**3GPP TSG RAN meeting #100 RP-230913**

**Taipei, Taiwan, June 12-15, 2023** *revised RP-230119*

## Status Report to TSG

**Title: Status report for WI NR NTN (Non-Terrestrial Networks) enhancements; rapporteur: Thales**

**Agenda item:** 9.3.2.7

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **WI / SI Name** | Rel-18 NR NTN (Non-Terrestrial Networks) enhancements | | | | |
| included in this status report | Study Item:  No | Core part:  Yes | Performance part:  Yes | | Testing part:  No |
| **Acronym** | NR-NTN-enh | | | | |
| **Unique ID** | 941006 | | | | |
| **TSG Tdoc of latest approved WI/SI description (if any)** | *RP-230809* | | | | |
| **Target Completion Date**  **(indicate if changed)** | Study Item: | Core part: 12/2023 | Performance part: 06/2024 | Testing part: | |
| **Overall Completion level** | Study Item: | Core part:  Overall: 60%  RAN1: 75%  RAN2: 50%  RAN3: 50%  RAN4: 50% | Performance Part:  Overall: 0%  RAN4: 0% | Testing part: | |

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** | | RAN2 |
| **Rapporteur** | **Name** | Nicolas Chuberre |
| **Company** | Thales |
| **Email** | Nicolas.chuberre@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?** | Yes |

*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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Request for an additional 0.5 TU in RAN1 to address issues related to the support of FDD and to the potential modification of PRACH config in above 10 GHz frequency bands.

See Liaison Statement “LS on the system parameters for NTN above 10 GHz” from RAN4 to RAN1 in R4-2305926.

## 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

* **RAN1#112bis emeeting, April 17th - 27th, 2023:**

1. Coverage enhancement for NR NTN

**Observation**

For NTN-specific PUSCH DMRS bundling,

* In LEO 1200 with elevation angle 30 deg. and SCS = 15 kHz, RAN1’s understanding is the following:
  + Phase difference limit (Table 6.4.2.5-1 in 38.101-1) cannot be satisfied over multiple slots (for carrier bandwidth 5 MHz or larger), if the PRB allocation is not within 6 PRBs from the DC carrier, pre-compensation by UE and post-compensation by gNB are not assumed, and 70.5 (us/s) timing drift rate is assumed.
  + Note: this does not imply that UE shall be scheduled within 6 PRBs from the DC carrier.

**Working assumption**

For NTN-specific PUSCH DMRS bundling, to satisfy the phase difference limit without causing phase discontinuity, it is assumed that pre-compensation to keep phase rotation due to timing drift within the phase difference limit can be performed at UE side.

* UE shall not perform TA pre-compensation update within an actual TDW if it causes phase discontinuity that may violate the phase difference limit.
  + FFS: how to determine the actual TDW
* FFS: specification impact
* Send an LS to RAN4

**Agreement**

Final LS is endorsed in R1-2304094 with the following revision to the action:

**ACTION**: RAN1 respectfully asks RAN4 to take the above RAN1 observations and ~~agreement~~ working assumption into account.

**Working assumption**

For PUCCH repetition for Msg4 HARQ-ACK, support Option B as container of the repetition request or capability report indicated by UE.

* Option B: Higher layer signaling in Msg3 PUSCH

Send an LS to RAN2 at RAN1#113 to provide details of “repetition request or capability report”, to ask the feasibility of Option B, and if feasible, to specify the details of Option B.

**Agreement**

For NTN-specific PUSCH DMRS bundling, support Alt 2 for TDW determination.

* Alt 2: gNB-centric TDW determination
  + Nominal TDW is determined based on gNB configuration.
  + Actual TDW is determined based on gNB configuration/indication.
  + Note: Alt 2 does not imply that spec impact of actual TDW determination is assumed for NTN.
  + FFS: details, including UE capability and assistance information reporting

**Agreement**

For PUCCH repetition for Msg4 HARQ-ACK, support Alt 1-1 for dynamic indication of repetition factor from gNB. Further discuss which field(s) to be used.

* Alt 1: Field in DCI scheduling the Msg4 PDSCH
  + Alt 1-1: One or two bits of the existing field(s)
    - Alt 1-1a: MCS field
    - Alt 1-1b: PUCCH resource indicator field (e.g., with repetition factor configuration per PUCCH resource)
    - Alt 1-1c: HARQ process number filed
    - Alt 1-1d: DAI field
    - Alt 1-1e: PDSCH-to-HARQ\_feedback timing indicator field

**Agreement**

For PUCCH repetition for Msg4 HARQ-ACK, apply frequency hopping mechanism in R15/16/17 defined for PUCCH transmission for Msg4 HARQ-ACK, in every slot.

**Agreement**

For PUCCH repetition for Msg4 HARQ-ACK, candidate values of only one repetition factor configuration via SIB are {2, 4, 8}.

* i.e., configuration of only ‘1’ is not supported.

1. “Network verified UE location for NR NTN ”

**Agreement**

For RTT determination in NTN, discuss further the accuracy, and reporting details of combinations of the following UE and gNB receive-transmit time difference measurements:

* Alt-1: UE Rx-Tx time difference based on Option 3 and gNB Rx-Tx time difference as defined in TS 38.215.
  + Note 1: The signaling method of UE Rx-Tx time difference definition option 1 is not precluded if Alt1 is adopted
* Alt-2: UE Rx-Tx time difference based on Option 2 and gNB Rx-Tx time difference as defined in TS 38.215.
  + Note 2: The LMF will use the time stamp of the PRS and the time stamp of SRS to calculate the time difference between the transmission of PRS and the reception of SRS
* Alt-3: UE Rx-Tx time difference based on Option 2 and gNB Rx-Tx time difference based on Option 4

      FFS: One or multiple SRS can be used in determining the arrival time

      FFS: Additional enhancement including additional information to be reported, if justified

Note 3: The impact of UE autonomous adjustment of TA (when applied) should be taken into account

Note 4: The gNB Rx-Tx time difference option in the above alternatives may need updates accordingly based on the outcome of discussion on reference point for the gNB Rx – Tx time difference

Email discussions

* **RAN1#113 Incheon, Korea, May 22th – 26th, 2023:**

**Agreement**

One company thinks that when the network knows the suitable DL beam for RACH-less handover, the pre-allocated grant can be associated with a SSB index of the target cell, and when the network does not know the suitable DL beam, RACH-based HO can be used instead of introducing beam-sweeped pre-allocated grants associated with multiple SSB indexes. Other companies think that the association between the pre-allocated grant for initial transmission and SSB index should be supported without any condition(s), and think that RSRP threshold may be helpful.

**Agreement**

If single beam is indicated, UE will monitor the target cell PDCCH scheduling the first PUSCH based on the indicated beam. RAN1 will further discuss the case where multiple beams are indicated.

**Agreement**

The draft LS in R1-2306151 is endorsed. Final LS in R1-2306217.

**Agreement**

**Conclusion:**

From RAN1 perspective, no feasibility issue is identified for hard satellite switching without PCI change.

Reply to RAN2 with the following LS content:

|  |
| --- |
| **Question 1:** Forhard satellite switching without PCI change, if RAN1 identifies any major technical issues?  **Reply:**  RAN1 discussed the resynchronization of UE when hard switching, given that new common TA, K\_mac, ephemeris and cell-specific K-offset are applied during resynchronization to new satellite.  From RAN1 perspective, no feasibility issue is identified for hard satellite switching without PCI change. |

**Agreement**

The draft LS in R1-2306209 is endorsed. Final LS in R1-2306210.

1. Coverage enhancement for NR NTN

**Working assumption**

For PUCCH repetition for Msg4 HARQ-ACK,

* Two-state information is transmitted as ‘repetition request or capability report’ in the existing agreements/working assumptions.
  + The two-state information represents state 1: ‘repetition request or capability report’ or state 2: no indication.
  + How to transmit the two-state information is up to RAN2 when higher layer signaling is used for the transmission.
  + In state 1, only either repetition request or capability report is transmitted from each UE when transmitted, and they are not differentiated in the signaling.
  + Note: repetition request and capability report are defined as in the working assumption reached at RAN1#112.

**Agreement**

Draft LS to RAN2 in R1-2306085 is endorsed with the following change:

It is noted that an additional working assumption was reached for repetition request or capability report.

Final LS in R1-2306105

**Agreement**

If PUCCH repetition discussed in R18 NR NTN coverage enhancement is supported for PUCCH transmission when dedicated PUCCH resource configuration is not provided:

* The agreements and working assumptions for PUCCH for Msg4 HARQ-ACK are applied to any PUCCH transmission by using common PUCCH resource
* The same repetition factor is applied for PUCCH for Msg4 HARQ-ACK and subsequent PUCCH transmissions by using common PUCCH resource
* Note: It is not precluded for gNB to provide dedicated PUCCH config via Msg4 PDSCH.

R1-2306023 Summary #2 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)

**R1-2306024 Summary #3 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)**

**Working assumption**

For NTN-specific PUSCH DMRS bundling, reuse clause 6.1.7 in TS38.214 for nominal TDW determination, except for aspects related to UE capabilities and assistance information (if needed).

* i.e., if PUSCH-TimeDomainWindowLength is configured, nominal TDW is determined by PUSCH-TimeDomainWindowLength; otherwise, nominal TDW is determined based on UE capability(ies) signaling.
* FFS: which UE capability(ies) signaling is(are) used
* FFS: whether/how to use UE assistance information, if supported

**Agreement**

For NTN-specific PUSCH DMRS bundling, one or more of the following is down-selected for actual TDW determination.

