table 7.5.3-1 of [10, TS 38.133], if the UE indicates ul-TimingAlignmentEUTRA-NR as 'required' and uplink transmission timing based on timing adjustment indication for a TAG from MCG and a TAG from SCG are determined to be different by the UE, the UE adjusts the transmission timing for PUSCH/SRS/PUCCH transmission on all serving cells part of the band with the synchronous contiguous intra-band EN-DC based on timing adjustment indication for a TAG from a serving cell in MCG in the band. The UE is not expected to transmit a PUSCH/SRS/PUCCH in one CG when the PUSCH/SRS/PUCCH is overlapping in time, even partially, with random access preamble transmitted in another CG.Using higher-layer ephemeris parameters for the serving satellite, if configured, the UE shall calculate $N\_{TA,adj}^{UE}$, using serving satellite position and its own position, to pre-compensate the two-way transmission delay on the service link.Using indicated higher-layer Common TA parameters, if configured, the UE shall determine the one-way propagation time ( $Delay\_{common})$ used for  $N\_{TA,adj}^{common}$ calculation as follows:$$Delay\_{common}\left(t\right)= \frac{TACommon}{2}+ \frac{TACommonDrift}{2}×\left(t−t\_{epocℎ}\right)+\frac{TACommonDriftVariation}{2}×\left(t−t\_{epocℎ}\right)^{2} $$where $t\_{epocℎ}$ is the epoch time of the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation.*This one-way transmission delay function $Delay\_{common}(t)$ gives the distance at time $t$ between the satellite and the uplink time synchronization reference point divided by the speed of light.DL and UL are frame aligned at the uplink time synchronization reference point with an offset given by $N\_{TA,offset}$.The UE shall derive $N\_{TA,adj}^{common} $based on $Delay\_{common}\left(t\right)$ to pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the satellite.For a SCS of  kHz, the timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG in multiples of . The start timing of the random access preamble is described in [4, TS 38.211].---------------------------------- End of TP for 3GPP TS 38.213 --------------------------------- |

Companies are encouraged to provide views and comments within the following table:

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| **Companies** | **Comments and Views** |
| LG | We thinks it is sufficient to define the equation of one-way common delay. Therefore, we can remove two sentences as follows:~~This one-way transmission delay function~~ $Delay\_{common}(t)$ ~~gives the distance at time~~ $t$ ~~between the satellite and the uplink time synchronization reference point divided by the speed of light.~~~~DL and UL are frame aligned at the uplink time synchronization reference point with an offset given by~~ $N\_{TA,offset}$~~.~~ |
| Lenovo | Support moderator’s proposal. |
| Sony | We support the updated TP. |
| OPPO | We are not supportive to the updated TP. The word ‘shall’ should be replaced with ‘can’ or ‘may’ to not limit UE implementation. Using higher-layer ephemeris parameters for the serving satellite, if configured, the UE may ~~shall~~ calculate $N\_{TA,adj}^{UE}$, using serving satellite position and its own position, to pre-compensate the two-way transmission delay on the service link.Using indicated higher-layer Common TA parameters, if configured, the UE may ~~shall~~ determine the one-way propagation time ( $Delay\_{common})$ used for  $N\_{TA,adj}^{common}$ calculation as follows:$$Delay\_{common}\left(t\right)= \frac{TACommon}{2}+ \frac{TACommonDrift}{2}×\left(t−t\_{epocℎ}\right)+\frac{TACommonDriftVariation}{2}×\left(t−t\_{epocℎ}\right)^{2} $$where $t\_{epocℎ}$ is the epoch time of the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation.*This one-way transmission delay function $Delay\_{common}(t)$ gives the distance at time $t$ between the satellite and the uplink time synchronization reference point divided by the speed of light.DL and UL are frame aligned at the uplink time synchronization reference point with an offset given by $N\_{TA,offset}$.The UE may ~~shall~~ derive $N\_{TA,adj}^{common} $based on $Delay\_{common}\left(t\right)$ to pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the satellite. |
| ZTE | We can compromise to capture the formula of $Delay\_{common}\left(t\right)$ . However, we still think specification should focus on what UE should do. It is not preferred to introduce new but unnecessary terminology and description to just illustrate the purposes. Therefore, the first and last paragraphs illustrating the purposes of $N\_{TA,adj}^{UE}$ and $N\_{TA,adj}^{common}$ are not necessary (38.211 has already defined them in the formula of TA). And there is no need to introduce the terminology “one-way propagation time”, etc., to describe the purpose of $Delay\_{common}(t)$. We only need to specify how to calculate $Delay\_{common}(t)$.Based on above consideration, we propose following modifications:~~Using higher-layer ephemeris parameters for the serving satellite, if configured, the UE shall calculate~~ $N\_{TA,adj}^{UE}$~~, using serving satellite position and its own position, to pre-compensate the two-way transmission delay on the service link.~~~~Using indicated higher-layer Common TA parameters, if configured, the UE shall determine the one-way propagation time (~~ $Delay\_{common})$ ~~used for~~$N\_{TA,adj}^{common}$ ~~calculation as follows:~~$N\_{TA,adj}^{common} $is derived by the UE based on $Delay\_{common}\left(t\right)$ ,which can be obtained as:$$Delay\_{common}\left(t\right)= \frac{TACommon}{2}+ \frac{TACommonDrift}{2}×\left(t−t\_{epocℎ}\right)+\frac{TACommonDriftVariation}{2}×\left(t−t\_{epocℎ}\right)^{2} $$where $t\_{epocℎ}$ is the epoch time of the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation.*This ~~one-way transmission delay function~~ $Delay\_{common}(t)$ gives the distance at time $t$ between the satellite and the uplink time synchronization reference point divided by the speed of light.DL and UL are frame aligned at the uplink time synchronization reference point with an offset given by $N\_{TA,offset}$.~~The UE shall derive~~ $N\_{TA,adj}^{common} $~~based on~~ $Delay\_{common}\left(t\right)$ ~~to pre-compensate the two-way transmission delay between the uplink time synchronization reference point and the satellite.~~ |

# [Active] Topic#13 Reply LS on NR NTN Neighbour Cell and Satellite Information

## Companies’ contributions summary

RAN2 has requested input from RAN1 on whether common TA parameters of the neighbour cells need to be provided to the UEs for neighbour cell measurements. Response LS needed

R1-2200883- Reply LS on NR NTN Neighbour Cell and Satellite Information - RAN2, Qualcomm is recopied hereafter.

Original LS from RAN4 can be found in R4-2120309 LS on NR NTN Neighbor Cell and Satellite Information.

