**3GPP TSG RAN meeting #109 RP-251934**

**Beijing, China, September 15-18th, 2025** *rev of RP-xxxx*

## Status Report to TSG

**Title: Status report for SID: Study on GNSS (Global Navigation Satellite System) resilient NR-NTN (Non-Terrestrial Networks) operation; rapporteur: Thales**

**Agenda item:** 9.2.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **WI / SI Name** | Rel-20 Study on GNSS (Global Navigation Satellite System) resilient NR-NTN (Non-Terrestrial Networks) operation | | | | |
| included in this status report | Study Item:  Yes | Core part:  No | Performance part:  No | | Testing part:  No |
| **Acronym** | FS\_NR\_NTN\_GNSS\_resilient | | | | |
| **Unique ID** | 1080071 | | | | |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-251863 | | | | |
| **Target Completion Date**  **(indicate if changed)** | Study Item:  06/2026 | Core part:  N/A | Performance part: N/A | Testing part: | |
| **Overall Completion level** | Study Item:  Overall: 10%  RAN1: 10%  RAN4: 0% | Core part:  N/A | Performance Part:  N/A | Testing part:  N/A | |

Note: Overall completion level percentage numbers should use one of the colors below:

* xx%: Normal progress, no RAN plenary action needed
* xx%: Progress behind schedule, may need RAN plenary intervention. If so, SR should clearly define requested action
* xx%: Progress critically behind, RAN plenary shall intervene. SR should define requested action

**Source:**

|  |  |  |
| --- | --- | --- |
| **Leading WG** | | RAN1 |
| **Rapporteur** | **Name** | Mohamed El Jaafari |
| **Company** | Thales |
| **Email** | Mohamed.el-jaafari@thalesaleniaspace.com |

## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | No |

*If you answered No: Then please remove the Excel file from the zip file of this status report.*

*If you answered Yes: Then please fill out the attached Excel template to request a modification of the time budgets for your WI /SI. The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI. The basis are the endorsed time budgets of the last RAN meeting. Please highlight all changes of the values.  
 One time unit (TU) corresponds to ~ 2 hours in the meeting.  
 If this status report covers a WI with Core and Performance part, then please have one line for each in the attached Excel table.  
 Note: If no Excel table is attached, then this means no time budget change.*

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## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

NOTE: Agreements and Open issues impacted cross-TSG aspects shall be explicitly highlighted

## 2.1 RAN1

#### 2.1.1 Agreements

#### 2.1.1.1 Decisions during RAN1#122

**Agreement**

For the study on GNSS resilient operation, scenarios should be considered where:

* Scenario 1: The UE cannot rely on its GNSS for timing and frequency compensation on the service link.
* Scenario 2: There is a previously acquired GNSS based position
  + UE has not received GNSS information for time duration T from the last acquired GNSS position and hence, the GNSS accuracy is degraded
    - FFS: value of T
    - FFS: GNSS based UE location validity duration
    - FFS: GNSS accuracy
* Note: Two scenarios above belong to description as in SID.

**Agreement**

For the study on GNSS resilient operation, the following scenarios are considered for evaluation purposes:

|  |  |  |  |
| --- | --- | --- | --- |
| **Satellite orbit** | GSO | LEO-1200 | LEO-600 |
| **Satellite altitude** | 35786 km | 1200 km | 600 km |
| **Satellite scenario parameters** | At least Table 6.1.1.1-1 in TR 38.821, Parameters in Table 6.1.1.1-2 in TR 38.821could be considered. | | |
| **Beam size (note 3)** | At least values captured in Table 6.1.1.1-1/2 are considered, | | |
| **Minimum elevation angle** | 30° (LEO), 12.5° (GSO) | | |
| **Frequency ranges/bands** | FR1 NTN (2GHz/Ku: 14 GHz) and FR2 NTN (30 GHz) | | |
| **UE type** | Handheld (L/S band), VSAT (Ku/Ka) | | |
| **UE speed (note 1)** | L/S band: 3 km/h, 120km/h, 1500 km/h, Ku/Ka: 3 km/h , 120 km/h, 1500 km/h, (note 2) | | |
| **Beam/cell type (note 4)** | (Quasi)-Earth-fixed beams/cells and Earth-moving | | |
| Note 1: UE altitude is considered  Note 2: 10 km altitude in case of aircraft scenario. 1500 km/h is for aircraft scenario.  Note 3: Same values can be reused for other elevation angle than nadir. Beam size of the edge beam can be reported by companies.  Note 4: Footprint of the beam could be: case 1: within the orbital plane, case 2: at 90° with respect to orbital plane. Companies to report the elevation angle of the beam.  Note 5: Other parameters can be reported by companies. | | | |

**Note: The cyan highlighted parameters are prioritized for evaluation purposes.**

**Agreement:**

For PRACH performance evaluation for existing PRACH formats, adopt the following methods:

* Baseline: Analytical characterization of performance based on e.g. properties of ZC sequences and values of differential Delay / Doppler.
* Optional: Link level evaluations
  + The following table is proposed for LLS parameters

|  |  |  |
| --- | --- | --- |
| Configurations | S/L-band | Ka/Ku-band |
| Carrier Frequency | 2 GHz | For Ka: UL 30GHz, for Ku: UL 14 GHz |
| Channel Model | Baseline NTN TDL-C rural model in TR38.811 | |
| Antenna Configuration at the TRP (satellite) | 1 Rx | 1 Rx |
| Antenna Configuration at the UE | A single omni-directional antenna element | VSAT with 60 cm equivalent aperture diameter |
| PRACH format | To be reported by companies. | To be reported by companies |
| PRACH configuration | To be reported by companies. | |
| Metric | PRACH detection rate, FAR (Based on the preamble pool size is not less than 64), CDF of estimation error for frequency/timing | |
| Receiver | Companies to report the receiver for PRACH detection. | |

**Agreement:**

For evaluation regarding GNSS-resilient operation, based on GNSS information or the lack of it, it is assumed that the UE has a horizontal location uncertainty within an area

* Case a: the location uncertainty area is the area served by the cell or beam.
* Case b: the location uncertainty area is a circle of radius X km
  + X to be reported

UE altitude error should be taken into account.