* Actual TDW is determined by the existing events and,
  + Alt A: No additional event
    - i.e., no spec impact is assumed for actual TDW determination.
  + Alt B: New event of TA pre-compensation timing dynamically indicated by gNB
    - i.e., TA pre-compensation timing can be dynamically indicated by gNB
    - Note: UE can perform TA pre-compensation update at the indicated timing
    - FFS: detailed indication
  + Alt C: as dynamically indicated by gNB
    - i.e., actual TDW can be dynamically indicated by gNB
    - FFS: detailed indication
  + Alt D: New event based on epoch time
    - FFS details
  + Alt E: New event based on antenna switching

**Agreement**

For NTN-specific PUSCH DMRS bundling,

* As UE capability report (in addition to FG 44-2), one or more of the following is down-selected.
  + Option 1a: No new capability except for FG44-2
    - Note: FG 30-4 is reported [in consideration of pre-compensation to keep phase rotation due to timing drift within the phase difference limit and without taking TA pre-compensation update into account]
  + Option 1b: Max TDW size when pre-compensation to keep phase rotation due to timing drift within the phase difference limit is performed and without taking TA pre-compensation update into account
    - Note: FG 30-4 is not reported for NTN band
  + Option 1c: Support of antenna switching with DMRS bundling in NTN
  + Option 1d: Max TDW size per NTN platform (e.g., LEO, MEO, GEO) with taking TA pre-compensation update into account
    - FFS details
  + Option 1e: Max TDW size per elevation angle with taking TA pre-compensation update into account
  + Option 1f: Whether to support actual TDW across pre-compensation segments
    - Segments defined in R17 IoT-NTN is baseline, FFS details
  + Option 1g: Whether to support TA pre-compensation update within an actual TDW that does not violate the phase difference limit
* As UE assistance information (i.e., report by signaling other than UE capability report (FFS details)), one or more of the following is down-selected.
  + Option 2a: No assistance information
  + Option 2b: Max TDW size based on reporting timing
    - FFS which timing is referred
  + Option 2c: TA adjustment timing
  + Option 2d: Antenna switching interval

**Agreement**

For PUCCH repetition for Msg4 HARQ-ACK,

* Support Alt 1-1d for dynamic indication of repetition factor:
  + Alt 1-1d: DAI field
    - DAI field in DCI format 1\_0 with CRC scrambled by TC-RNTI is used for indication.

1. “Network verified UE location for NR NTN ”

**Agreement**

For network verified UE location in NTN, satellite ephemeris information should be available at the LMF.

**Agreement**

For network verified UE location in NTN common TA information should be reported at least from gNB to LMF.

Working assumption

In NTN, gNB receive-transmit time difference calculated at uplink time synchronization reference point is reported to the LMF.

#### 2.1.2 Remaining Open issues

Coverage enhancements

Normative is on going

Network verified UE location

Normative is on going

## 2.2 RAN2

#### 2.2.1 Agreements

The agreeable Work plan can be found in R2-2301344 R18 WI NR-NTN-enh work plan at RAN1, 2 and 3

* **RAN2#121bis Athens, Greece, February 27th – March 3rd, 2023**

a) Coverage enhancements

Agreements:

1. Rel-18 NTN coverage enhancements work will focus on addressing the RAN2 impact (if any) from RAN1 agreements on PUCCH enhancements for MSG4 HARQ-ACK and DMRS bundling for PUSCH. No further enhancements are pursued in this release

b) Network verified UE location

Agreements:

1. NTN UE doesn’t support positioning measurement and report in RRC INACTIVE

c) Mobility enhancements

Agreements:

1. For signaling the TN coverage, the corresponding geographical area information is provided by broadcast signalling by the network via a list of (possibly overlapping) areas where each area is defined using center location coordinates + radius (where the area is meant to describe a group of cells, not just a single one). FFS on the SIB. FFS on whether additional information in dedicated signalling is needed/useful

Agreements via email – from offline 106:

1. Area center location and its radius for TN coverage information is signalled using Ellipsoid-Point and radius separately. FFS if Rel-17 referenceLocation and distanceThresh are directly reused

2. Decision on the size of TN coverage area list is postponed until more is known on the format of this information and how is it sent.

Agreements online:

1. The discussion on how to indicate the frequency information for each TN coverage area should be combined with the discussion on which SIB will be used to indicate the TN coverage area, possibly based on evaluation of the signalling overhead

2. The acquired TN area coverage information remains valid until the next system information update of the SIB including TN coverage info

Working assumption:

1. We do not introduce new triggers making the UE reacquire the TN coverage information from SI

Agreements via email – from offline 107:

1. On a frequency band number shared by TN and NTN (e.g., n1), if NTN-specific assistance information is NOT provided for a neighbour cell configured in SIB3/SIB4, UE assumes this is a TN neighbour cell. This understanding is also applicable for Rel-17 and it does not need any spec update

Agreements:

1. RAN2 understands that for earth-moving cell reselection, the UE can derive the trajectory of serving cell with rough accuracy based on serving satellite ephemeris and epochTime, with the assumption that the serving cell reference location broadcast by the network is the one at Epoch time (FFS whether a new epochTime IE is needed). RAN2 understanding is that both PVT and orbital parameters can be used for this. FFS if additional information is needed to allow more accurate measurements.

2. For earth-moving cell, new IE is introduced to indicate the reference location of serving cell.

3. For cell (re)selection in earth-moving system, a distance threshold is introduced for location-based measurement initiation, which reuses distanceThresh in SIB19.

4. For cell (re)selection in earth-moving system, time-based measurement initiation is used to address feeder-link switch case.

5. Time-based cell reselection criteria is not pursued in R18.

Agreements:

1. In Rel-18 we don’t aim at RACH-less HO for NTN-TN mobility

2. For initial UL transmission in RACH-less HO, support pre-allocated grant in RACH-less HO command

Agreements via email – from offline 109:

1. NTN RACH-less HO is supported for Intra-satellite handover with the same feeder link. i.e., with same gateway/gNB;

2. NTN RACH-less HO can be supported for intra-satellite handover with different feeder links, i.e., with gateway/gNB switch, inter-satellite handover with gateway/gNB switch, and inter-satellite handover with same gateway/gNB.

3. RAN2 confirms the general UE procedure for NTN RACH-less HO

1. receive a RACH-less HO command which can include pre-allocated grant optionally. FFS N\_TA is optional. (RRC)

2. start timer T304 for the target cell (RRC)

3. perform DL and UL synchronization, and start timer T430. FFS how to perform RACH-less UL synchronization to NTN target cell. (RRC, MAC)

4. start time alignment timer (MAC)

5. monitor target cell PDCCH for dynamic grant if pre-allocated grant is not configured in RACH-less HO command (MAC, PHY)

6. send initial UL transmission including RRCReconfigurationComplete message using the available UL grant (RRC, MAC, PHY)

7. consider RACH-less HO is completed upon receiving NW confirmation. FFS how to confirm RACH-less HO is successfully completed. (RRC, MAC)

8. stop timer T304 for the target cell. (RRC)

FFS whether to release UL grant if pre-allocated after RACH-less HO completion

FFS RACH-less HO failure handling, e.g. whether UE fallback to RACH-based HO to the target cell

FFS procedure for RACH-less HO combined with PCI unchanged or CHO if supported

4. The pre-allocated grant is provided as type-1 CG

5. Send an LS to RAN1 informing RAN2 agreements on NTN RACH-less HO and check RAN1 views on the following aspects:

1. whether the pre-allocated grant is provided with association to SSBs; if so, whether a RSRP threshold is configured for SSB selection.

2. to monitor target cell PDCCH for dynamic grant for initial UL transmission, whether beam indication can be provided in RACH-less HO command.

3. power control for initial UL transmission

Agreements online:

1. At least for pre-allocated grant, for the confirmation of RACH-less HO completion we reuse of LTE approach, i.e., UE Contention Resolution Identity MAC CE is used but UE ignores the content of this field. FFS if anything else is needed for dynamic grant

2. Consider to support combining RACH-less HO with time-based CHO for NTN, taking into account the 1) validity of pre-allocated grant and potential waste of reserved resource; 2) when/how to provide dynamic grant in PDCCH.

Agreements:

1. In quasi-earth fixed cell case, for hard satellite switch in the same SSB frequency and same gNB (no key change), satellite switching without PCI changing (not requiring L3 mobility) is supported, unless major technical issues are identified by RAN1 (as usual RAN2 will aim at minimizing the specification impact so that it fits in Rel-18)

2. Remove the part in brackets “as usual RAN2 will aim at minimizing the specification impact so that it fits in Rel-18” in the LS to RAN1. The action to RAN1 will also ask for feedback for the hard satellite switch (not only the soft satellite switch case), e.g. action to RAN1 is to see if there are any major technical issues (as in the agreement).

LS out

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Email discussions

* [AT121bis-e][105][NR NTN Enh] Coverage enhancements (Interdigital)
* [AT121bis-e][106][NR NTN Enh] Signaling of TN coverage (Nokia)
* [AT121bis-e][107][NR NTN Enh] NW type information (Samsung)
* [AT121bis-e][108][NR NTN Enh] Common (C)HO configuration (Ericsson)
* [AT121bis-e][109][NR NTN Enh] RACH-less HO (Samsung)
* [AT121bis-e][110][NR NTN Enh] LS to RAN1 on unchanged PCI (CATT)
* [Post121bis-e][109][NR NTN Enh] LS on RACH-less HO (Samsung)
* [Post121bis-e][111][NR NTN] Stage 2 corrections (Oppo)
* **RAN2#122 Incheon, Korea, May 22th – 26th, 2023:**

a) Coverage enhancements

b) Network verified UE location

Agreements:

1. In order to resolve the mirror point ambiguity issue, the network relies on the legacy signaling and procedure to configure NTN UE to measure and report neighbor cells or reference signals/beams. No spec changes to radio interface are needed from RAN2 perspective. Unclear if changes are needed to other interfaces, NRPPa protocol (RAN2 will no longer discuss this)

Working Assumption:

1. A Rel-18 UE capability is needed for indicating whether UE supports the feature of network verified UE location in NR NTN network

c) Mobility enhancements

Agreements:

1. An RRC\_IDLE/RRC\_INACTIVE UE is not required to perform neighbour cell measurements for cell reselection for a TN frequency in the area, if configured, where there is no coverage of that frequency, regardless of the frequency priority

2. Reuse the same format of Rel-17 referenceLocation and distanceThresh for signaling the TN coverage area centre and radius

3. TN coverage info is NOT included in SIB19. FFS if we use an existing SIB or a new one

4. We don’t introduce RRC dedicated signalling to provide more accurate TN coverage information

Agreements:

1. We no longer consider option 3 alone for signaling the frequency information for TN coverage area (in case option 3 should be combined with option 1). Come back in the next meeting to decide between option 2 (plus possible fixes if needed) and option 1+3.

1. Re-use epochTime-r17 in ntn-Config IE to provide the time reference for an Earth moving cell reference location.

2. Re-use t-Service-r17 format for the IE used to trigger UE neighbour cell measurements prior to cell replacement due to feeder link switch. FFS whether we reuse exactly the same IE name as in R17 (updating the field description) or a new one

Agreements:

1. Location-based cell reselection criteria are not pursued in R18.

Agreements:

 Come back to the proposal to broadcast the target cell’s servingCellConfigCommon (as common (C)HO signalling) after feedback from RAN3

 Send al LS to RAN3 asking whether, in case target cell’s servingCellConfigCommon is broadcast in the source cell (as common (C)HO signalling), the target cell’s servingCellConfigCommon can be transferred to the source cell in the inter-gNB HO case in R18

 Group handover related to P1~P4 from R2-2304736 is not supported in Rel-18.

