**3GPP TSG-RAN WG2 Meeting #119-bis electronic *R2-2210851***

**Online, October 10 - 19th, 2022**

**Agenda Item: 6.10.2**

**Source: Thales**

**Title: Summary of [AT119bis-e][110][NR NTN] Stage-2 CR (Thales)**

**Document for: Discussion and Decision**

# Introduction

This document aims to summarize the following discussion which aims at consolidating a CR for TS 38.300 as outcome of RAN2#119-bis-e.

* [AT119bis-e][110][NR NTN] Stage-2 corrections (Thales)

Initial scope: Discuss the CRs/TPs in AI 6.10.2

Initial intended outcome: Summary of the offline discussion and corresponding draft CR:

Deadline (for companies' feedback): Tuesday 2022-10-18 16:00 UTC

Deadline (for rapporteur's summary in R2-2210851 and draft CR in R2-2210852): Tuesday 2022-10-18 20:00 UTC

Status: Ongoing

Among the TDOCs submitted under RAN2 NR-NTN agenda, at least the following are considered: R2-2209539, R2-2209658, R2-2210567, R2-2210086, R2-2210742, R2-2210759, R2-2210634

# 1st round discussion

## 2.1 Chapter 3.1 Abbreviations

In R2-2210567, the following corrections (in red) are proposed:

Adding

*GNSS Global Navigation Satellite System*

*SMTC SS/PBCH block Measurement Timing Configuration*

**Question 2.1: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.2 Chapter 7.3.1 Overview

In R2-2210759, the following corrections (in red) are proposed:

*- SIB19 contains NTN-specific parameters for serving cell and~~/or~~ optionally NTN-specific parameters for neighbour cells as defined in TS 38.331 [12].*

**Question 2.2: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.3 Chapter 16.14.2.1 Scheduling and Timing

In R2-2210086 and R2-2210567 and R2-2210759, the following corrections (in red) are proposed:

*To accommodate the propagation delay in NTNs, several timing relationships are enhanced by a Common Timing Advance (Common TA) and two scheduling offsets and illustrated in Figure 16.14.2.1-1:*

*- is a configured offset that corresponds to the RTT between the Reference Point (RP) and the NTN payload.*

*- is a configured scheduling offset that need to be larger or equal to the sum of the service link RTT and the common TA.*

*- is a configured offset that need to be larger or equal to the RTT between the RP and the NTN Gateway.*

**

*Figure 16.14.2.1-1: Illustration of timing relationship*

*DL and UL are frame aligned at the uplink time synchronization reference point (RP) with an offset given by NTA,offset (see clause 4.3 of TS 38.211 [52]).*

*is a scheduling offset ~~supported in NTN~~ for MAC CE timing relationship enhancement ~~and estimation of UE-gNB RTT~~. It is provided by the network if downlink and uplink frame timing are not aligned at the NTN Gateway. It is needed for UE timing of downlink configuration change indicated by a MAC-CE command in PDSCH.*

**Question 2.3.1: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

Two corrections options are proposed

*Option 1: The is also used in the beam failure recovery for UE monitoring PDCCH (see clause 6 in TS 38.213 [38]) and in random access procedure for UE to determine the start of random access response window (see clause 8.2 in TS 38.213 [38]).*

*Option 2: The is also used in the random access procedure, to determine the start time of RAR window/MsgB window after a Msg1/MsgA transmission and contention resolution timer after a Msg3 transmission.*

**Question 2.3.2: Which options above do companies prefer ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Op1/Opt2/Other** | **Comments/Suggestions** |
| Google | Opt2 | The description in Opt2 is more general and also covers the case for BFR. |
|  |  |  |

**[Rapporteur summary]:**

## 2.4 Chapter 16.14.2.2 Pre-compensation by the UE

In R2-2210567 and R2-2210759, the following corrections (in red) are proposed:

#### *16.14.2.2 Timing Advance and Frequency Pre-compensation*

*For the serving cell, the network broadcasts satellite ephemeris information and common TA parameters. The UE shall have valid GNSS position as well as the satellite ephemeris and common TA before connecting to an NTN cell. To achieve synchronisation, before and during connection to an NTN cell, the UE computes the service link RTT based on the GNSS position and the satellite ephemeris, computes the common TA based on the common TA parameters (see clause 4.2 in TS 38.213 [38]), and autonomously pre-compensates the TTA for the RTT between UE and the RP as illustrated in Figure 16.14.2.1-1 (see clause 4.3 of TS 38.211 [52]).*

*The UE computes the frequency Doppler shift of the service link, and autonomously pre-compensates for it in the uplink transmissions, by considering UE position and the satellite ephemeris. If the UE does not have a valid GNSS position and/or valid satellite ephemeris, it does not communicate with the network until both are regained.*

*In connected mode, the UE should be able to continuously update the Timing Advance and frequency pre-compensation.*

*The UE may be configured to report Timing Advance during Random Access procedures or in connected mode. In connected mode, event-triggered reporting of the Timing Advance is supported.*

*While the pre-compensation of the instantaneous Doppler shift experienced on the service link is to be performed by the UE, the management of Doppler shift experienced over the feeder link and transponder frequency error is outside 3GPP scope and left to the satellite network implementation.*

**Question 2.4: Which options above do companies prefer ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Op1/Opt2/Other** | **Comments/Suggestions** |
| Google | Agree the changes |  |
|  |  |  |

**[Rapporteur summary]:**

## 2.5 Chapter 16.14.3.1 Mobility in RRC\_IDLE and RRC\_INACTIVE

In R2-2209539 and R2-2210567, the following corrections (in red) are proposed:

*The same principles as described in 9.2.1 apply to mobility in RRC\_IDLE for NTN and the same principles as described in 9.2.2 apply to mobility in RRC\_INACTIVE for NTN unless hereunder specified.*

*The network may broadcast multiple Tracking Area Codes (TACs) per PLMN in an NR NTN cell. A TAC change in the System Information is under network control, i.e. it may not be exactly synchronised with real-time illumination of beams on ground.*

*The UE can determine the network type (terrestrial or non-terrestrial) implicitly by the existence of cellBarredNTN in SIB1.*

*The NTN ephemeris is provisioned. It includes serving cell's satellite ephemeris and neighbouring cell's satellite ephemeris. The UE can use neighbouring cell’s satellite ephemeris to perform measurement on neighbour cells for cell selection/reselection.*

**Question 2.5: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree, except for the last sentence added | The last sentence seems not necessary and not precise enough. The details on how to perform/adjust measurement based on the satellite ephemeris have been provided in 16.14.3.3. |

**[Rapporteur summary]:**

## 2.6 Chapter 16.14.3.2.1 Hand-over

In R2-2210567, the following corrections (in red) are proposed:

*The same principle as described in 9.2.3.2 applies unless hereunder specified:*

*During mobility between NTN and Terrestrial Network (TN), a UE is not required to connect to both NTN and TN at the same time.*

*NOTE: NTN-TN hand-over refers to mobility in both directions, i.e. from NTN to TN (hand-in) and from TN to NTN (hand-out).*

*DAPS handover is not supported for NTN in this release of the specification.*

*UE may support mobility between gNBs operating with NTN payloads in different orbits (GSO, NGSO at different altitudes).*

**Question 2.6: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.7 Chapter 16.14.3.2.2 Conditional Hand-over

In R2-2210762, the following corrections (in red) are proposed:

*The same principle as described in 9.2.3.4 applies to NTN unless hereunder specified.*

*NTN supports the following additional triggering conditions upon which UE may execute CHO to a candidate cell, as defined in TS 38.331 [12]:*