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| **R1-2200883/ R2-2201884:****1. Overall Description:**RAN2 would like to thank RAN4 for the LS. RAN2 would like to provide following response.Question-1: Would the parameters listed above be relevant to measurements and mobility? If the answer is dependent on satellite types, e.g. GSO and NGSO, and RRC state, what would be the answers to the respective satellite types? RAN2 answer: For measurement purpose, SMTCs, ephemeris, epoch time and DL polarization information would be relevant regardless of satellite types and RRC state. RAN2 has agreed the assumption that feeder link delay is known to and compensated by the network. The network can compensate feeder link delay to configure SMTCs to UEs in the connected mode. In addition, RAN2 has agreed for IDLE mode measurements that UE autonomously adjusts the SMTCs based on location and ephemeris. It is FFS whether network assistance information is provided to UEs. RAN2 think feeder link delay (i.e., common TA and K\_MAC) of the neighbor cell should also be provided to UE for neighbor cell SMTC adjustment. However, RAN1 feedback is needed to decide whether common TA parameters (*TACommon*, *TACommonDrift*, *TACommonDriftVariation* and [*TACommonThirdOrder*]) of the neighbor cells need to be provided to the UEs for neighbor cell measurements. RAN2 assumes it is up to network whether to use PVT format or Keplerian format for both serving and neighbor cells. RAN1 feedback is needed to decide whether the validity timer information for serving and neighbor/target cell needs to be different or whether there will be separate validity timers for PVT parameters and orbital parameters.RAN1-107e had made the conclusion that DL frequency compensation by gNB for the service link Doppler is not supported in Release 17, therefore, (A4) and (B4) are not needed.For handover, a UE would need those parameters listed in the LS regardless of satellite types except (B4).Question-2: Would there be parameters that are not listed but necessary for measurements and mobility from RAN2 perspective? If the answer is dependent on satellite types, e.g. GSO and NGSO, and RRC state, what would be the answers to the respective satellite types?RAN2 answer: For neighbor cell measurement, please see the response to the Question 1. Additionally for IDLE mode measurement trigger in NGSO fixed cell, (A6): serving cell stop time and reference location are also needed.For handover, following additional parameters are also needed. (B7): Epoch time of the ephemeris (B8): Kmac (to determine UE-gNB RTT and perform RACH to target), Question-3: Would the parameters be available to UE, e.g. provided by serving cell, for measurements and mobility? If the answer is dependent on satellite types, e.g. GSO and NGSO, and RRC state, what would be the answers to the respective satellite types?RAN2 answer: Yes. Questions-4: What would be the expected UE behavior from the perspective of handover, measurement, and measurement reporting if any or all of the information listed above is not provided to the UE by a serving cell or if any of all of the provided information cannot be used by the UE because, e.g. the validity timer expires? If the answer is dependent on satellite types, e.g. GSO and NGSO, and RRC state, what would be the answers to the respective satellite types?RAN2 answer: RAN2 assumes all the information needed for measurement and handover would be provided to the UE by the network. If any of the information is not available or is not valid, then the UE would have to acquire the system information of the target or neighbor cell which is not desirable from handover interruption time point of view.**2. Actions:****To** **RAN4.****ACTION:** RAN2 respectfully asks RAN4 to take into account the above information and provide feedback if needed.**To RAN1.****ACTION:** RAN2 respectfully asks RAN1 to take into account the above information and provide answer to the Question 1 on whether following parameters need to be provided to UEs for neighbor cell measurements and handover1. A2/B2 (common TA parameters),
2. A3/B3 (Validity timer information for neighbor cell measurements/target cell mobility, e.g. if it is different from that for serving cell open loop TA control),
3. Separate validity durations for PVT parameters and Orbital parameters, and
4. A5/B5 (DL and UL Polarization information).
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| **Companies** | **Proposals** |
| Xiaomi | **Proposal 2:** The common TA parameters of neighbour cells need to be provided to the UEs if the feeder link delay is not compensated by the network. The common TA parameters of neighbour cells is not needed to the UEs if the feeder link delay is compensated by the network.**Proposal 3:** The validity timer information for serving and neighbour/target cell can be different. |
| PANASONIC R&D Center Germany | **Proposal 4:** Contents of NTN SIB of the target cell including common TA parameters would need to be indicated to the UE. Discussion on how these parameters are indicated to the UE is necessary.**Proposal 3:** Because epoch time is expressed by SFN and subframe number, discussion on how the UE obtains the neighbor cell SFN would be necessary. The following options should be considered. Option 1: gNB provides information on the neighbor cell SFN together with the epoch timeOption 2: UE determines the epoch time based on the SFN obtained from the neighbor cell’s MIB.  |
| NTT DOCOMO, INC. | **Proposal 6:** Support dedicated signalling to provide the NTN validity duration together with common TA parameters and satellite ephemeris, which has the same information as NTN-specific SIB, to a UE in RRC\_CONNECTED. |
| Nokia, Nokia Shanghai Bell | **Proposal 14:** The need for providing A2/B2 should be evaluated by RAN4 rather than RAN1, as it relates to the UE’s ability to track SSB transmissions that are drifting in time relative to serving satellite transmissions if the cells are not transmitted from the same satellite.**Proposal 15:** For neighbor measurements for cells that are not co-located in the same satellite, the validity timer (A3/B3) should be associated to the neighbor satellite rather than the serving satellite.**Proposal 16:** PVT and Orbital parameters (and Common TA related parameters) share a single validity duration.**Proposal 17:** DL and UL Polarization information may be supported for neighbor cell measurements. |

## Initial proposal and companies views’ collection for 1st round

In original LS from RAN4, the parameters are categorized into two groups as follows:

**For NTN UE measurements, e.g. neighbor cell measurement within- or inter-satellite**:

(A1) Neighbor cell Ephemeris information and the format, e.g. PVT format or Keplarian format

(A2) Common TA

(A3) Validity timer information for neighbor cell measurements, e.g. if it is different from that for serving cell open loop TA control

- Would the timer length, if provided, be different from that for serving cell? For example, a required accuracy of service and/or feeder link delay information for neighbor cell measurement may not need to be as accurate as that for serving cell open loop TA control.

(A4) The amount of frequency compensation, if DL frequency compensation for the service link Doppler is applied

(A5) DL Polarization information

**For NTN UE mobility, e.g. target cell measurement, synchronization, and (conditional) handover within- or inter-satellite**:

(B1) Target cell Ephemeris information and the format, e.g. PVT format or Keplarian format

(B2) Common TA

(B3) Validity timer information for target cell mobility, e.g. if it is different from that for serving cell open loop TA control

(B4) The amount of frequency compensation, if DL frequency compensation for the service link Doppler is applied

(B5) DL and UL Polarization information

(B6) K\_offset

**Initial Proposal 13:**

**Companies are encouraged to provide answer to the Question 1 on whether following parameters need to be provided to UEs for neighbor cell measurements and handover:**

1. **A2/B2 (common TA parameters),**
2. **A3/B3 (Validity timer information for neighbor cell measurements/target cell mobility, e.g. if it is different from that for serving cell open loop TA control),**
3. **Separate validity durations for PVT parameters and Orbital parameters, and**
4. **A5/B5 (DL and UL Polarization information).**

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| Nokia, Nokia Shanghai Bell | 1. This need to be addressed by RAN4 rather than RAN1
2. If satellite for neighbor cell is different, different validity timers would need to apply.
3. The PVT and orbital parameters should have same validity duration (similar as for serving satellite ephemeris)
4. According to current RAN1 agreements, there should be provided as parameters.
 |
| Ericsson | 1. Needed in HO command. Also needed for neighbour cell measurements if UE is required to do autonomous neighbour cell SMTC adjustments.
2. Validity duration is needed for neighbor cell measurements and mobility.
3. The validity duration may be different for serving/target and neighbour cells. The validity duration does not depend on ephemeris format (i.e. PVT parameters or Orbital parameters). It is up to the network to decide which ephemeris format to use for which cell.
4. At RAN1#106-e, it was agreed that polarization information is to be included:

Agreement:Support polarization signalling for target serving cell in handover command message.Agreement:Support polarization signalling for non-serving cell in RRM measurement configuration. |
| Apple | (1). Okay(2). For A3/B3, we think it should be validity duration, rather than validity timer. (3). We assume only one ephemeris parameter format is used in one time for a cell. Either PVT parameters or orbital parameters. The validity duration may be different. (4). Okay  |
| ZTE | For (1), we think common TA parameters should be provided to achieve UL synchronization in handover and estimating SMTC delay in measurement.For (2), validity timer information should be provided based on neighbor cell since it may be different from the serving cell.For (3), PVT and Orbital parameters should share the same validity duration. For serving cell, only one UL sync validity duration is agreed for both ephemeris formats. Hence, there is no need to separate validity duration for different ephemeris format for neighbor cell.For (4), the polarization information should be provided as the agreements listed by Ericsson have been achieved in RAN1#106be  |
| NTT DOCOMO, INC. | For neighbor cell measurement and HO cases, (1)common TA parameters and (2)validity timer information are needed. When served by different satellites, (3)separate validity durations of satellite ephemeris will be needed.The (4)polarization information is supported in current agreements. |
| Huawei, HiSilicon | We support to include the parameters in (1)(2)(4) for neighbor cell measurements and handover. For (3), we don’t think there is need to differentiate validity duration between ephemeris formats.  |
| NEC | We think (1) (2) and (4) are needed by the UE for neighbor cell measurements and handover.  |
| Panasonic | (1)(2) Common TA parameters (A2/B2) and validity timer information (A3/B3) needs to be provided to UEs for neighbor cell measurement and handover. (3) validity duration is common for satellite ephemeris and common TA parameters according to RAN1's agreement. Separate validity duration for PVT and orbital ephemeris information does not need to be indicated. (4) DL polarization infromation is necessary for measurement. Both DL and UL polarization information is necessary for handover.In addition to the above, discussion on epoch time is necessary. In the RAN1's agreement, epoch time is indicated by SFN and subframe number. On the other hand, SFN and subframe number may be different between the serving cell and the neighbor cell, and UE may not be able to detect SFN and subframe number of the neighbor cell. It is necessary to clarify which SFN and subframe number should be indicated as the epoch time of the neighbor cell assistance information. |
| Xiaomi | 1. A2/B2 is needed if the feeder link delay is not compensated by the network. However, A2/B2 is not needed if the feeder link delay is compensated by the network based on RAN2’s LS that RAN2 has agreed the assumption that feeder link delay is known to and compensated by the network.
2. A3/B3 is needed for neighbor cell measurement/target cell mobility.
3. The validity duration could be different for PVT parameters and orbital parameters in principle, but the use case of broadcasting two formats of satellite ephemeris should be clarified. However, even though there are two satellite ephemeris formats in the NTN SIB, considering the duration is used not only for satellite ephemeris, but also for other parameters such as common TA related parameters, we think that a single duration is enough.
4. A5/B5 is needed based on RAN1’s agreements.
 |
| MediaTek | We support (1), (2), and (4). We see no need for (3), as the UE prediction time should not be different from one cell to another, and cannot see why validity duration of ephemeris and common TA parameters should be different. |
| OPPO | 1. Yes, it is needed.
2. Yes, it is needed.
3. No strong view
4. Yes, it is needed based on RAN1 agreements.
 |
| Samsung | Support for (1), (2), (4). |
| CATT | Not sure if it is suitable to discuss these issues in RAN1. For RRM measurement, it belong RAN2 or RAN1 scope. 1. **A2/B2 (common TA parameters)**

**It is optional. If reference point is at the satellite, common TA is not configured.****Moreover, if two cells are associated with same satellite, common TA should be same.****So IF the gNB has not configured, UE will assume same common TA for neighboring cells.**1. **A3/B3 (Validity timer information for neighbor cell measurements/target cell mobility, e.g. if it is different from that for serving cell open loop TA control),**

**For same satellite, the validity timer can be same.**1. **Separate validity durations for PVT parameters and Orbital parameters, and**

**It could be separate, since the predication accuracy will be different for PVT and orbital parameters.**1. **A5/B5 (DL and UL Polarization information).**

**It might be useful.** |
| LG | We propose our views in R1-2202288 in agenda item 5.First of all, the common TA parameters (*TACommon*, *TACommonDrift* and *TACommonDriftVariation*) and validity timer information should be provided to UEs for neighbor cell measurements and handover.Also, we prefer to support separate validity durations for different satellite ephemeris formats in Rel-17 NTN.Finally, DL/UL Polarization information need to be provided to UEs for neighbor cell measurements and handover since following agreements were already made in RAN1 #106b-e meeting:

|  |
| --- |
| Agreement:Support polarization signalling for target serving cell in handover command message.Agreement:Support polarization signalling for non-serving cell in RRM measurement configuration. |

 |
| Lenovo | We think all of these should be provided to UEs for neighbor cell measurements and handover. |

## TP for Draft Reply LS and companies views’ collection for 2st round

Based on views expressed during first round, and the answers provided by different companies, the followings tentative text proposal for Draft Reply LS is made.

Let’s work as group to provide an appropriate wording for this TP. Hopefully we will have a stable TP by February 24:

**Updated proposal 13**

**Adopt the following TP for Draft Reply LS to RAN2 on NR NTN Neighbour Cell and Satellite Information**

|  |  |
| --- | --- |
| **3GPP TSG RAN WG1 Meeting #108-e R1-220xxxx****e-Meeting, February 21th – March 3rd, 2022****Title:** DraftReply LS to RAN2 on NR NTN Neighbour Cell and Satellite Information **Reply to:** LS on NR NTN Neighbor Cell and Satellite Information (R1-2200883/ R2-2201884)**Release:** Release 17**Work Item:** NR\_NTN\_solutions-Core**Source:** RAN1**To:** RAN2**Cc:** **Contact Person:** **Name:** Mohamed EL JAAFARI **E-mail Address:** mohamed.el-jaafari@thalesaleniaspace.com **Send any reply LS to:** 3GPP Liaisons Coordinator, mailto: 3GPPLiaison@etsi.org**Attachments:** None**1. Overall Description:**RAN1 would like to thank RAN2 for sending the LS on NR NTN Neighbor Cell and Satellite Information. RAN1 has discussed the questions asked by RAN2 and RAN1 answer is provided below.Regarding the question whether A2/B2 (common TA parameters) need to be provided to UEs for neighbor cell measurements and handover:**RAN1 answer:** A2/B2 (high-layer common TA parameters: TACommon, TACommonDrift and TACommonDriftVariation) should be provided to achieve UL synchronization in handover and estimating SMTC delay in measurement.Regarding the question whether A3/B3 need to be provided to UEs for neighbor cell measurements and handover: **RAN1 answer:** Validity duration information should be provided based on neighbor cell since it may be different from the serving cell (e.g. satellite for neighbor cell is different). Further, from RAN1 perspective, the Epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) should be also provided to the UE.Regarding the separate validity durations for PVT parameters and Orbital parameters:**RAN1 answer:** The validity duration may be different for serving and target/neighbor cells. However, the validity duration does not depend on ephemeris format (i.e. PVT parameters or Orbital parameters). It is up to the network to decide which ephemeris format to use for which cell.Regarding the question whether A5/B5 (DL and UL Polarization information) need to be provided to UEs for neighbor cell measurements and handover:**RAN1 answer:** The polarization information needs to be provided to UE for neighbor cell measurements and handover as per the following agreements made at RAN1#106-e:

|  |
| --- |
| **RAN1#106-e Agreement**:Support polarization signalling for target serving cell in handover command message.**RAN1#106-e Agreement**:Support polarization signalling for non-serving cell in RRM measurement configuration |

**2. Actions:****To RAN2 group:****ACTION:** RAN1 respectfully asks RAN2 to take the above into account for future work and the reply LS to RAN4.**3. Date of Next TSG-RAN WG1 Meetings:**TSG-RAN WG1 Meeting #109-e 16 – 27 May 2022 Electronic MeetingTSG-RAN WG1 Meeting #110 22 – 26 August 2022 Toulouse |