Agreements:

1. In NTN RACH-less handover, NW either indicates NTA in the target cell is identical to the source cell, or the NTA explicitly provided by the NW is 0. RAN2 will not discuss the case where NTA does not equal to 0

Agreements:

1. From RAN2 perspective synchronization among source and target cells is not an issue in NTN RACH-less HO

2. Release pre-allocated UL grant after RACH-less HO completion

3. LTE approach (of confirming the HO completion) is reused for both pre-allocated grant and dynamic grant. FFS any enhancement to the confirmation of RACH-less HO completion, e.g. the NW does not send the UE Contention Resolution Identity MAC CE, and sends PDCCH/PDSCH addressed to C-RNTI

4. Remove “FFS how to perform RACH-less UL synchronization to NTN target cell”, RAN2 assumes the UL sync handling in the target cell is the same in RACH-based HO and RACH-less HO, except how to acquire NTA (FFS on the spec impact , if any)

Agreements:

 t-Service in SIB19 can also be interpreted by Rel-18 UE in Connected mode to know that a satellite change or feeder link change happens

 In hard switch unchanged PCI scenario (i.e. no handover), the UE needs to know the time the UE attempts to re-synchronize. (FFS whether a new “t-Start” / a t-gap is needed or whether t-Service can be reused (i.e. no other IE) if the gap is very short/zero).

LS out

Email discussions

* [AT122][103][NR-NTN Enh] NTN-TN cell reselection (Nokia)
* [AT122][104][NR-NTN Enh] Location-based cell reselection enhancements (CMCC)
* [AT122][105][NR-NTN Enh] Common signaling in (C)HO (OPPO)
* [AT122][106][NR-NTN Enh] RACH-less HO (Huawei)
* [AT122][107][NR-NTN] CR0668 (vivo)
* [AT122][108][NR-NTN] CR0676 (OPPO)
* [AT122][109][NR-NTN] CR3979 (QC)
* [AT122][110][NR-NTN] CR4112 (Intel)
* [AT122][111][NR-NTN] RRC CR for kmac (OPPO)
* [AT122][112][NR-NTN] CR4040 (ASUSTeK)
* [Post122][108][NR-NTN Enh] Stage 2 Running CR (Thales)
* [Post122][109][NR-NTN Enh] MAC Running CR (Interdigital)
* [Post122][110][NR-NTN Enh] 38.304 Running CR (ZTE)
* [Post122][111][NR-NTN Enh] RRC Running CR (Ericsson)

#### 2.2.2 Remaining Open issues

a) Coverage enhancements

* Specify signalling and procedures to support UL coverage enhancements

b) Network verified UE location

* specification of necessary enhancements to multi-RTT to support the network verified UE location in NTN assuming a single satellite in view. DL-TDoA methods for verification may be considered as lower priority and if time permits and condition in Note is satisfied

c) NTN-TN and NTN-NTN mobility and service continuity enhancements

* Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements

## 2.3 RAN3

#### 2.3.1 Agreements

* **RAN3#119bis emeeting, April 17th - 27th, 2023:**

1. Mobility enhancements

Agreements

* WA: Uu Cell ID is used to be exchanged via Xn Setup and Configuration Update procedure.
* Confirm to add the handover window start and duration IEs to the NGAP Source NG-RAN Node to Target NG-RAN Node Transparent Container IE.
* Confirm to enhance the early data forwarding with data discarding for NG HO.

Understandings

* RAN3 understands a source gNB can only prepare one potential target cell for NG HO as stated in TS38.413.

Documents agreed

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Email discussions

* R3-231892 # NTN1\_ServiceContinuity (moderator - SS)

1. Network verified UE location

Agreements

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Email discussions

* R3-231893 # NTN2\_LocationVerification (moderator - HW)
* **RAN3#120 Incheon, Korea, May 22th – 26th, 2023:**

1. Mobility enhancements

Agreements

* Change the WA to the agreement:
* Uu Cell ID should be used in Xn Setup and Configuration Update procedures.
* WA: Do not exchange multiple TACs over Xn for NTN.
* When time-based trigger condition is used, the source NG-RAN node should consider the time indicated to the UE to decide when start the early data forwarding to the target NG-RAN node.

Understandings

* **MCC to minute: The usage of mapped cell ID is not precluded.**

Documents agreed

* R3-233454 (TP for NR NTN BL CR TS38.300) Discussion on the time-based trigger condition in NR NTN (Nokia, Nokia Shanghai Bell)
* R3-233494 NGAP Support for Time-Based HO in NTN (Ericsson, Thales, Intelsat, Lockheed Martin, Hughes Network Systems, CATT, ESA, Nokia, Nokia Shanghai Bell)
* R3-233455 (TP for NR NTN BL CR TS38.413) Support time-based trigger condition in NR NTN NG-HO (Nokia, Nokia Shanghai Bell)
* R3-233526 Time-Based HO for NTN - NGAP Impacts (Ericsson, Thales, ZTE, Omnispace, TTP, CATT, Hughes Network Systems, Huawei, Lockheed Martin, Intelsat, ESA) CR0891r5, TS 38.413 v17.4.0, Rel-18, Cat. B
* R3-233527 LS to SA2 on time-based trigger condition in NG HO for NR NTN
* R3-233435 New TP for TS38.300

Email discussions

* R3-233437 # NRNTN1\_ServiceContinuity, (moderator - E///)

1. Network verified UE location

Agreements

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BL CRs agreed

* R3-232541 XnAP BLCR on NTN Functionality (Huawei, Ericsson, Thales, ZTE, Omnispace, TTP, Nokia, Nokia Shanghai Bell, CATT, Hughes, EchoStar, CMCC) CR0933r4, TS 38.423 v17.4.0, Rel-18, Cat. B
* R3-232826 (BLCR to 38.300) Stage 2 BL CR for NR NTN (Ericsson, CATT, Thales, Huawei, Samsung, ZTE, Nokia, Nokia Shanghai Bell, Qualcomm Incorporated) draftCR

Email discussions

* -

#### 2.3.2 Remaining Open issues

To be further discussed as part of NTN-TN and NTN-NTN mobility and service continuity enhancements

* **Do not exchange TAC(s) over Xn for NTN. Solution to be further discussed. To be continued...**
* **FFS on details, e.g. Introduce a DL discarding related IE in Early Status Transfer Transparent Container IE.**
* **To address the issue of time delay in CHO with time condition, the target gNB may wait for an additional time after the CHO time window has expired, according to implementation?**
* **Continue on working on stage2 TP and stage3 TPs based on agreements, to be continued...**
* **Whether to send an LS to SA2 to clarify the understanding of RAN3, that is no services can be provided to the NTN UE until its location has been verified at initial network attach?**
* **How to describe which TAC should be used in semantic description?**

## 2.4 RAN4

The applicable work plan in RAN4 can be found under R4-2300973

#### 2.4.1 Agreements

* **RAN4#106-bis-e, April 17th – 26th 2023, Online**

1. NR-NTN deployment in above 10 GHz

[UERF aspects]

**Issue 1-1: UE types**

* Encourage companies to provide the regulation differences leading to different RF/RRM requirements between the mobile and fixed NTN UEs, and further discuss whether RAN4 needs to define the different UE types.
* Discuss possible differentiation of NTN UE types in above 10 GHz, based on RF parameters (noise figure, antenna types, antenna gain and transmission power, or alternatively minimum EIRP in the peak direction, Effective Isotropic Sensitivity EIS, etc.).
* The impact on RF and RRM requirements will be investigated, and analysis on RF requirement impact is prioritized.

**Issue 2-1: Beam tracking capability**

*Tentative agreement:*

the (Rx and Tx) beam pointing error are compliant with at least the relevant ETSI harmonized standard. (e.g.

* + - * EN 303 978    “Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in geostationary orbit, operating in the 27,5 GHz to 30,0 GHz frequency bands”;
      * EN 303 979    “Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in non-geostationary orbit, operating in the 27,5 GHz to 29,1 GHz and 29,5 GHz to 30,0 GHz frequency bands”).

[BSRF Test Demod aspects]

SAN RF requirements

**Agreement:**

* Multi-band operation is not supported in Rel-18

**Way Forward**

* Further evaluate the needed power backoff to support 64QAM in DL, EVM and other related requirements to support 64QAM in DL

**Way Forward**

* FFS how to specify OOB and ΔfOOB.

**Way Forward**

* FFS if PFD regulatory requirements shall be included or only be referenced in RAN4 specifications.

System parameters

**Sub-topic 1-1 (Issues 1-1-1, 1-1-2, 1-1-3, 1-1-4)**, **updated:** Above 10 GHz NTN band definition and related parameters

* Starting with option below and further work on the text proposal of “note 1 and note 2”. LS to RAN1/RAN2 can be considered.
  + It’s not precluded to further extend the frequency ranges in the future if needed and justified.
  + Agree the definition of NTN frequency ranges as shown in the Proposed Table 5.1-1 to be introduced to TS 38.101-5 and TS 38.108.

Proposed Table 5.1-1: Definition of NTN frequency ranges

|  |  |
| --- | --- |
| Frequency range designation | Corresponding frequency range |
| FR1-NTN1 | 410 MHz – 7125 MHz |
| FR2-NTN2 | 17300 MHz – 30000 MHz |
| NOTE 1: [NTN bands within this frequency range are regarded as a FR1 band when references from other specifications.]  NOTE 2: [NTN bands within this frequency range are regarded as a FR2 band when references from other specifications.] | |

**Sub-topic 1-1 (Issue 1-1-5):** Tx-Rx frequency separation

* Flexible Tx-Rx frequency separation can be used for Ka band NTN FDD operation.