* UE altitude error to be reported.

For both Case a and Case b above, RAN1 to evaluate at least:

* Differential delay values
* Differential frequency offset/Doppler values

#### 2.1.2 Remaining Open issues

Assess impact on initial access and connected mode procedures for NR-NTN.

## 2.2 RAN4

#### 2.2.1 Agreements

None

#### 2.2.1.1 Decisions during RAN4#116

None

#### 2.2.2 Remaining Open issues

Assess potential impact on RRM specifications related to initial access and connected mode procedures for NR-NTN.

## 3. Detailed progress in SA/CT WGs since last TSG meeting (for all involved WGs)

NOTE: This section only needs to be filled in for WI/SIs where there is a corresponding relevant WI/SI in SA/CT.

## 3.1 SA2

#### 3.1.1 Agreements with cross-TSG impacts

#### 3.1.2 Remaining Open issues with cross-TSG impacts

NOTE: This section should also flag any critical dependencies that need TSG attention.   
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## 4. References

## 4.1 RAN1

**RAN1#122 meeting, Bengaluru, India, August 25-29th, 2025:**

* R1-2505124 Discussion on NR-NTN GNSS resilience SageRAN
* R1-2505142 On GNSS-resilient operation for NR-NTN Ericsson
* R1-2505153 Discussion on Rel-20 GNSS resilient NR NTN operation FUTUREWEI
* R1-2505169 Discussion on NR NTN GNSS resilience Spreadtrum, UNISOC
* R1-2505223 GNSS resilience for NR-NTN Huawei, HiSilicon
* R1-2505307 Discussion on NR-NTN GNSS resilience CATT
* R1-2505359 Considerations on NR-NTN Resilience to GNSS Unavailability and Degradation THALES
* R1-2505413 Discussion on NR-NTN GNSS resilience vivo
* R1-2505460 Discussion on NR-NTN GNSS resilience Xiaomi
* R1-2505508 Discussion on NR-NTN GNSS resilience ZTE Corporation, Sanechips
* R1-2505581 Discussion on NR-NTN GNSS resilience Samsung
* R1-2505590 Discussion on NR-NTN GNSS resilience Fraunhofer IIS, Fraunhofer HHI
* R1-2505632 GNSS Resilient NR-NTN Operation in 5G Adv Tejas Network Limited
* R1-2505672 Discussion on NR-NTN GNSS resilience Ofinno
* R1-2505695 Random access for NR NTN GNSS resilient operation Sharp
* R1-2505754 Discussion on NR-NTN GNSS resilience OPPO
* R1-2505779 Discussion on NR-NTN GNSS resilience China Telecom
* R1-2505859 Considerations for the study of NR-NTN GNSS resilience Eutelsat Group
* R1-2505910 Considerations of NR-NTN GNSS Resilient Operations Apple
* R1-2505937 Discussion on NR-NTN GNSS resilience NEC
* R1-2505940 Discussion on the GNSS resilient NR-NTN operation TCL
* R1-2505949 Discussion on GNSS resilient NR-NTN operation LG Electronics
* R1-2505977 Discussion on GNSS resilient NR-NTN Panasonic
* R1-2506001 Discussion on NR-NTN GNSS resilience HONOR
* R1-2506040 GNSS resilient operations in NR NTN MediaTek Inc.
* R1-2506048 Initial views on GNSS resilient operation for NR over NTN Nokia
* R1-2506062 Discussion on NR-NTN GNSS resilient operations ETRI
* R1-2506094 Discussion on NR-NTN GNSS resilience CMCC
* R1-2506115 Discussion on GNSS resilient NR-NTN operation Sony
* R1-2506132 Discussion on NR-NTN GNSS Resilient Operations Lenovo
* R1-2506154 Considerations for GNSS resilient NR-NTN operation ST Engineering iDirect
* R1-2506155 NR-NTN GNSS resilience InterDigital, Inc.
* R1-2506165 Discussion on GNSS resilient NR-NTN operation TOYOTA Info Technology Center
* R1-2506215 NR-NTN GNSS resilience Qualcomm Incorporated
* R1-2506264 Discussion of NR-NTN GNSS Resilience Johns Hopkins University APL
* R1-2506302 Study on NR-NTN GNSS resilience NTT DOCOMO, INC.
* R1-2506334 Discussion on GNSS resilience for NR-NTN CSCN
* R1-2506343 Discussion on NR-NTN GNSS resilience Google
* R1-2506357 Discussion on GNSS Resilient Operation for NR NTN CEWiT
* R1-2506385 Discussion on NR-NTN GNSS resilience ViaSat Satellite Holdings Ltd, Inmarsat, Terrestar, Ligado, Space42, Thuraya

## 4.2 RAN4

**RAN4#116 meeting, Bengaluru, India, August 25-29th, 2025: None**

***END***