Companies are encouraged to provide views within the following table:

|  |  |
| --- | --- |
| **Companies** | **Comments and Views** |
| LG | OK. |
| Lenovo | Support. |
| OPPO | support |
| Panasonic | The contents of the LS look ok, but discussion for clarification on SFN used for epoch time indication is necessary. In the RAN1's agreement, epoch time is indicated by SFN and subframe number. On the other hand, SFN and subframe number may be different between the serving cell and the neighbor cell, and UE may not be able to detect SFN and subframe number of the neighbor cell. It is necessary to clarify which SFN and subframe number (serving cell or neighbor cell) should be indicated as the epoch time of the neighbor cell assistance information. |
| ZTE | OK. |
|  |  |

# Proposals for GTW on Feb 23rd

**Updated Proposal 5**

* **Add one additional NTN validity duration value for GEO i.e. 900 s. X = 4 bits.**
* **The Network may not indicate ntnUlSyncValidityDuration.**
	+ **Note: If it is not indicated, SIB update procedure (by incrementing ValueTag in SIB1) can be used to indicate that NTN SIB carrying the ephemeris and common TA parameters has changed.**

**Updated Proposal 8**

**Modify second bullet of RAN1#107-e agreement on Epoch time as follows:**

**Otherwise, when Epoch time is not explicitly indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the NTN-specific SIB SI message is transmitted.**

**Update Proposal 4:**

**Confirm that the agreed position and velocity state vector ephemeris format for LEO/MEO/GEO is also applied for HAPS/ATG**.

**Updated Proposal 3**

Modify bit allocations for orbital parameters ephemeris format as follows:

* **Orbital parameters are indicated in 21 bytes payload:**
	+ - **Semi-major axis α (m) is 33 bits**
			* **Range: [6500. 43000]km**
			* **The quantization step is 4.2** $×10^{−3}$**m**
		- **Eccentricity e is 20 bits**
			* **Range: ≤ 0.015**
			* **The quantization step is 1.4** $×10^{−8}$
		- **Argument of periapsis ω (rad) is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Longitude of ascending node (Ω rad) is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Inclination i (rad) is 27 bits**
			* **Range: [- π/2 . + π/2]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**
		- **Mean anomaly M (rad) at epoch time to is 28 bits**
			* **Range: [0. 2π]**
			* **The quantization step is 2.3** $×10^{−8}$ **rad**

**Updated Proposal 1:**

Confirm the following working assumption made at RAN1#107-e:

When TAC ($T\_{A}$) in msg2/msgB is received. UE receives the first adjustment and $N\_{TA}$ is updated as:

$N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.

Where. $T\_{A}$ is the TAC field in msg2/msgB

# Conclusion

The following RAN1 agreements, TPs on UL time and frequency synchronization for NR NTN were made at RAN1 Meeting #108-e:

|  |
| --- |
|  |

# References

1. R1-2112890 3GPP TSG-RAN WG1 Agreements under 8.4 up to eMeeting RAN1#107-e. WI rapporteur (Thales). November 2021
2. R1-2200938 Maintenance on UL time and frequency synchronization enhancement for NTN Huawei, HiSilicon
3. R1-2201011 Maintenance on UL timing and frequency synchronization in NTN THALES
4. R1-2201216 Enhancements on UL Time and Frequency Synchronisation for NR-NTN MediaTek Inc.
5. R1-2201272 Discussion on remaining issue for UL time and frequency synchronization OPPO
6. R1-2201359 Remaining issues on UL time and frequency synchronization enhancement for NTN CATT
7. R1-2201387 Enhancements on UL time and frequency synchronization PANASONIC R&D Center Germany
8. R1-2201477 Remaining issues on UL time and frequency synchronization enhancements for NTN NTT DOCOMO, INC.
9. R1-2201547 Discussion on enhancements on UL time and frequency synchronization for NTN Spreadtrum Communications
10. R1-2201581 Discussion on ambiguity of common TA calculation Sony
11. R1-2201646 Maintenance aspects of time and frequency synchronization for Rel-17 NR over NTN Nokia, Nokia Shanghai Bell
12. R1-2201745 Remaining issues on UL time/frequency synchronization for NTN InterDigital, Inc.
13. R1-2201772 Remaining Issues of Uplink Time and Frequency Synchronization for NR NTN Apple
14. R1-2201805 On UL time and frequency synchronization maintenance issues for NTN Ericsson Hungary Ltd
15. R1-2201853 Remaining issues on enhancements on UL time and frequency synchronization for NTN CMCC
16. R1-2201922 Remaining issues on UL time and frequency synchronization for NTN Xiaomi
17. R1-2202012 Maintenance issues on UL time and frequency synchronization for NTN Samsung
18. R1-2202138 Remaining issues on UL time and frequency synchronization for NTN Qualcomm Incorporated
19. R1-2202207 Remaining issues of UL synchronization for NR-NTN ZTE
20. R1-2202286 Remaining issues on UL time and frequency synchronization enhancements in NTN LG Electronics
21. R1-2202359 Remaining issues on UL time and frequency synchronization enhancement for NTN Baicells
22. R1-2202361 Remaining issues on UL time synchronization for NR NTN NEC

#  Appendix I: RAN1 agreements on UL time and frequency synchronization for NR NTN

TSG-RAN1 Agreements can be found in [1, R1-2112890]

# Appendix II: Summary of proposals

|  |  |  |
| --- | --- | --- |
| **[R1-2200938](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2200938.zip)** | Huawei, HiSilicon | **Observation 1:** The velocity range (+/- 8000 m/s) is not correct for the current agreement.**Proposal 1:** The velocity range of +/- 8000 m/s should change to [-7864, 7863] according to the bit allocation and granularity. **Observation 2:** A UE needsthe absolute time (e.g. UTC) of the starting time of a DL or end time of a SI in order to achieve a better satellite propagator accuracy.**Observation 3:** How to acquire the absolute time can be up to UE implementation without any additional specification effort. |
| **[R1-2201011](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201011.zip)** | THALES | **Observation 1.** With ephemeris in PV format with the bit allocation agreed in RAN1#107-e. the UE can predict the Satellite position and velocity errors with sufficient accuracy.**Observation 2.** When the network indicates ephemeris using Keplerian/orbital parameter format with the bit allocation agreed in RAN1#107-e. satellite position errors at the UE are high. An optimal quantization step is needed for Keplerian orbital parameters.**Observation 3.** An optimal bit allocation in 21 bytes (instead of the 18 bytes as agreed in RAN#107-e) improves significantly the Satellite position and velocity prediction at the UE.**Observation 4.** In Case of GEO based NTN. ntnUlSyncValidityDuration can be set to 15mn if the serving satellite ephemeris format is Keplerian-based with optimal bit allocation.**Proposal 1:**Modify bit allocations for orbital parameters ephemeris format as follows:1. Orbital parameters are indicated in 21 bytes payload:
	* 1. Semi-major axis α (m) is 33 bits
			1. Range: [6500. 43000]km
			2. The quantization step is 4.2 $×10^{−3}$m
		2. Eccentricity e is 20 bits
			1. Range: ≤ 0.015
			2. The quantization step is 1.4 $×10^{−8}$
		3. Argument of periapsis ω (rad) is 28 bits
			1. Range: [0. 2π]
			2. The quantization step is 2.3 $×10^{−8}$ rad
		4. Longitude of ascending node (Ω rad) is 28 bits
			1. Range: [0. 2π]
			2. The quantization step is 2.3 $×10^{−8}$ rad
		5. Inclination i (rad) is 27 bits
			1. Range: [- π/2 . + π/2]
			2. The quantization step is 2.3 $×10^{−8}$ rad
		6. Mean anomaly M (rad) at epoch time to is 28 bits
			1. Range: [0. 2π]
			2. The quantization step is 2.3 $×10^{−8}$ rad