**Sub-topic 1-2 (Issue 1-2-1) updated:** NR-ARFCN

* Following global channel raster definition with step size as 4 and 8 (60 kHz, 120 kHz) for DL part and step size as 1 and 2 (60 kHz, 120 kHz) for uplink part.
  + **Note:** Not preclude the possibility of operating with lower SCS. Companies to discuss if lower SCS could be used, such as at least 30 kHz. FFT maximum size constraint (4096) should be considered.
  + **The following channel raster NREF values for bands n512, n511 and n510 can be used as starting point for further check**

|  |  |  |  |
| --- | --- | --- | --- |
| NR *operating band* | ΔFRaster  (kHz) | Uplink  range of NREF  (First – <Step size> – Last) | Downlink  range of NREF  (First – <Step size> – Last) |
| n512 | 60 | 2070833 – <1> – 2112499 | [1553334] – <4> – [1746666] |
| 120 | 2070833 – <2> – 2112499 | [1553334] – <8> – [1746664] |
| n511 | 60 | 2084999 – <1> –2112499 | [1553334] – <4> – [1746666] |
| 120 | 2084999 – <2> –2112499 | [1553334] – <8> – [1746664] |
| n510 | 60 | 2070833 – <1> – 2084999 | [1553334] – <4> – [1746666] |
| 120 | 2070833 – <2> – 2084999 | [1553334] – <8> – [1746664] |

**Sub-topic 1-2 (Issue 1-2-2) updated:** GSCN

* Following global sync raster design, with step size as [12], [24] for 120 kHz and 240 kHz SCS of SS block.
  + LS can be considered to communicate with RAN1/RAN2 for system parameters.
  + **Note:** Not preclude the possibility of operating with lower SCS. Companies to discuss if lower SCS could be used, such as at least 30 kHz.
  + **Reuse and copy the following Table 3 GSCN parameters to NTN specifications for Ka bands.**

Table 3: GSCN parameters for the global frequency raster

|  |  |  |  |
| --- | --- | --- | --- |
| Range of frequencies (MHz) | SS block frequency position SSREF | GSCN | Range of GSCN |
| 3000 – 24250 | 3000 MHz + N \* 1.44 MHz,  N = 0:14756 | 7499 + N | 7499 – 22255 |

* + **Table 4 can be used as the starting point for Ka bands sync raster entries for further check.**

Table 4: Applicable SS raster entries per *operating band* (FR2-NTN)

|  |  |  |  |
| --- | --- | --- | --- |
| NR *operating band* | SS Block SCS | SS Block pattern (note 1) | Range of GSCN  (First – <Step size> – Last) |
| n512 | 120 kHz | Case D | 17444 – <[12]> – 19424 |
|  | 240 kHz | Case E | 17456 – <[24]> – 19400 |
| n511 | 120 kHz | Case D | 17444 – <[12]> – 19424 |
|  | 240 kHz | Case E | 17456 – <[24]> – 19400 |
| n510 | 120 kHz | Case D | 17444 – <[12]> – 19424 |
|  | 240 kHz | Case E | 17456 – <[24]> – 19400 |
| NOTE 1: SS Block pattern is defined in section 4.1 in TS 38.213. | | | |

**Sub-topic 1-3 (Issue 1-3-1) updated:** LS to RAN1 & RAN2

* RAN4 to agree to send LS to RAN1 & RAN2 for NTN topic in above 10 GHz for Rel-18 to inform on open issues and RAN4 progress. Open issues and progress may include both RF and RRM.
  + **Note:** THALES LS proposal merged with CATT LS

**Sub-topic 1-5 (Issue 1-5-1):** Rel-18 handheld FR2-NTN

* **DO NOT** consider NTN handheld in above 10 GHz.
  + **Note:** Handheld is out of scope for FR2 NTN in Rel-18.

**Sub-topic 1-5 (Issue 1-5-3) updated:** NS usage

* Agree to use (at least) NS methodology. Specific adaptation/extension of NS framework for above 10 GHz may be added later on.

Co-existence studies (scenario)

Following agreements have been made:

1. Consideration of requirements defined in FCC rules and ITU-R Radio Regulations, resolutions and recommendations for NTN UE will discussed in UE RF part, [140] in this meeting.
2. RAN4 can further discuss and address Off-axis EIRP requirements in UE RF requirements if needed. From generic co-existence study perspective, no need to consider such aspect. This issue will be further discussed and handled in thread [140].
3. For calibration phase, assuming FRF=1 with single polarization

* This assumption has no linkage/restriction on real network deployment
* Further discuss other values and the impact on co-existence study

1. RAN4 to update the coexistence simulations TDoc with the simulation scope mentioned below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Combination | Aggressor | Victim | Scope of Coexistence Simulation | Study Phase |
| 1 | TN with NTN | NTN UL | TN UL | ACLR NTN UE to be varied/defined  ACS TN gNB fixed |  |
| 2 | TN with NTN | TN UL | NTN UL | ACLR TN UE fixed  ACS NTN SAN to be varied/defined |  |
| 3 | TN with NTN | NTN UL | TN DL | ACLR NTN UE to be varied/defined  ACS TN UE fixed |  |
| 4 | TN with NTN | TN DL | NTN UL | ACLR TN gNB fixed  ACS NTN SAN to be varied/defined |  |
| 5 | TN with NTN | TN DL | NTN DL | ACLR TN gNB fixed  ACS NTN UE to be varied/defined |  |
| 6 | TN with NTN | NTN DL | TN DL | ACLR NTN SAN to be varied/defined  ACS TN UE fixed |  |
| 7 | TN with NTN | NTN DL | TN UL | ACLR NTN SAN to be varied/defined  ACS TN gNB fixed |  |
| 8 | TN with NTN | TN UL | NTN DL | ACLR TN UE fixed  ACS NTN UE to be varied/defined |  |
| NOTE 1: For coexistence between Ka-Band DL and adjacent TN bands, there are no 3GPP defined/specified TN bands. | | | | | |

1. Use TN urban macro scenarios (and no TN dense urban) for the calibration and the coexistence analysis with NTN in above 10 GHz.

Co-existence studies (Network layout)

Following agreements have been made:

1. Drop NTN UE inside the TN cluster as a starting point as the worst case.
2. Active ratio of TN (Urban) is 20%
3. 90 degree will be used as Elevation angle of NTN UE. Further discuss other values including 10, 30 etc.
4. To simplify the discussion on joint issues 2-3, 2-4 & 3-1, consider following approaches for the deployment of NTN UE and satellite
5. The Satellite should be generated in the visible area/sky of NTN UE;
6. NTN UEs point to the satellite accurately or with a deviation provided by satellite vendors;

* To simplify the work in calibration phase, NTN UEs point to the satellite accurately without any deviations.
* Further discuss the deviation for co-existence simulation, satellite vendors and operators are encouraged to provide a vertical angle value and a deviation value.

1. The position of the satellite should guarantee that NTN UE vertical angle towards the satellite is with certain value(s) or within the range of [10, 20, 30 or other numbers] degree to 90 degree;

* For calibration, use 30 degree and 90 degree instead of the range.
* Further discuss the range and/or the value for co-existence simulation.

1. Horizontal angle of NTN UEs should be calculated based on the satellite position

Co-existence studies (System parameter)

Following agreements have been made:

1. Take 5.9 dB as the Noise Figure for all Satellite types for calibration purpose.
2. Use following NTN Ka-band uplink parameters:

**Ka-Band DownLink (i.e. ~17 GHz for DL) for different satellite orbits**

|  |  |  |  |
| --- | --- | --- | --- |
| **SAN parameters** | **GEO** | **LEO-1200 km** | **LEO-600 km** |
| Equivalent satellite antenna aperture (m) | 5,9 | 0,6 | 0,6 |
| Satellite EIRP density (dBW/MHz) | 40 | 10 | 4 |
| Satellite Tx max Gain (dBi) | 58,5 | 38,5 | 38,5 |

1. For NTN UE Noise Figure, take 4 dB for calibration purpose only and further discuss the value for co-existence simulation.
2. Use the following parabolic antenna model for SAN and NTN UE

With:

is the Bessel function of first type and order with argument *x*

θ is the angle in a spherical coordinates system,

*D*: Antenna diameter

λ: Wavelength

1. Focus on circular aperture antenna pattern on SAN side and Ka Band NTN UE side from co-existence study perspective

* FFS whether and how to consider phased array antenna pattern
* Not preclude to consider phased array antenna pattern in the future if needed

1. Prioritized L-ESIM and fixed VSAT scenarios for NTN-TN coexistence studies above 10 GHz.
2. Use following TN parameters

* TN BS height is 25m
* TN BS NF: 10dB
* TN UE NF: 10dB

1. Use TR 38.803 for TN parameters related to calibration and coexistence analysis with NTN in above 10 GHz.
2. NTN UE antenna will be set to follow serving satellite in horizontal for simulation.

Co-existence studies (Evaluation methodology)

1. Use following models for **calibration.**Further discuss models for co-existence simulation.

|  |  |
| --- | --- |
| **Link** | **Propagation model** |
| TN BS to Fixed VSAT on roof | Free space path loss |
| TN BS to L-ESIM at 1.5 m | UMa as in 3GPP TR 38.803 |
| TN BS to TN UE | UMa as in 3GPP TR 38.803 |
| TN UE to Fixed VSAT on roof | UMa as in 3GPP TR 38.803 (BS is to be replaced with VSAT) |
| TN UE to L-ESIM | Umi |
| Satellite to TN BS/UE | 3GPP TR 38.821 |
| Satellite to VSAT/ESIM | 3GPP TR 38.821 |
| TN BS to Satellite | 3GPP TR 38.821 |
| Note1: For the propagation models which use the 3GPP TR 38.821 [3], to use same assumptions as in [3] and consider the atmospheric losses and the scintillation losses.  Note2: TN BS height is 25m | |

To use 1 UE for both TN and NTN in the DL and 10 UEs for NTN and 1 UEs for TN in the UL. Further discuss ACLR2 for above 10GHz band.

Co-existence studies (Initial results and calibration)

Following agreements have been made:

1. RAN4 to start the calibration for the Ka-band NTN coexistence study. Coupling loss and geometry SINR in different scenarios should be calibrated.

* According to the approved work plan, the calibration phase shall be concluded before August meeting.
* RAN4 target to finalize the simulation results collection activity in 2023 RAN4 October meeting.
* A calibration table will be provided by Samsung

1. Calibration table can be found in R4-2305929.

Assumptions for NTN co-existence study in above 10GHz bands agreed till this meeting have been captured in R4-2305930.

[RRM aspects]

**Issue 2-1: Numerologies in NR-NTN above 10 GHz bands**

**Agreement:**

* RAN4 to consider the following numerologies for RRM requirement definition for NR-NTN above 10 GHz bands:
  + Consider SSB SCS larger than 30kHz, i.e. 120kHz and 240kHz
  + Consider UL SCS larger than 30kHz, i.e. 60kHz and 120kHz
* RAN4 to send an LS to RAN1 and RAN2

**Issue 2-2: UE UL Timing Accuracy Requirements for higher UL SCS than 30kHz in NR-NTN above 10 GHz bands**

**Agreement:**

* The assumption of the maximum total positioning error due to UE location and Satellite position estimation error shall be tightened compared to the assumption of the existing Rel-17 NR NTN.
  + The exact values and required conditions will be further discussed/determined in the future meetings.
  + Alternatives can be further discussed, e.g. ECP (only for 60kHz SCS), limiting UL SCS, limiting SSB SCS, limiting UE mobility, etc.
* Note: the above “maximum total positioning error due to UE location and Satellite position estimation error” will not be specified in the requirement but it’s only used as an assumption to derive the UE Tx timing requirement.