*- The RRM measurement-based event A4;*

*- A time-based trigger condition;*

*- A location-based trigger condition.*

*A time-based or a location-based trigger condition is always configured together with one of the measurement-based trigger conditions (CHO events A3/A4/A5). Location is defined by the distance between UE and a reference location.*

*It is up to UE implementation how the UE evaluates the time- or location-based condition jointly with the RRM event Ax, as long as the UE has RRM measurement results when the configured time-based condition or the location-based condition is met, as defined in TS 38.331 [12].*

**Question 2.7: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.8 Chapter 16.14.3.3 Measurements

In R2-2209539 & R2-2210567, the following corrections (in red) are proposed:

*…*

*The network can configure:*

*- multiple SMTCs in parallel per carrier and for a given set of cells depending on UE capabilities;*

*- measurement gaps based on multiple SMTCs.*

*- satellite assistance information (e.g., ephemeris, common TA parameters) provided via system information for UE to perform measurement on neighbour cells in RRC\_IDLE/RRC\_INACTIVE/RRC\_CONNECTED.*

*NW-controlled adjustment of SMTCs can be based on UE assistance information reported in RRC\_CONNECTED. UE in RRC\_IDLE/RRC\_INACTIVE can adjust SMTCs based on its location and satellite assistance information (e.g. ephemeris, common TA parameters).*

*UE assistance information is in the form of the service link propagation delay difference(s) between the serving cell and neighbour cell(s).*

*…*

**Question 2.8: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.9 Chapter 16.14.3.3 Measurements

In R2-2210634, the following corrections (in red) are proposed:

**Two corrections options are proposed**

**Option 1**

*NW-controlled adjustment of SMTCs can be based on UE assistance information reported in Connected mode. For Idle/Inactive mode, UE can adjust SMTCs based on its location and satellite assistance information (e.g. ephemeris, common TA parameters), only if the SMTCs are associated to the carrier frequencies that also appear in the satellite assistance information.*

*UE assistance information is in the form of a service link propagation delay difference between serving cell and neighbour cells.*

**Option 2**

*NW-controlled adjustment of SMTCs can be based on UE assistance information reported in Connected mode. For Idle/Inactive mode UE can adjust SMTCs based on its location and satellite assistance information (e.g. ephemeris, common TA parameters).*

*UE assistance information is in the form of a service link propagation delay difference between serving cell and neighbour cells.*

*NOTE: UE is expected to find the same carrier frequency that is associated to a SMTC in the satellite assistance information in SIB19.*

**Question 2.9: Which options above do companies prefer ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Op1/Opt2/Other** | **Comments/Suggestions** |
| Google | Opt1 | [Proponent] As the association between the SMTC in SIB2/4 and the satellite assistance information in SIB19 may not exist (i.e., the frequencies do not match), we think it is better to clarify the UE behaviour in such a situation. The added calcification in opt1 implies that the UE in such a situation will still perform measurement based on the configured SMTC, without performing the adjustment.  Opt2 is less preferred as it may constrain the NW from saving the signal overheads for certain scenarios. For example, the NW may want to omit the satellite assistance information for the neighbouring cells that use the same satellite as the serving cell does (but operate in different frequencies). |
|  |  |  |

**[Rapporteur summary]:**

## 2.10 Chapter 16.14.4.2 Assumptions

In R2-2210567, the following corrections (in red) are proposed:

*A feeder link switch over may result in transferring the established connection for the affected UEs between two gNBs.*

*For soft feeder link switch over, an NTN payload is able to connect to more than one NTN Gateways during a given period, i.e. a temporary overlap can be ensured during the transition between the feeder links.*

*For hard feeder link switch over, an NTN payload connects to only one NTN Gateway at any given time, i.e. a radio link interruption may occur during the transition between the feeder links.*

**Question 2.10: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.11 Chapter 16.14.5 NG-RAN signalling

In R2-2210567, the following corrections (in red) are proposed:

*The Cell Identity, as defined in TS 38.413 [26] and TS 38.423 [50], used in following cases corresponds to a Mapped Cell ID, irrespective of the orbit of the NTN payload or the types of service links supported:*

*- The Cell Identity indicated by the gNB to the Core Network as part of the User Location Information;*

*- The Cell Identity used for Paging Optimization in NG interface;*

*- The Cell Identity used for Area of Interest;*

*- The Cell Identity used for PWS.*

*The Cell Identity included within the target identification of the handover messages allows identifying the correct target cell.*

*The Cell Identities used in the RAN Paging Area during Xn RAN paging allow the identification of the correct target cells for RAN paging.*

*NOTE 1: The Cell Identity used for RAN Paging is assumed to typically represent a Uu Cell ID.*

*The mapping between Mapped Cell IDs and geographical areas is configured in the RAN and Core Network.*

*NOTE 2: A specific geographical location may be mapped to multiple Mapped Cell ID(s), and such Mapped Cell IDs may be configured to indicate differerent geographical areas (e.g. overlapping and/or with different dimensions).*

*The gNB is responsible for constructing the Mapped Cell ID based on the UE location information received from the UE, if available. The mapping may be pre-configured (e.g., up to operator's policy) or up to implementation.*

*NOTE 3: As described in TS 23.501 [3], the User Location Information may enable the AMF to determine whether the UE is allowed to operate at its present location. Special Mapped Cell IDs or TACs may be used to indicate areas outside the serving PLMN's country.*

*The gNB reports the broadcasted TAC(s) of the selected PLMN to the AMF as part of ULI. In case the gNB knows the UE's location information, the gNB may determine the TAI the UE is currently located in and provide that TAI to the AMF as part of ULI.*

**Question 2.11: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.12 Chapter 16.14.6 AMF (Re-)Selection by gNB

In R2-2210567, the following corrections (in red) are proposed:

### *16.14.6 AMF (Re-)Selection*

*The gNB implements the NAS Node Selection Function specified in TS 38.410 [16].*

*For a UE in RRC\_CONNECTED, the gNB is configured to ensure that the UE connects to an AMF that serves the country in which the UE is located. If the gNB detects that the UE is in a different country to that served by the serving AMF, then it should perform an NG handover to change to an appropriate AMF, or initiate an UE Context Release Request procedure towards the serving AMF (in which case the AMF may decide to de-register the UE).*

**Question 2.12: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.13 Chapter 16.14.7 O&M Requirements

In R2-2210567, the following corrections (in red) are proposed:

*The following NTN related parameters shall be provided by O&M to the gNB providing NTN access:*

*- Ephemeris information describing the orbital trajectory information or coordinates for the NTN payloads. This information is provided on a regular basis or upon demand to the gNB;*

*- Two different sets of ephemeris format shall be supported:*

*- Set 1: Satellite position and velocity state vectors:*

*- Position;*

*- Velocity.*

*- Set 2: At least the following parameters in orbital parameter ephemeris format, as specified in NIMA TR 8350.2 [51]:*

*- Semi-major axis;*

*- Eccentricity;*

*- Argument of periapsis;*

*- Longitude of ascending node;*

*- Inclination;*

*- Mean anomaly at epoch time.*

*- The explicit epoch time associated to ephemeris data;*

*- The location of the NTN Gateways;*

*NOTE 1: The ephemeris of the satellites and the location of the NTN Gateways, are used at least for the Uplink timing and frequency synchronization. It may also be used for the random access and the mobility management purposes.*

*- Additional information to enable gNB operation for feeder/service link switch overs.*

*NOTE 2: The NTN related parameters provided by O&M to the gNB may depend on the type of supported service links, i.e., Earth-fixed, quasi-Earth-fixed, Earth-moving.*

**Question 2.13: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.14 Chapter 16.14.8 Coarse UE location reporting

In R2-2209658, the following corrections (in red) are proposed:

*If user consent is required, the network can only request coarse UE location reporting provided that user consent is available. Upon network request, after AS security is established in connected mode, a UE should report its coarse UE location information (most significant bits of the GNSS coordinates, ensuring an accuracy in the order of 2 km) to the NG-RAN if available.*

**Question 2.14: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.15 Chapter B.4 Example implementation of Non-Terrestrial Networks

In R2-2210567, the following corrections (in red) are proposed:

*The gNB depicted in Figure B.4-1 may be subdivided into non-NTN infrastructure gNB functions and the NTN Service Link provisioning system. The NTN infrastructure may be thought of being subdivided into the NTN Service Link provisioning system and the NTN Control function. The NTN Service Link provisioning system may consist of one or more NTN payloads and NTN Gateways.*

*The NTN payload is embarked on a spaceborne (or airborne) vehicle, providing a structure, power, commanding, telemetry, attitude control for the satellite (resp. HAPS) and possibly an appropriate thermal environment, radiation shielding.*

*The NTN Service Link provisioning system maps the NR-Uu radio protocol over radio resources of the NTN infrastructure (e.g. beams, channels, Tx power).*

*The NTN control function controls the spaceborne (or airborne) vehicles as well as the radio resources of the NTN infrastructure (NTN payload(s) & NTN Gateway(s)). It provides control data, e.g. Ephemeris, to the non-NTN infrastructure gNB functions of the gNB.*

*Provision of NTN control data to the gNB is out of 3GPP scope.*

*NOTE: The transport of NR-Uu protocol between the NTN Service Link provisioning system and the non-NTN infrastructure gNB functions is out of 3GPP scope.*

*At least the following NTN related parameters are expected to be provided by O&M to the gNB for its operation:*

*a) Earth-fixed beams: for each beam provided by a given NTN payload:*

*- The Cell identifier (NG and Uu) mapped to the beam;*

*- The Cell's reference location (e.g. cell's center and range).*

*b) Quasi-Earth-fixed beams: for each beam provided by a given NTN payload:*

*- The Cell identifier (NG and Uu) and time window mapped to a beam;*

*- The Cell's/beam's reference location (e.g. cell's center and range);*

*- The time window of the successive switch overs (feeder link, service link);*

*- The identifier and time window of all serving satellites and NTN Gateways.*

*c) Earth moving beams: for each beam provided by a given NTN payload:*

*- The Uu Cell identifier mapped to a beam and mapping information to fixed geographical areas reported on NG, including information about the beams direction and motion of the beam's foot print on Earth;*

*- Its elevation wrt NTN payload;*

*- Schedule of successive serving NTN Gateways/gNBs;*

*- Schedule of successive switch overs (feeder link, service link).*

**Question 2.15: Do companies agree with the above proposal or have further suggestions ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Comments/Suggestions** |
| Thales | Agree |  |
| Google | Agree |  |

**[Rapporteur summary]:**

## 2.16 Other points

**Question 2.16: Are there any other corrections to be discussed ?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments/Suggestions** |
|  |  |  |

**[Rapporteur summary]:**

# 2nd round discussion

# 4. Summary and Proposals

# 5. References

1. 3GPP TS 38.300 “NR; NR and NG-RAN Overall description; Stage-2”, v17.2.0
2. R2-2209539 CR Correction on neighbour cells’ satellite ephemeris information (38.300) MediaTek Inc.
3. R2-2209658 CR Correction on user consent for UE coarse location request Huawei, HiSilicon
4. R2-2210086 CR NTN stage-2 correction OPPO
5. R2-2210567 CR Corrections to TS 38.300 for Rel-17 NR NTN Samsung Research America
6. R2-2210634 CR Corrections to the UE-Based SMTC Adjustment in NTN Google Inc.
7. R2-2210742 CR Corrections on CHO evaluation for NTN CATT
8. R2-2210759 discussion R17 NR NTN Stage 2 corrections Ericsson

# 6. Contact information

|  |  |
| --- | --- |
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