**Proposal 2**NTN validity duration is indicated to the UE in 4 bits with:Value range { 5. 10. 15. 20. 25. 30. 35. 40. 45. 50. 55. 60. 120. 180. 240.900}Unit is second**Proposal 3:** Confirm the following working assumption made at RAN1#107-e:When TAC ($T\_{A}$) in msg2/msgB is received. UE receives the first adjustment and $N\_{TA}$ is updated as:$N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$. Where. $T\_{A}$ is the TAC field in msg2/msgB |
| **[R1-2201216](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201216.zip)** | MediaTek Inc. | **Observation 1:** UE’s behaviour needs to be specified when UL synchronization is lost, due to expiry of the UL validity timer.**Observation 2:** Before expiry of UL validity timer, the connected UE can read the NTN-specific SIBx to re-acquire new assistance information.**Proposal 1:** RAN2 can discuss on how to acquire new or additional assistance information if new or additional assistance information (i.e. serving satellite ephemeris data or Common TA parameters) is not available within the associated validity duration. **Observation 3**: There is no limitation in NR NTN for UE to re-acquire the NTN-specific SIB when UL synchronization is lost.**Observation 4:** On NTN cell access when paged, a UE may need to read the NTN-specific SIB within a typical time in the order of a second. It may not be necessary to re-acquire SIB-1 or SIB-2 assuming these SIBs have not changed within the current system information notification period.**Observation 5:** It may be more flexible to have parameters like cell-specific Koffset, k\_mac, Indication for network enabled/disabled TA report, Cell reference location, t-Service, Validity duration for UL sync information in NTN-specific SIB in case it is beneficial for the network to update these within the system information notification period. **Proposal 2:** Add the GEO candidate values for UL validity timer: {300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800}.Validity timer duration is configured per cell and indicated to the UE in X=5 bits with:1. Value range {5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 120, 180, 240, 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800}
2. Unit is second

**Proposal 3**: RAN4 can further discuss and conclude on combination of open and closed loop TA control in NTN.**Proposal 4**: Agree Pseudo CR to TS 38.211 Section 4.3.1 to update Figure 4.1.1-1: Uplink-downlink timing relation with $N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}$. |
| **[R1-2201272](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201272.zip)** | OPPO | **Proposal 1:** Adopt TP#1.**Proposal 2:** Adopt TP#2. |
| **[R1-2201359](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201359.zip)** | CATT | 1. On the double-correction of close-loop TA and open-TA, implementation specific way can be used to resolve this issue.
2. Correct the description on the implicit epoch time as following:

Otherwise, when not indicated in SIB (other than SIB1), epoch time of assistance information (i.e. Serving satellite ephemeris and Common TA parameters) is implicitly known as the end of the SI window during which the SI message is transmitted.1. Confirm working assumption:

When TAC ($T\_{A})$ in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as follows:$N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.  $where T\_{A} is the TAC field in msg2/msgB$.1. 5bit of TAC can be used to support the scope of $T\_{A}$ in the initial access considering different subcarrier intervals.
2. Adopt the two following CRs on timing relationship and parameter descriptions:

**Updated CR 38.211:**

|  |
| --- |
| Uplink frame number  for transmission from the UE shall start $$T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$$before the start of the corresponding downlink frame at the UE where  $\_{}$$\_{}$$\_{}$$\_{}^{}$$\_{}^{}$- $\_{}^{}$$\_{}^{}$- $N\_{TA}$ , $N\_{TA,offset}$ ,$ N\_{TA,adj}^{common}$ and $N\_{TA,adj}^{UE}$ are given by clause 4.2 of [5, TS 38.213]. |

Updated CR 38.213 with added wording in red color:

|  |
| --- |
| **4.2 Transmission timing adjustments**UE periodically reads SIB message to acquire assisted information including satellite ephemeris and commonTA parameter, and timing advance is adjusted according to UE GNSS position information and assistance information indicated by the network. The network broadcast the validity duration for assistance information by high-level parameter ntnUlSyncValidityDuration in the SIB message. The UE assumes that it has lost uplink synchronization if serving satellite ephemeris and Common TA parameter are not available within the associated validity duration.A UE can be provided a value $N\_{TA,offset}$ of a timing advance offset for a serving cell by n-TimingAdvanceOffset for the serving cell. If the UE is not provided n-TimingAdvanceOffset for a serving cell, the UE determines a default value $N\_{TA,offset}$ of the timing advance offset for the serving cell as described in [10, TS 38.133]. If a UE is configured with two UL carriers for a serving cell, a same timing advance offset value $N\_{TA,offset}$ applies to both carriers. Upon reception of a timing advance command for a TAG, the UE adjusts uplink timing for PUSCH/SRS/PUCCH transmission on all the serving cells in the TAG based on a value $N\_{TA,offset}$ that the UE expects to be same for all the serving cells in the TAG and based on the received timing advance command where the uplink timing for PUSCH/SRS/PUCCH transmissions is the same for all the serving cells in the TAG. For a band with synchronous contiguous intra-band EN-DC in a band combination with non-applicable maximum transmit timing difference requirements as described in Note 1 of Table 7.5.3-1 of [10, TS 38.133], if the UE indicates ul-TimingAlignmentEUTRA-NR as 'required' and uplink transmission timing based on timing adjustment indication for a TAG from MCG and a TAG from SCG are determined to be different by the UE, the UE adjusts the transmission timing for PUSCH/SRS/PUCCH transmission on all serving cells part of the band with the synchronous contiguous intra-band EN-DC based on timing adjustment indication for a TAG from a serving cell in MCG in the band. The UE is not expected to transmit a PUSCH/SRS/PUCCH in one CG when the PUSCH/SRS/PUCCH is overlapping in time, even partially, with random access preamble transmitted in another CG.$N\_{TA,adj}^{common}$ is derived from the higher-layer parameters TACommon, TACommonDrift, and TACommonDriftVariation if configured, otherwise $N\_{TA,adj}^{common}=0$.$N\_{TA,adj}^{UE}$ is UE self-estimated TA to pre-compensate for the service link delay. And it is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}$ is updated automatically by UE based on orbit modelling.$N\_{TA}$ is Timing advance adjust value and updated based on TA Command field in msg2/msgB and MAC CE TA command. It is defined as 0 for PRACH.or a SCS of  kHz, the timing advance command for a TAG indicates the change of the uplink timing relative to the current uplink timing for the TAG in multiples of . The start timing of the random access preamble is described in [4, TS 38.211]. |

 |
| **[R1-2201387](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201387.zip)** | PANASONIC R&D Center Germany | **Proposal 1**: NTN validity duration is configured per cell and indicated to the UE in X bits with:1. Value range {5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 120, 180, 240, Infinity}
2. Unit is second
3. Note: An infinite validity duration is subject to clause 5.2.2.2.1 in TS 38.331 on SIB validity setting it equal to a maximum of 3 hours.