**Issue 2-3: Measurement and Mobility Requirements in NR-NTN above 10 GHz bands**

**Agreement:**

* Do not define requirements for mobility between NTN Ka band and NTN FR1 for Rel-18
* Do not define requirements for mobility between NTN Ka band and TN in FR1 or FR2 for Rel-18

**Issue 2-4: Other impacts**

**Conclusion:**

Based on the discussion conducted over email thread “[106bis-e][221] NR\_NTN\_enh – LS,” no additional RRM aspects are going to be included in the LS to be sent from RF session. RAN4 continues discussions on the details of higher SCSs than 30kHz in the future meetings.

1. Coverage enhancements

[UERF aspects]

No UERF aspects discussioins are expected.

[BSRF Test Demod aspects]

No discussions in this meeting.

[RRM aspects]

No RRM aspects discussioins are expected.

1. Network verified UE location

[UERF aspects]

No UERF aspects discussioins are expected.

[BSRF Test Demod aspects]

No discussions in this meeting.

[RRM aspects]

No discussions in this meeting.

1. Mobility enhancements

[UERF aspects]

No UERF aspects discussioins are expected.

[BSRF Test Demod aspects]

No discussions in this meeting.

[RRM aspects]

**Issue 4-1: NTN-NTN Cell reselection enhancements for earth moving cell**

**Issue 4-1-A: Time-based cell reselection in earth moving cell NTN deployments**

* No agreement.

**Issue 4-1-B: For location-based cell reselection in earth moving cell NTN deployments**

**Agreement:**

* For location-based cell reselection in earth moving cell NTN deployments:
  + Whether the coverage information of serving cell is (absolutely) necessary:
    - No consensus in the group on whether serving cell coverage information is absolutely necessary.
    - Consider further progress and conclusion from RAN2, if any
  + Whether and to what extent restrict the use of the values of DRX cycle:
    - FFS: Do not further restrict DRX cycle beyond Rel-17 NR NTN.

**Issue 4-1-C: whether and how to manipulate Kcarrier in Ttrigger**

* No agreement. Further discussion in May meeting for “earth moving cell” and “quasi-earth fixed cell.”

**Issue 4-2: NTN-TN Cell reselection enhancements (to reduce UE power consumption)**

* No agreement. Wait for further progress from RAN2. Companies can provide further analyses in the next meeting as usual. The analyses and discussions may depend on the following aspects:
  + The direction of cell reselection, e.g. from TN to NTN, from NTN to TN
  + The type of satellites, e.g. GEO, GSO, NGSO
  + The type of NTN cell deployment, e.g. earth fixed cell vs. earth moving cell
  + Accuracy of TN coverage information provided by NTN cell.
  + Whether assistance information of neighbour NTN cells ( e.g. ephemeris data, frequency layer and PCI) provided by serving TN cell is mandatory in terms of RRM requirement definition/applicability

**Issue 4-3: NTN-NTN Cell reselection enhancements (to reduce UE power consumption)**

No agreement. In the future meetings, companies can provide further analyses on whether and to what extent UE measurement for LEO NTN-NTN cell reselection can be relaxed to reduce power consumption. The analyses should take into account, e.g. LEO cell type, cell deployment type (earth moving and quasi-earth fixed cell), UE implementation vs. RAN2 spec support based approach, feasibility, quantitative analyses in terms of gain-loss, etc.

**Issue 5-1: RACH-less (C)HO**

**Agreement:**

* RAN4 to define RACH-less NTN HO requirements based on the RACH-less LTE HO requirements. NR and NTN specific adjustments shall be made. The adjustments to investigate may include:
  + FFS on known/unknown condition
  + FFS on necessity of fine time tracking if target cell is known
  + FFS on others if identified
* Note: some aspects would need to wait for further RAN2 progress.

**Issue 5-2: HO for satellite switching without PCI change**

* No agreement. Wait for further progress from RAN2.

**Issue 5-3: Group-based HO for signalling overhead reduction**

* No agreement. Wait for further progress from RAN2.

**Issue 5-4: Location based CHO enhancements for earth moving NTN cell**

* No agreement. Wait for further progress from RAN2.

===

Documents approved:

* R4-2306624 WF on NTN UE RF requirements in Ka-band
* R4-2305925 WF on NTN enhancement - [106bis-e][309] NR\_NTN\_enh\_Part1
* R4-2305926 LS on System Parameters for NTN above 10 GHz
* R4-2305927 WF on SAN RF requirements
* R4-2306002 WF on [311] NR\_NTN\_enh\_Part3
* R4-2305929 Calibration table for NTN co-existence study in above 10GHz band
* R4-2306003 Assumptions for NTN co-existence study in above 10GHz band
* R4-2306358 WF on NR NTN enhancement RRM requirements

Documents agreed:

* -

[Other documents]

Email discussion summaries:

* R4-2306302 Topic summary for [106-bis-e][140] NR\_NTN\_enh\_UERF
* R4-2305979 Email discussion summary for [106bis-e][309] NR\_NTN\_enh\_Part1
* R4-2305980 Email discussion summary for [106bis-e][310] NR\_NTN\_enh\_Part2
* R4-2305981 Email discussion summary for [106bis-e][311] NR\_NTN\_enh\_Part3
* R4-2306252 Topic summary for [106-bis-e][221] NR\_NTN\_enh
* **RAN4#107, May 22nd – 26th 2023, Incheon**

1. NR-NTN deployment in above 10 GHz

[UERF aspects]

**Issue 1-1: Differentiate UE types from mobility perspective**

**Issue 1-2: Differentiate antenna assumption for GEO and LEO UE**

**Agreement:**

* At least consider the differentiation between mechanical and electronic steering;
  + FFS on phased array or parabolic;
  + Encourage satellite companies to provide the data to show the beam switching delay.
* As the baseline, assume that UE has the single beam towards one single satellite at a given time.

**Issue 2-1: Noise figure**

**Agreement:**

* For the August meeting, more detailed background should be provided to derive the corresponding noise figure..
* For the coexistence study, companies are encouraged to consider the following NF for NTN UE :
  + Option 1: 2dB;
  + Option 2: 6dB

**Issue 3-2: Beam pointing/accuracy related requirements**

**Agreement:**

* It is assumed for the NTN capable UE operating in above 10 GHz that the (Rx and Tx) beam pointing error are compliant with the relevant ETSI harmonized standard, e.g.:
  + EN 303 978, “Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in geostationary orbit, operating in the 27,5 GHz to 30,0 GHz frequency bands”;
* For the next meeting, it’s encouraged to provide the technical requirement inputs for fixed VSAT;

**Issue 3-3: on-axis and off-axis EIRP requirements**

**Agreement:**

* To define the off-axis EIRP requirement;
  + Note: this requirement for wanted signal within the assigned channel;
* For on-axis EIRP limit, this depend on the power class;
* To capture the maximum EIRP limit for certain power class;

[BSRF Test Demod aspects]

SAN RF requirements

**OTA reference sensitivity level**

The OTA reference sensitivity level will be defined



Where

PkT = -174 dBm/Hz

NF will be aligned with the co-existence study assumption conclusion,

SNR FFS,

IM = 2 dB,

The following is used for the starting point for G:

G = [50.5-58.5] dBi, [30.5-38.5] dBi, and [30.5-38.5] dBi for GEO, LEO-1200, and LEO-600.

Note: The above Rx max Gain ranges are taken from Table 6.1.1.1-1 and Table 6.1.1.1-2 of TR 38.821.

Table 6.1.1.1-1: Set-1 satellite parameters for system level simulator calibration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Satellite orbit | | GEO | LEO-1200 | LEO-600 |
| Satellite altitude | | 35786 km | 1200 km | 600 km |
| Satellite antenna pattern | | Section 6.4.1 in [2] | Section 6.4.1 in [2] | Section 6.4.1 in [2] |
| Payload characteristics for UL transmissions | | | | |
| Equivalent satellite antenna aperture (Note1) | Ka-band (i.e. 30 GHz for UL) | 3.33 m | 0.33 m | 0.33 m |
| G/T | 28 dB K-1 | 13 dB K-1 | 13 dB K-1 |
| Satellite RX max Gain | 58.5 dBi | 38.5 dBi | 38.5 dBi |

Table 6.1.1.1-2: Set-2 satellite parameters for system level simulator calibration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Satellite orbit | | GEO | LEO-1200 | LEO-600 |
| Satellite altitude | | 35786 km | 1200 km | 600 km |
| Satellite antenna pattern | | Section 6.4.1 in [2] | Section 6.4.1 in [2] | Section 6.4.1 in [2] |
| Equivalent satellite antenna aperture (Note1) | Ka-band (i.e. 30 GHz for UL) | 1.33 m | 0.13 m | 0.13 m |
| G/T | 20 dB K-1 | 5 dB K-1 | 5 dB K-1 |
| Satellite Rx max Gain | 50.5 dBi | 30.5 dBi | 30.5 dBi |
| NOTE 1: This value is equivalent to the antenna diameter in Sec. 6.4.1 of [2].  NOTE 2: This beam size refers to the Nadir pointing of the satellite  NOTE 3: All these satellite parameters are applied per beam.  NOTE 4: The EIRP density values are considered identical for all frequency re-use factor options. | | | | |

FRC can be discussed in future meetings.

**Out of band blocking**

FFS if this requirement is needed. Companies are encouraged to contribution on the justification for the necessity of this requirement.

System parameters

**Issue 1-1-1: NTN frequency range(s) NOTE 1**

* Agreement: Keep [ ] for this meeting, if no critical issues identified by RAN4 and other WGs, the [ ] on Note 1 can be removed by August RAN4 meeting.

**Issue 1-1-2: NTN frequency range(s) NOTE 2**

* Agreement: Option 2, Keep [ ] for this meeting, if no critical issues identified by RAN4 and other WGs, the [ ] on Note 1 can be removed by August RAN4 meeting.

**Issue 1-1-3: NTN frequency range(s) extension**

* Agreement: Ku band handling is out of scope of existing Rel-18 NTN WI and can be discussed in future subject to RAN-P decision on Ku band introduction.

**Issue 1-2-1: CBW and frequency range details**

* Agreement: RAN4 can further discuss the additional CBW and SCS supporting on Ka band per the request from operators.

**Issue 1-3-1: NR-ARFCN**

* Agreement: Use following NR-ARFCN for NTN Ka-band (specify the following channel raster NREF values for bands n512, n511 and n510.):

**Table 1: Applicable NR-ARFCN per *operating band***

|  |  |  |  |
| --- | --- | --- | --- |
| NR *operating band* | ΔFRaster  (kHz) | Uplink  range of NREF  (First – <Step size> – Last) | Downlink  range of NREF  (First – <Step size> – Last) |
| n512 | 60 | 2070833 – <1> – 2112499 | 1553336 – <4> – 1746664 |
| 120 | 2070833 – <2> – 2112499 | 1553336 – <8> – 1746664 |
| n511 | 60 | 2084999 – <1> –2112499 | 1553336 – <4> – 1746664 |
| 120 | 2084999 – <2> –2112499 | 1553336 – <8> – 1746664 |
| n510 | 60 | 2070833 – <1> – 2084999 | 1553336 – <4> – 1746664 |
| 120 | 2070833 – <2> – 2084999 | 1553336 – <8> – 1746664 |

**Issue 1-3-2: GSCN**

* Agreement: To further consider the **remaining 2 Options:**
  + Option 1: Use following GSCN for Ka-band as following

Table 2: Applicable SS raster entries per *operating band* (FR2-NTN)

|  |  |  |  |
| --- | --- | --- | --- |
| NR *operating band* | SS Block SCS | SS Block pattern (note 1) | Range of GSCN  (First – <Step size> – Last) |
| n512 | 120 kHz | Case D | 17448 – <12> – 19428 |
|  | 240 kHz | Case E | 17472– <24> – 19416 |
| n511 | 120 kHz | Case D | 17448 – <12> – 19428 |
|  | 240 kHz | Case E | 17472– <24> – 19416 |
| n510 | 120 kHz | Case D | 17448 – <12> – 19428 |
|  | 240 kHz | Case E | 17472– <24> – 19416 |
| NOTE 1: SS Block pattern is defined in section 4.1 in TS 38.213. | | | |

* + Option 3: Remove [] from agreed WF at RAN4#106-bis-e

Table 2: Applicable SS raster entries per *operating band*

|  |  |  |  |
| --- | --- | --- | --- |
| NR *operating band* | SS Block SCS | SS Block pattern (note 1) | Range of GSCN  (First – <Step size> – Last) |
| n512 | 120 kHz | Case D | 17444 – <12> – 19424 |
|  | 240 kHz | Case E | 17456 – <24> – 19400 |
| n511 | 120 kHz | Case D | 17444 – <12> – 19424 |
|  | 240 kHz | Case E | 17456 – <24> – 19400 |
| n510 | 120 kHz | Case D | 17444 – <12> – 19424 |
|  | 240 kHz | Case E | 17456 – <24> – 19400 |
| NOTE 1: SS Block pattern is defined in section 4.1 in TS 38.213. | | | |

Co-existence studies (scenario and layout)

Following agreements have been made:

1. Take the table in Annex 1 as starting point for TN and NTN system deployment assumptions in co-existence studies.

* Consider the situation of NTN UE inside several TN clusters first
* No need to consider fixed NTN UE vertical angle value by the assumption that NTN UE can track the satellite by either mechanical or electronic method.
  + Further discuss the detailed simulation methodology.
* Further discuss the NTN UE elevation angle value: [10] & 90 degree

1. Take the assumption that NTN UE antenna points to the satellite accurately as starting point.
2. Mobile VSAT coexistence study for NGSO scenarios is out of the scope of co-existence study.
3. FRF=2 with two polarizations (RHCP, LHCP)

Co-existence studies (System parameter)

Following agreements have been made:

1. For SAN NF, further evaluate based on following candidate options:

* Option 1: 3.5dB
* Option 2: 5.9 dB

1. Take the normalised SAN antenna pattern for Ka-Band coexistence studies and related half-power beam-width ().

|  |  |  |  |
| --- | --- | --- | --- |
| **Equation** | **Half-power beam-width**  **Value** | **GEO constellation type @ 17GHz** | **LEO constellation type @ 17GHz** |
|  |  | 0.1763 degrees | 1.7337 degrees |

where:

* is the Bessel function of first type and order with argument *x*
* θ is the angle in a spherical coordinates system,
* *D* : Antenna diameter
* λ : Wavelength

1. For SAN antenna adjacent beam spacing (3dB BW),

**ABS[rad] = sqrt(3) x sin(HPBW[degrees]/2)** or **ABS[rad] = sqrt(3) x sinr(HPBW[rad]/2)**

* with ABS [degree]=180/pi x ABS[rad] and
* with HPBW the Half-Power BandWidth of the main lobe from the satellite antenna pattern.

1. Align TN parameters as below

|  |  |
| --- | --- |
| Size of each nominal channel BW in MHz | 200 |
| Transmission bandwidth in MHz | 190.08 |
| UE number per cell | Same as the number of BS beam |

In the simulation assumptions, align Table 2.4.2-1 with the previous BS antenna table:

* The antenna element gain shall be 5.5 dBi.
* Antenna element vertical radiation pattern (dB),
* Antenna element horizontal radiation pattern (dB),

1. Use UMi as the propagation model for TN UE to L-ESIM.
2. Use flat ACIR modelling for co-existence

[RRM aspects]

**Issue 2-1: UE UL Timing Accuracy Requirements for UL SCSs of 60kHz and 120kHz**

**Agreement:**

* The assumption of the maximum total positioning error due to UE location and Satellite position estimation error shall be tightened as below:
  + For UL SCS of 60kHz, [X] meters.
  + For UL SCS of 120kHz, [Y] meters
  + The above is applicable only when SSB SCS is equal to or higher than 120kHz
  + FFS on whether applicable to UE in mobile platform.
  + FFS on whether and how to connect the tightened UE positioning error to the advanced GNSS capability or UE type.
  + FFS whether to use different requirements for different types of devices defined in the RF session and/or different satellite types
  + FFS on different UE UL Timing Accuracy Requirements for different physical signals/channels, e.g. relaxed requirements for PRACH for certain PRACH formats, compared to other signal/channels.

**Issue 2-2: Measurement and Mobility Requirements in NR-NTN above 10 GHz bands**

* No agreement.

1. Coverage enhancements

[UERF aspects]

No UERF aspects discussioins are expected.

[BSRF Test Demod aspects]

No discussions in this meeting.

[RRM aspects]

No RRM aspects discussioins are expected.

1. Network verified UE location

[UERF aspects]

No UERF aspects discussioins are expected.

[BSRF Test Demod aspects]

No discussions in this meeting.

[RRM aspects]

**Agreement:**

* FFS: RAN4 to define measurement period and accuracy requirements for UE Rx-Tx measurement
  + Existing TN requirements can be used as baseline, e.g. 9.9.4.6 Measurement Period Requirements without Measurement Gaps
  + NTN specific aspects including necessary side conditions, if any, will be further discussed based on RAN1 progress

1. Mobility enhancements

[UERF aspects]

No UERF aspects discussioins are expected.

[BSRF Test Demod aspects]

No discussions in this meeting.

[RRM aspects]

**Issue 4-1-A: Time-based cell reselection in earth moving cell NTN deployments**

* No agreement.

**Issue 4-1-B: For location-based cell reselection in earth moving cell NTN deployments**

**Agreement:**

* RAN4 to define UE requirements on location-based cell reselection in earth moving cell NTN deployments if the existing requirements are not applicable for earth moving system. The new requirement can be based on the existing requirement, and the updates may include “the margin for distance threshold” and “the definition of the reference Location.”
  + Do not further restrict DRX cycle beyond Rel-17 NR NTN.
  + FFS: Whether the coverage information of serving cell is (absolutely) necessary

**Issue 4-1-C: whether and how to manipulate Kcarrier in Ttrigger**

* No agreement.

**Issue 4-2: NTN-TN Cell reselection enhancements (to reduce UE power consumption)**

**Agreement:**

* FFS: RAN4 to define RRM requirements on TN-to-NTN reselection.
  + RAN4 to agree to reuse same side condition of assistance information for neighbour NTN cells from R17 WF R4-2207114.
  + Additional side conditions can be added, as needed, and the conditions may depend on satellite types (GSO vs. non-GSO) and/or NTN cell deployments for non-GSO (earth-fixed vs. earth-moving cell).

**Agreement:**

* RAN4 to define RRM requirements on NTN-to-TN cell reselection requirement without measurement enhancement for the following cases:
  + both GSO and non-GSO
  + both earth fixed cell and earth moving cell
  + FFS on
    - whether/how to define the detailed UE behaviour when the UE is out of TN coverage.

**Agreement:**

* RAN4 to not define accuracy of TN coverage information provided by NTN cell.

**Issue 4-3: NTN-NTN Cell reselection enhancements (to reduce UE power consumption)**

* No agreement.

**Issue 5-1: RACH-less (C)HO**

**Agreement:**

* RAN4 to define RACH-less HO requirements for intra-/inter-satellite handover with and without gateway/gNB switch.
  + Known and Unknown target cell condition:
    - Reuse the R17 known/unknown condition applied in NTN HO requirements.
    - If any other new aspects to be additionally added are identified based on RAN1/2 progress, those aspects will be further discussed in RAN4.
  + Whether to define the requirements for both known and unknown target cells
    - Consider both known and unknown target cells.
  + Whether to include fine time tracking latency in the HO latency requirement,
    - Fine time tracking latency will be included even when target cell is known.
  + Additional latency can be added, if identified and needed, based on the detailed design of the feature to be made by RAN1 and RAN2
* The detailed formula and exact values in the requirements, e.g. T\_IU, T\_SI-NR, T\_RACH, T\_delta, T\_processing, T\_margin, T\_search, etc. if relevant, will be defined in the next meeting accordingly.

**Issue 5-2: HO for satellite switching without PCI change**

* No agreement.

**Issue 5-3: Group-based HO for signalling overhead reduction**

* No agreement. Wait for further progress from RAN2.

**Issue 5-4: Location based CHO enhancements for earth moving NTN cell**

* No agreement. Wait for further progress from RAN2.