**Proposal 2**: Add to SIB-NTN a counter with at least 5 bits for the SFN-cycles which have elapsed since the first instance of the SIB-NTN in each validity period. **Proposal 3:** Because epoch time is expressed by SFN and subframe number, discussion on how the UE obtains the neighbor cell SFN would be necessary. The following options should be considered. Option 1: gNB provides information on the neighbor cell SFN together with the epoch timeOption 2: UE determines the epoch time based on the SFN obtained from the neighbor cell’s MIB. **Proposal 4:** Contents of NTN SIB of the target cell including common TA parameters would need to be indicated to the UE. Discussion on how these parameters are indicated to the UE is necessary. |
| **[R1-2201477](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201477.zip)** | NTT DOCOMO, INC. | **Observation 1:** With the validity duration of 10 seconds, Common TA, Common TA drift rate and Common TA drift rate variation are enough for LEO-600km for FR1. Common TA third order derivative is needed LEO-600km for FR2.**Observation 2:** Different combinations of common TA parameters are needed for different NTN types and UE capability on NTN type. For example,1. LEO: Common TA, Common TA drift rate and Common TA drift rate variation are necessary for moderate validity duration and FR1.
2. GEO: Common TA is enough due to its feature of stationary location to earth
3. HAPS: Common TA (and Common TA drift rate optionally) may be needed

**Observation 3:** Based on the indicated common TA parameters and the agreed one-way propagation time formular, the calculated common TA at UE side could be absolute TA value which is not in unit of Tc directly.**Observation 4:** The position and velocity state vector ephemeris format for HAPS scenario should be introduced with different bit allocations. **Proposal 1:** Common TA third order derivative is optionally supported based on the validity duration and carrier frequency.**Proposal 2:** Based on NTN type and UE capability on NTN type, UE assumes that following combination of common TA parameters are included at least in SIB message:1. LEO: Common TA, Common TA drift rate and Common TA drift rate variation in mandatory, and Common TA third order derivative optionally based on carrier frequency.
2. GEO: Common TA in mandatory
3. HAPS: Common TA in mandatory, Common TA drift rate optionally

**Proposal 3:** Confirm the working assumption made in 107-e meeting: When TAC ($T\_{A})$ in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:$N\_{TA}=T\_{A}. 16.\frac{64}{2^{μ}} $ , where $T\_{A} $is the TAC field in msg2/msgB**Proposal 4:** Revise the TA equation as TTA = (NTA+NTA,offset+ NTA,adjUE)\*Tc + TTA,adjcommon, where TTA,adjcommon equals 2∙$Delay\_{common}\left(t\right)$.**Proposal 5:** One additional large value other than “infinity” could be added on the value range of validity duration for GEO.**Proposal 6:** Support dedicated signalling to provide the NTN validity duration together with common TA parameters and satellite ephemeris, which has the same information as NTN-specific SIB, to a UE in RRC\_CONNECTED.**Proposal 7:** The position and velocity state vector ephemeris format for HAPS is supported as the following.1. Position and velocity state vector ephemeris format 12 bytes payload.
	1. The field size for position [m] is 54 bits
		1. Position range is driven by HAPS: +/- 50 km
		2. The quantization step is 0.38m for position
	2. The field size for velocity [m/s] is 42 bits
		1. Velocity range is driven by HAPS: +/- 140 m/s
		2. The quantization step is 0.017 m/s for Velocity
 |
| **[R1-2201547](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201547.zip)** | Spreadtrum Communications | **Proposal 1:** Confirm the Working assumption on on TA update in RRC\_CONNECTED state:Working assumption:When TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:1. Option 1: $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.

where, $T\_{A}$ is the TAC field in msg2/msgB**Proposal 2:** The solution to resolve the issue on combination of open and closed loop TA control is up to the UE implementation to meet the RAN4 gradual timing adjustment requirement. |
| **[R1-2201581](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201581.zip)** | Sony | **Proposal 1:** The agreed equation of $Delay\_{common}\left(t\right) $and epoch time $t\_{epoch}$ definition in RAN1 107-e should be captured in specification.**Proposal 2:** Following the text proposal can be considered for TS38.211 specification:>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted >>>>>>>>>>>>>>>>>>>>>>>>>>>>Uplink frame number  for transmission from the UE shall start $T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$ before the start of the corresponding downlink frame at the UE where- $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from two times one-way propagation time $Delay\_{common}\left(t\right)$ which is calculated from TAInfo-r17 if configured. If TAInfo-r17 is not configured, $N\_{TA,adj}^{common}=0$;1. the $Delay\_{common}$ used for $N\_{TA,adj}^{common}$ is calculated as follows:

$$Delay\_{common}\left(t\right)= D\_{Common }\left(t\_{epoch}\right)+ DCommonDrift× \left(t−t\_{epoch}\right)+DCommonDriftVariation× \left(t−t\_{epoch}\right)^{2} $$Where:1. $D\_{Common }=\frac{taCommon−r17}{2}$, $DCommonDrift=\frac{taCommonDrift−r17}{2}$ and $DCommonDriftVariation=\frac{taCommonDriftVariant−r17}{2}$
2. $t\_{epoch}$ is derived as follows:
	1. EpochTime-r17 when configured through [SIB] or [dedicated signaling].
	2. otherwise, when indicated in [SIB (other than SIB1)], epoch time of assistance information is implicitly known as the end of the SI window during which the SI message is transmitted.

- $N\_{TA,adj}^{UE}$ is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.>>>>>>>>>>>>>>>>>>>>>>>>>>>> unchanged text omitted >>>>>>>>>>>>>>>>>>>>>>>>>>>> |
| **[R1-2201646](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201646.zip)** | Nokia, Nokia Shanghai Bell | **Observation 1:** Operation of closed loop and open loop TA control in RRC connected state needs careful design to avoid instability due to erroneous calculation of the UE-specific TA value by the UE.**Observation 2:** If TAC is generated to fix a temporary deviation in the UE transmission timing, when UE updates their autonomous components on the timing advance formula, there may be an overcompensation of the timing advance, generating a similar deviation on the opposite direction (Figure 8).**Observation 3:** If TAC is generated to introduce an offset in UE timing due to gNB internal optimizations, the TAC should be applied regardless of UE accuracy for timing estimation. **Observation 4:** In order to guarantee TA update loop stability, two operation states for TAC update are needed.**Observation 5:** Even if the UE has obtained new serving satellite ephemeris and Common TA related parameters prior to the time of the validity timer expiring, the UE may lose synchronization if the current validity timer expires before the Epoch time of the new serving satellite ephemeris and Common TA.**Observation 6:** The network is not able to know whether the validity timer has expired at the UE side or is about to expire soon. This may lead to situations where the UE is not able to fulfil the requirements associated to the scheduling commands (PUCCH and PUSCH transmissions).**Observation 7:** RAN1 and RAN2 have different understandings of the applicability of the validity timer/validity duration.**Observation 8:** Is seems that RAN1 and RAN2 have different understandings of UE actions prior to the validity timer expiry.**Observation 9:** There may be periods with uncertainty related to UE’s UL synchronization status if the UE is allowed to read serving satellite ephemeris and Common TA related parameters after the expiry of the validity timer.**Proposal 1:** The update rate that the UE applies for both the UE-specific TA and Common TA should be such that the applied TA fulfilles the RAN4 time synchronization requirements.**Proposal 2:** The Common TA should be calculated in a deterministic way and applied at the same time for all UEs.**Proposal 3:** For UE in RRC connected mode, in case closed loop TA control is used, open loop TA control should be applied only in a way that does not impact the stability and accuracy as provided by closed loop TA control.**Proposal 4:** The gNB should be able to use the closed-loop solution (Timing Advance Commands over DL MAC-CE) at any time. **Proposal 5:** The TAC should operate in two different states to allow both differential and absolute indication of the TAC updates.**Proposal 6:** If a UE has obtained new serving satellite ephemeris and Common TA related parameters prior to the time of the validity timer expiring, the UE is allowed to maintain its UL synchronization until the new Epoch time is reached. For this, the time interval from the expiration of the validity timer until the new Epoch time must not be larger than the new validity duration. In this case, 1. The UE restarts the validity timer before the new Epoch time, or,
2. The UE suspends the timer during this period such that it does not expire.

**Proposal 7:** The UE shall at any time be able to guarantee that is has a valid UL synchronization.**Proposal 8:** In case the validity timer is about to expire, the UE informs the gNB that it will lose synchronization soon.**Proposal 9:** Upon receiving a signal from the UE that the UE’s validity timer will expire soon, the gNB either  1. Stops scheduling the UE in the uplink and broadcast ephemeris information and Common TA as planned via SIB.
2. Provides UE-specific assistance signal including ephemeris information of the satellite, the relevant associated Common TA parameters.

**Proposal 10:** After having received UE-specific synchronization information or after having read the SIB again while having earlier informed the gNB on an oncoming validity timer expiration, the UE indicates to the gNB that it has maintained or re-established UL synchronization and that it has reset the validity timer.**Proposal 11:** To reduce the signalling overhead for UE reporting, UE only informs gNB to maintain the validity timer status when there is potential UL or DL data transmission. **Proposal 12:** Inform RAN2 that the validity duration is only intended to be applicable for serving satellite ephemeris and common TA related parameters.**Proposal 13:** Inform RAN2 that under normal operation, a UE is expected to have read new and updated serving satellite ephemeris information prior to the expiry of the validity timer.**Proposal 14:** The need for providing A2/B2 should be evaluated by RAN4 rather than RAN1, as it relates to the UE’s ability to track SSB transmissions that are drifting in time relative to serving satellite transmissions if the cells are not transmitted from the same satellite.**Proposal 15:** For neighbor measurements for cells that are not co-located in the same satellite, the validity timer (A3/B3) should be associated to the neighbor satellite rather than the serving satellite.**Proposal 16:** PVT and Orbital parameters (and Common TA related parameters) share a single validity duration.**Proposal 17:** DL and UL Polarization information may be supported for neighbor cell measurements.**Proposal 18:** RAN1 to send LS to RAN4 in order to clarify the additional aspects that would need to be considered related to the sudden jumps in the UE transmit timing due to UE reading updated information for the serving satellite ephemeris.**Proposal 1: Update the RRC parameter table such that the following parameters are marked as both cell-specific and UE specific parameters: TACommon, TACommonDrift, TACommonDriftVariation, ServingSatelliteEphemerisStateVectorX, ServingSatelliteEphemerisStateVectorY, ServingSatelliteEphemerisStateVectorZ, ServingSatelliteEphemerisStateVectorVx, ServingSatelliteEphemerisStateVectorVy, ServingSatelliteEphemerisStateVectorVz, ServingSatelliteEphemerisSemiMajorAxis, ServingSatelliteEphemerisEccentricityE, ServingSatelliteEphemerisArgumentOfPeriapsis, ServingSatellite EphemerisLongitudeOfAscendingNode, ServingSatelliteEphemerisInclinationI, ServingSatelliteEphemerisMeanAnomalyM, ntnUlSyncValidityDuration, EpochTime.****Proposal 2: Change the RRC parameter name of ServingSatelliteEphemerisInclinationI to ServingSatelliteEphemerisInclination.****Proposal 3: Change the RRC parameter name of ServingSatelliteEphemerisMeanAnomalyM to ServingSatelliteEphemerisMeanAnomaly.****Proposal 4: Update the RRC parameter table, such that *CellSpecific\_Koffset* and *K\_mac* are marked as both cell-specific and UE specific parameters.****Proposal 5: RAN1 to update the descriptions and ranges for the above discussed NTN related RRC parameters in order to ensure clear and well-defined interpretations of these.****Proposal 6: Write an LS to RAN2 to inform of the suggested and required changes of RRC parameter properties and names.** |
| **[R1-2201745](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201745.zip)** | InterDigital, Inc. | **Observation-1:** Due to fast movement of LEO satellites, a coordinate-based ephemeris representation will become quickly obsolete and require frequent updates.**Observation-2:** Over the timescales of initial access, error to orbital prediction introduced by e.g., atmospheric drag is relatively minor and should allow sufficiently accurate estimates for timing pre-compensation.**Proposal-1:** Ephemeris format is determined based on NTN scenario without indication.**Proposal-2:** State vector is used for GEO/HAPS and orbital elements is used for LEO.**Proposal-3:** State vector ephemeris format is supported for HAPS.**Proposal-4:** Support a larger value of validity timer for GEO scenario. |
| **[R1-2201772](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201772.zip)** | Apple | **Proposal 1:** Confirm the working assumption that when TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$, where $T\_{A}$ is the TAC field in msg2/msgB. **Proposal 2:** For the double correction issue, RAN1 to wait for RAN4’s final decision before concluding the RAN1 discussion. 1. In case gradual timing adjustment requirement applies, RAN1 to define the reference timing when new GNSS position or new ephemeris parameters are applied.

**Proposal 3:** An additional NTN validity duration value longer than 240 seconds is supported for GEO scenario. **Proposal 4:** In the higher layer parameter list for NR NTN, 1. includes the quantization step for serving satellite ephemeris position and velocity state vector parameters,
2. includes the bit allocation for serving satellite ephemeris orbital parameters.
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| **[R1-2201805](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201805.zip)** | Ericsson Hungary Ltd | **[Observation 1](#_Toc95768502)** [It is unclear if serving satellite ephemeris is needed for HAPS since the propagation delay and Doppler shift are similar or equivalent to those in a terrestrial network.](#_Toc95768502)**[Observation 2](#_Toc95768503)** [If serving satellite ephemeris is broadcast for a HAPS, the UE must be aware that the non-terrestrial node is a HAPS rather than a satellite since satellite orbit propagation models do not work for HAPS.](#_Toc95768503)**[Proposal 1](#_Toc95768504)** [Add NTN validity duration values suitable for GEO, e.g., {900 s, 1800 s, 3600 s, 7200 s}. To limit the field size to 4 bits, other values could be removed, e.g., {25 s, 35 s, 45 s, 55 s}.](#_Toc95768504)**[Proposal 2](#_Toc95768505)****[Adopt the following TP for 3GPP TS 38.211:](#_Toc95768505)** --------------------------------- Start of TP for 3GPP TS 38.211 ---------------------------------* + - 4.3.1 Frames and subframes

<Unchanged Text Omitted>Uplink frame number  for transmission from the UE shall start $T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$ before the start of the corresponding downlink frame at the UE where- $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* if configured, otherwise $N\_{TA,adj}^{common}=0$;- $N\_{TA,adj}^{UE}$ is computed by the UE to pre-compensate for the two-way delay between the UE and the serving satellite, based on UE position and serving satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.--------------------------------- End of TP for 3GPP TS 38.211 ----------------------------------**[Proposal 3](#_Toc95768506)****[Adopt the following TP for 3GPP TS 38.213:](#_Toc95768506)** --------------------------------- Start of TP for 3GPP TS 38.213 ----------------------------------* 1. 4.2 Transmission timing adjustments

<Unchanged Text Omitted>Using higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation*, if configured, the UE shall determine $\_{}^{}$ to pre-compensate the two-way transmission delay between the satellite and the uplink time synchronization reference point as follows:The one-way transmission delay function $\_{}$ gives the distance at time $$ between the satellite and the uplink time synchronization reference point divided by the speed of light and is defined as$$\_{}\left(\right)\left(\_{}\right)\left(\_{}\right)^{}$$where $\_{}$ is the epoch time of the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* and $$, $$ and $$.For transmission of UL slot $$, the UE shall determine the $\_{}^{}$ that corresponds to the two-way transmission delay $\left⌊\_{}\left(\_{}\right)\_{}\left(\_{}\right)\_{}\right⌋$, where1. $\_{}\_{}\_{}\left(\_{}\right)$
2. $\_{}\_{}\left(\_{}\_{}\right)\_{}\_{}\left(\_{}\right)$
3. $\_{}$ is the transmission time of the corresponding DL slot $$ from the uplink time synchronization reference point.