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Documents approved:

* R4-2310483 WF on UE RF requirements for NR NTN enhancement
* R4-2309766 WF for system parameters on Ka band
* R4-2309767 WF for co-existence study of Above 10GHz NTN band
* R4-2309771 Simulation assumption for co-existence study of Above 10GHz NTN band
* R4-2309770 WF on above 10GHz SAN RF requirements
* R4-2310168 WF on NR NTN enhancements RRM requirements

Documents agreed:

* -

[Other documents]

Email discussion summaries:

* R4-2310026 Topic summary for [107][143] NR\_NTN\_enh\_UERF
* R4-2310315 Ad hoc minutes for NR\_NTN\_enh\_UERF
* R4-2310448 Topic summary for [107][309] NR\_NTN\_enh\_Part1
* R4-2310449 Topic summary for [107][311] NR\_NTN\_enh\_Part3
* R4-2309971 Topic summary for [107][226] NR\_NTN\_enh

#### 2.4.1 Remaining Open issues

**NR-NTN deployment in above 10 GHz**

* Study implications of FDD operation in FR2 and derive requirements for the identified example band appropriately.
* Relevant coexistence scenarios and analysis
* Specify Rx/Tx requirements for satellite access node and different VSAT UE class (not only 60 cm aperture) as appropriate for the identified example band
* Identify values for physical layer parameters chosen from the existing FR1 and FR2 sets.

**Coverage enhancements**

* Specify PUCCH enhancements for Msg4 HARQ-ACK (e.g. repetition)

**Network verified UE location**

* Specify necessary enhancements to multi-RTT to support the network verified UE location in NTN assuming a single satellite in view

**NTN-TN and NTN-NTN mobility and service continuity enhancements**

* Specify NTN-TN and NTN-NTN measurement/mobility and service continuity enhancements

## 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.

Aspects related to Network verified UE location

## 4. References

## 4.1 RAN1

**RAN1#112bis emeeting, April 17th - 27th, 2023:**

* R1-2302406 discussion R18 WI NR-NTN-enh work plan at RAN1, 2 and 3 THALES
* R1-2304172 other Session notes for 9.9 (NTN (Non-Terrestrial Networks) enhancements) Ad-Hoc Chair (Huawei)
* R1-2304244 discussion Summary EOM on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)
* R1-2304252 LS out [Draft] LS on higher layer signaling in Msg3 PUSCH for PUCCH repetition for Msg4 HARQ-ACK Moderator (NTT DOCOMO, INC.)
* R1-2304093 LS out [Draft] LS on PUSCH DMRS bundling for NR NTN coverage enhancement Moderator (NTT DOCOMO, INC.)
* R1-2303950 discussion Summary #1 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)
* R1-2303951 discussion Summary #2 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)
* R1-2303952 discussion Summary #3 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)
* R1-2303643 discussion Views on Coverage enhancement for NR NTN Sharp
* R1-2303625 discussion Discussion on coverage enhancement for NR-NTN Panasonic
* R1-2303204 discussion Discussion on coverage enhancement for NR NTN ETRI
* R1-2303725 discussion Discussion on coverage enhancement for NR NTN NTT DOCOMO, INC.
* R1-2303748 discussion Discussion on coverage enhancement for NR NTN LG Electronics
* R1-2303953 discussion Summary #4 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)
* R1-2304094 LS out LS on PUSCH DMRS bundling for NR NTN coverage enhancement RAN1, NTT DOCOMO, INC.
* R1-2302433 discussion Further considerations on coverage enhancements for NR over NTN Nokia, Nokia Shanghai Bell
* R1-2302564 discussion Discussion on coverage enhancement for NR NTN OPPO
* R1-2302502 discussion Discussions on remaining issues of coverage enhancements in NR NTN vivo
* R1-2302364 discussion Discussion on coverage enhancement for NR NTN Huawei, HiSilicon
* R1-2302857 discussion On coverage enhancement for NR NTN Sony
* R1-2302812 discussion On coverage enhancement for NR NTN Intel Corporation
* R1-2302719 discussion Further discussion on UL coverage enhancement for NR NTN CATT
* R1-2302748 discussion Coverage enhancement for NR NTN NEC
* R1-2302738 discussion Discussion on coverage enhancement for NR NTN Baicells
* R1-2302616 discussion Discussion on coverage enhancements for NTN Spreadtrum Communications
* R1-2303499 discussion On Coverage Enhancement for NR NTN Apple
* R1-2303534 discussion Coverage enhancements for NR NTN Lenovo
* R1-2303606 discussion Coverage enhancements for NR NTN Qualcomm Incorporated
* R1-2303351 discussion UL coverage enhancements MediaTek Inc.
* R1-2303294 discussion Discussion on coverage enhancement for NTN ZTE
* R1-2303250 discussion Discussion on coverage enhancement for NR NTN CMCC
* R1-2303144 discussion On coverage enhancement for NR NTN Samsung
* R1-2303014 discussion On coverage enhancements for NR NTN Ericsson
* R1-2303032 discussion Discussion on coverage enhancement for NR NTN China Telecom
* R1-2302998 discussion Discussion on coverage enhancement for NR-NTN xiaomi
* R1-2302999 discussion Discussion on the network verified location for NR-NTN xiaomi
* R1-2303145 discussion Network verified UE location for NR NTN Samsung
* R1-2303269 discussion NTN NW verified UE location Lenovo
* R1-2303295 discussion Discussion on network verified UE location for NR NTN ZTE
* R1-2303352 discussion Network verified UE location for NR NTN MediaTek Inc.
* R1-2303607 discussion Network verified UE location for NR NTN Qualcomm Incorporated
* R1-2303500 discussion On Network Verified UE Location Apple
* R1-2302720 discussion Further discussion on Network verified UE location for NR NTN CATT
* R1-2302813 discussion On network verified UE location for NR NTN Intel Corporation
* R1-2302858 discussion On network verified UE location for NR NTN Sony
* R1-2302894 discussion Discussion on Network-verified UE location for NR-NTN PANASONIC
* R1-2302365 discussion Discussion on network-verified UE location for NR NTN Huawei, HiSilicon
* R1-2302401 discussion Discussion on network verified UE location in NR NTN THALES
* R1-2302402 discussion FL Summary #1: Network verified UE location for NR NTN THALES
* R1-2302403 discussion FL Summary #2: Network verified UE location for NR NTN THALES
* R1-2302404 discussion FL Summary #3: Network verified UE location for NR NTN THALES
* R1-2302405 discussion FL Summary #4: Network verified UE location for NR NTN THALES
* R1-2302503 discussion Discussions on remaining issues of UE location verification in NR NTN vivo
* R1-2302565 discussion Discussion on network verified UE location for NR NTN OPPO
* R1-2302434 discussion Further discussion on aspects related to network verified UE location for NR over NTN Nokia, Nokia Shanghai Bell
* R1-2303749 discussion Discussion on network verified UE location for NR NTN LG Electronics
* R1-2303772 discussion Network verified UE location for Rel-18 NR NTN Sharp
* R1-2303726 discussion Discussion on Network verified UE location for NR NTN NTT DOCOMO, INC.
* R1-2303659 discussion Discussion on Network Verified UE Location for NR NTN TCL Communication Ltd.
* R1-2303205 discussion Discussion on Network verified UE location for NR NTN ETRI
* R1-2303433 discussion On Network verified UE location in NR NTN Ericsson Limited
* R1-2302274 LS in Reply LS on Latency impact for NTN verified UE location SA1, Xiaomi
* R1-2302263 LS in LS reply on RACH-less handover in NTN RAN4, OPPO

**RAN1#113 Incheon, Korea, May 22th – 26th, 2023:**

* R1-2305851 discussion Initial input on RRC parameters for Rel-18 IoT NTN enhancements Rapporteur (MediaTek Inc.)
* R1-2306004 discussion Initial input on higher layer parameters for Rel-18 NR NTN Rapporteur (Thales)
* R1-2306005 discussion RAN1 agreements for Rel-18 WI on NR NTN enhancements Rapporteur (Thales)
* R1-2306151 LS out Draft reply LS on RACH-less Handover Moderator (Samsung)
* R1-2306146 other Session notes for 9.9 (NTN (Non-Terrestrial Networks) enhancements) Ad-Hoc Chair (Huawei)
* R1-2304615 discussion R18 WI NR-NTN-enh work plan at RAN1, 2 and 3 THALES
* R1-2304573 discussion Discussion on coverage enhancements for NTN Spreadtrum Communications
* R1-2304408 discussion Coverage enhancements for NR NTN Quectel
* R1-2304434 discussion Coverage enhancements for NR over NTN Nokia, Nokia Shanghai Bell
* R1-2304496 discussion Discussions on remaining issues of coverage enhancements in NR NTN vivo
* R1-2304678 discussion Discussion on coverage enhancements for NR NTN CCU, NTPU
* R1-2304751 discussion Further discussion on UL coverage enhancement for NR NTN CATT
* R1-2304632 discussion Discussion on coverage enhancement for NR NTN Huawei, HiSilicon
* R1-2305109 discussion Discussion on coverage enhancement for NR NTN CMCC
* R1-2304815 discussion On coverage enhancement for NR NTN Intel Corporation
* R1-2304863 discussion Discussion on coverage enhancement for NR NTN China Telecom
* R1-2305006 discussion On coverage enhancements for NR NTN Ericsson
* R1-2305611 discussion Discussion on coverage enhancement for NR NTN NTT DOCOMO, INC.
* R1-2305068 discussion Coverage enhancement for NR NTN NEC
* R1-2304916 discussion Discussion on coverage enhancement for NR-NTN xiaomi
* R1-2304920 discussion Discussion on coverage enhancement for NR NTN Baicells
* R1-2304965 discussion Discussion on coverage enhancement for NR NTN Hyundai Motor Company
* R1-2305436 discussion Discussion on coverage enhancement for NR NTN OPPO
* R1-2305529 discussion On coverage enhancement for NR NTN Samsung
* R1-2305212 discussion Coverage enhancements for NR NTN Lenovo
* R1-2305390 discussion Discussion on coverage enhancement for NR NTN LG Electronics
* R1-2305352 discussion Coverage enhancements for NR NTN Qualcomm Incorporated
* R1-2305259 discussion Coverage Enhancement for NR NTN Apple
* R1-2306105 LS out LS on higher layer signaling in Msg3 PUSCH for PUCCH repetition for Msg4 HARQ-ACK RAN1, NTT DOCOMO
* R1-2306085 LS out [Draft] LS on higher layer signaling in Msg3 PUSCH for PUCCH repetition for Msg4 HARQ-ACK Moderator (NTT DOCOMO, INC.)
* R1-2306022 discussion Summary #1 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)
* R1-2306023 discussion Summary #2 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)
* R1-2306024 discussion Summary #3 on 9.9.1 Coverage enhancement for NR NTN Moderator (NTT DOCOMO, INC.)
* R1-2305782 discussion Discussion on coverage enhancements for NR NTN FGI
* R1-2305800 discussion Discussion on coverage enhancement for NR NTN ETRI
* R1-2305699 discussion Discussion on coverage enhancement for NR-NTN Panasonic
* R1-2305847 discussion Discussions on Coverage enhancement for NR NTN Sharp
* R1-2305556 discussion Discussion on coverage enhancement for NTN ZTE
* R1-2305640 discussion UL coverage enhancements MediaTek Inc.
* R1-2305641 discussion Network verified UE location for NR NTN MediaTek Inc.
* R1-2305557 discussion Discussion on network verified UE location for NR NTN ZTE
* R1-2305681 discussion Discussion on Network-verified UE location for NR NTN Panasonic
* R1-2305678 discussion Further Discussion on Network Verified UE Location TCL Communication Ltd.
* R1-2305745 discussion NTN NW verified UE location Lenovo
* R1-2305848 discussion Network verified UE location for Rel-18 NR NTN Sharp
* R1-2305801 discussion Discussion on Network verified UE location for NR NTN ETRI
* R1-2305918 discussion On network verified UE location NR NTN Ericsson
* R1-2305260 discussion Network Verified UE Location Apple
* R1-2305353 discussion Network verified UE location for NR NTN Qualcomm Incorporated
* R1-2305391 discussion Discussion on network verified UE location for NR NTN LG Electronics
* R1-2305530 discussion Network verified UE location for NR NTN Samsung
* R1-2305437 discussion Discussion on network verified UE location for NR NTN OPPO
* R1-2304917 discussion Discussion on the network verified location for NR-NTN xiaomi
* R1-2305612 discussion Discussion on Network verified UE location for NR NTN NTT DOCOMO, INC.
* R1-2305048 discussion On network verified UE location for NR NTN Sony
* R1-2304816 discussion On network verified UE location for NR NTN Intel Corporation
* R1-2304633 discussion Discussion on network-verified UE location for NR NTN Huawei, HiSilicon
* R1-2304752 discussion Further discussion on Network verified UE location for NR NTN CATT
* R1-2304497 discussion Discussions on remaining issues of UE location verification in NR NTN vivo
* R1-2304435 discussion Aspects related to network verified UE location for NR over NTN Nokia, Nokia Shanghai Bell
* R1-2304610 discussion Discussion on network verified UE location in NR NTN THALES
* R1-2304611 discussion FL Summary #1: Network verified UE location for NR NTN THALES
* R1-2304612 discussion FL Summary #2: Network verified UE location for NR NTN THALES
* R1-2304613 discussion FL Summary #3: Network verified UE location for NR NTN THALES
* R1-2304614 discussion FL Summary #4: Network verified UE location for NR NTN THALES
* R1-2305938 discussion Discussion on the LS of HARQ enhancement for IoT NTN Huawei, HiSilicon