---------------------------------- End of TP for 3GPP TS 38.213 ----------------------------------**[Proposal 4](#_Toc95768507)** [Adopt the following TP for 3GPP TS 38.211:](#_Toc95768507) ---------------------------------- Start of TP for 3GPP TS 38.211 ----------------------------------* + - 4.3.1 Frames and subframes

<Unchanged Text Omitted>Uplink frame number  for transmission from the UE shall start $T\_{TA}=\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{c}$ before the start of the corresponding downlink frame at the UE where- $N\_{TA}$ and $N\_{TA,offset}$ are given by clause 4.2 of [5, TS 38.213], except for msgA transmission on PUSCH where $N\_{TA}=0$ shall be used;- $N\_{TA,adj}^{common}$ is derived from the higher-layer parameters *TACommon*, *TACommonDrift*, and *TACommonDriftVariation* as specified in [5, TS 38.213] if configured, otherwise $N\_{TA,adj}^{common}=0$;- $N\_{TA,adj}^{UE}$ is computed by the UE based on satellite-ephemeris-related higher-layers parameters if configured, otherwise $N\_{TA,adj}^{UE}=0$.---------------------------------- End of TP for 3GPP TS 38.211 --------------------------------------------------------------------------- End of TP for 3GPP TS 38.211 -----------------------------------------**[Proposal 5](#_Toc95768508)** [If serving satellite ephemeris is broadcast for a HAPS, one of the existing serving satellite ephemeris formats can be used without modification.](#_Toc95768508)**[Proposal 6](#_Toc95768509)** [It can be left to UE implementation to detect that a non-terrestrial node is a HAPS.](#_Toc95768509) |
| **[R1-2201853](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201853.zip)** | CMCC | **Proposal 1:** Update of assistance information in SIB will not trigger system information modification procedure.* It is up to RAN2 to determine detailed solutions for updating the assistance information. (e.g., Changes of the assistance information should neither result in system information change notifications nor in a modification of valueTag in SIB1, just like “timeInfoUTC” field acts in SIB9.)

**Proposal 2:** Confirm the above working assumption. When TAC ($T\_{A})$ in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as follows:* $N\_{TA}=T\_{A}. 16.\frac{64}{2^{μ}}$

where,$ T\_{A}$ is the TAC field in msg2/msgB.**Proposal 3:** ForNTN validity duration configuration, larger values than 240 seconds are needed for GEO scenario.**Proposal 4:** “Infinity” is not needed in the NTN validity duration value range for the case of GEO. |
| **[R1-2201922](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201922.zip)** | Xiaomi | **Proposal 1:** The solution to resolve the issue on combination of open and closed loop TA control is up to the UE implementation to meet the RAN4’s requirements.**Proposal 2:** The common TA parameters of neighbour cells need to be provided to the UEs if the feeder link delay is not compensated by the network. The common TA parameters of neighbour cells is not needed to the UEs if the feeder link delay is compensated by the network.**Proposal 3:** The validity timer information for serving and neighbour/target cell can be different.**Proposal 4:** A single validity timers for PVT parameters and orbital parameters. |
| **[R1-2202012](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202012.zip)** | Samsung | **Observation 1:** The common TA, $T\_{c}$, can be divided into the minimum common TA, $T\_{c0}$, and a residual common TA, $T\_{cRes}$. The minimum common TA, $T\_{c0}$, can be derived by UE from satellite ephemeris (or simply altitude) information without additional signalling.**Observation 2:** The gNB jointly indicates the TA variation rate and the Doppler shift.**Observation 3:** Based on the indicated TA variation rate r\_TA (and the current TA), the UE can autonomously adjust its TA.**Observation 4:** Based on the indicated Doppler shift f\_D (and the compensated frequency offset), the UE can determine the residual Doppler shift and pre-compensate its UL transmission.**Proposal 1**: Confirm the following working assumption:When TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:1. Option 1: $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$,

where, $T\_{A}$ is the TAC field in msg2/msgB.**Proposal 2**: Each of the following options are supported based on the gNB configuration:1. Closed-loop TA control
2. Open-loop TA control
3. Combination of open&closed-loop TA control

**Proposal 3:** A gNB signals residual common TA value to UEs such that UEs can derive common TA by adding to minimum common TA value, which can be obtained by UE from the satellite ephemeris (or altitude) information.**Proposal 4:** Multiple reference points and common TA values should be considered for extremely large cells**Proposal 5:** The gNB signals common TA drift rate to enable autonomous TA update at UE.**Proposal 6:** The gNB can jointly signal common TA drift rate and Doppler shift such as the UE derives Doppler shift from common TA drift rate signaled by gNB or vice versa.**Proposal 7:** The gNB indicates the additional UL frequency offset value for the pre-compensation at UE side. |
| **[R1-2202138](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202138.zip)** | Qualcomm Incorporated | **Proposal 1:** When TAC ($T\_{A})$ in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as follows:$N\_{TA}=−128. 16.\frac{64}{2^{μ}}+T\_{A}. 16.\frac{64}{2^{μ}} $ ,$where, T\_{A} is the TAC field in msg2/msgB$. |
| **[R1-2202207](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202207.zip)** | ZTE | **Proposal 1:** Additional validity duration value for GEO is not supported. **Proposal 2:** UE should determine the reported TA value based on the time instant of real UL transmission (with consideration on the processing delay) instead of the time instant of triggering.**Proposal 3:** Confirm that the agreed position and velocity state vector ephemeris format for LEO/MEO/GEO is also applied for HAPS/ATG. |
| **[R1-2202286](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202286.zip)** | LG Electronics | **Proposal 1.** Confirm the following working assumption:Working assumption:When TAC ($T\_{A}$) in msg2/msgB is received, UE receives the first adjustment and $N\_{TA}$ is updated as:1. Option 1: $N\_{TA}=T\_{A}⋅16⋅\frac{64}{2^{μ}}$.

where, $T\_{A}$ is the TAC field in msg2/msgB**Proposal 2.** The common TA ($N\_{TA,common}$) and the UE specific TA ($N\_{TA,UE−specific}$) should be considered in addition to the TA command value in BWP switching for NR NTN UE. |
| **[R1-2202359](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202359.zip)** | Baicells | **Observation 1:** Due to the large RTT in NTN, repeated TA adjustment may be a more prominent problem in NTN.**Proposal 1:** To ensure TA adjustment can handle both the large TAC latency and high speed UE movement, RAN1 shall wait for the RAN4’s requirement and determine whether RAN1 need additional measures to solve this issue. |
| **[R1-2202361](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202361.zip)** | NEC | **Proposal 1.** The reference point of the epoch time for assistance information is the satellite.**Proposal 2.** The combination of open and closed loop TA control is up to the UE implementation to meet the RAN4 gradual timing adjustment requirement. |