## 4.2 RAN2

**RAN2#121bis Athens, Greece, February 27th – March 3rd, 2023**

Submitted TDOCs:

* R2-2302428 LS in Reply LS on RACH-less handover in NTN (R4-2303239; contact: OPPO) RAN4
* R2-2302694 discussion Discussion on NR NTN UE capabilities Intel Corporation
* R2-2302695 draftCR Draft 331 CR for NR NTN UE capabilities Intel Corporation
* R2-2302696 draftCR Draft 306 CR for NR NTN UE capabilities Intel Corporation
* R2-2303137 draftCR Stage-3 running 304 CR for NTN ZTE Corporation, Sanechips
* R2-2303162 Work Plan R18 WI NR-NTN-enh work plan at RAN1, 2 and 3 THALES
* R2-2303726 draftCR Stage 3 NTN running CR for 38.321 - RAN2#121bise InterDigital
* R2-2303737 CR Stage 3 Running RRC CR for NR NTN Rel-18 Ericsson
* R2-232473 discussion Discussion on initial blind Msg3 retransmission for NTN OPPO
* R2-2302536 discussion Discussion on initial blind Msg3 retransmission for NTN OPPO
* R2-2302798 discussion Discussion on blind Msg3 retransmission Huawei, HiSilicon
* R2-2303326 discussion Discussion on coverage enhancement for R18 NTN vivo
* R2-2303458 discussion Discussion on coverage enhancement for R18 NTN vivo
* R2-2303727 discussion Blind Msg3 retransmission in Rel-18 NTN InterDigital
* R2-2303834 discussion R18 NR NTN Coverage enhancements Ericsson
* R2-2303997 discussion Discussion on inital blind Msg3 retransmssion LG Electronics Inc.
* R2-2304245 discussion Report of [AT121bis-e][105][NR NTN enh] Coverage enhancements InterDigital (Rapporteur)
* R2-2302556 discussion Discussion on multiple-RTT based positioning in NTN Quectel
* R2-2302561 discussion Discussion on Network Verified UE Location CATT
* R2-2302679 discussion On Network Verified UE Location in NR NTN MediaTek Inc.
* R2-2302794 discussion On Network verified UE location Nokia, Nokia Shanghai Bell
* R2-2302848 discussion Discussion on network verified UE location Ericsson
* R2-2303036 discussion Single satellite Multi-RTT based positioning Qualcomm Incorporated
* R2-2303138 discussion Consideration on NW verified UE location ZTE Corporation, Sanechips
* R2-2303261 discussion Discussion on network verified UE location in NR NTN THALES
* R2-2303299 discussion Discussion on NTN NW verified UE location Lenovo
* R2-2303438 discussion Discussion on network verified UE location Xiaomi
* R2-2303524 discussion Discussion on network verified UE location CMCC
* R2-2303666 discussion Network Verified UE Location in NTN Samsung R&D Institute UK
* R2-2303955 discussion Discussion on Network Verified UE Location TCL Communication Ltd.
* R2-2304188 discussion Discussion on network verified UE location Ericsson
* R2-2303962 discussion Discussion on the network verfied UE location Huawei, HiSilicon
* R2-232476 discussion Discussion on NTN-TN cell reselection enhancement OPPO
* R2-2302539 discussion Discussion on NTN-TN cell reselection enhancement OPPO
* R2-2302562 discussion Discussion on Cell Reselection Enhancements in NTN-TN CATT
* R2-2302680 discussion On TN-NTN Cell Selection Re-selection in NR NTN MediaTek Inc.
* R2-2302699 discussion Discussion on TN-NTN cell reselection enhancements Intel Corporation
* R2-2302780 discussion Discussion on TN-NTN cell reselection enhancements CAICT
* R2-2303037 discussion TN cell coverage info and measurement relaxation Qualcomm Incorporated
* R2-2303086 discussion Cell selection/reselection enhancements in NTN-TN Sony
* R2-2303100 discussion Discussion on the NTN-TN cell reselection enhancements Huawei, HiSilicon, Turkcell
* R2-2303139 discussion Consideration on cell reselection enhancements for NTN-TN ZTE Corporation, Sanechips
* R2-2303168 discussion On TN Coverage Area Information - signaling, validity and definition aspects Nokia, Nokia Shanghai Bell
* R2-2303255 discussion Indication of TN area for neighbour cell measurement in NTN Lenovo
* R2-2303300 discussion Signaling the TN Coverage Information with a 2-step Approach Google Inc.
* R2-2303318 discussion Details of the TN coverage data signalling NEC Telecom MODUS Ltd.
* R2-2303325 discussion Discussion on Power saving for NTN-TN mobility vivo
* R2-2303334 discussion Discussion on the assistance information for NTN-TN cell reselection ITRI
* R2-2303415 discussion NTN-TN cell reselection enhancement Apple
* R2-2303439 discussion Cell reselection enhancements for NTN-TN mobility Xiaomi
* R2-2303457 discussion Discussion on Power saving for NTN-TN mobility vivo
* R2-2303477 discussion Discussion on NR NTN-TN cell reselection enhancements Transsion Holdings
* R2-2303525 discussion NTN-TN cell reselection enhancements CMCC
* R2-2303724 discussion NTN-TN Mobility Cell Reselection and PCI Values SHARP Corporation
* R2-2303728 discussion NTN-TN mobility and service continuity InterDigital
* R2-2303736 discussion TN NTN mobility enhancements Ericsson
* R2-2303766 discussion Discussion on NTN-TN Cell Reselection Enhancements Samsung Research America
* R2-2303790 discussion Further discussion on NTN-TN cell reselection enhancements NTT DOCOMO, INC.
* R2-2303975 discussion Discussion on NTN-TN cell reselection enhancements LG Electronics France
* R2-2304014 discussion Discussion on NTN-TN Cell re-selection ITL
* R2-2304246 discussion Report from [AT121bis-e][106][NR NTN Enh] Signalling of TN coverage (Nokia) Nokia, Nokia Shanghai Bell
* R2-2304247 discussion Report of [AT121bis-e][107][NR NTN Enh] NW type information (Samsung) Samsung
* R2-232475 discussion Discussion on NTN-NTN cell reselection enhancement OPPO
* R2-2302538 discussion Discussion on NTN-NTN cell reselection enhancement OPPO
* R2-2303140 discussion Report of [Post121][106][NR NTN enh] NTN-NTN cell reselection (ZTE) ZTE Corporation, Sanechips
* R2-2303169 discussion On NTN-NTN Reselections in EMC Nokia, Nokia Shanghai Bell
* R2-2303254 discussion Neighbour cell measurement triggering for reselection in NTN moving cells Lenovo
* R2-2303324 discussion Discussion on cell reselection enhancement for earth-moving cell vivo
* R2-2303416 discussion NTN-NTN cell reselection enhancement Apple
* R2-2303440 discussion Cell reselection enhancements for NTN-NTN mobility Xiaomi
* R2-2303456 discussion Discussion on cell reselection enhancement for earth-moving cell vivo
* R2-2303577 discussion Discussion on NTN-NTN mobility enhancements Spreadtrum Communications
* R2-2303729 discussion Cell reselection enhancements for Earth moving cell InterDigital
* R2-2303767 discussion Discussion on NTN-NTN Cell Reselection Enhancements Samsung Research America
* R2-2303976 discussion Discussion on NTN-NTN cell reselection enhancements LG Electronics France
* R2-2304271 LS out LS on RACH-less Handover RAN2
* R2-2304273 LS out LS on unchanged PCI RAN2
* R2-232482 discussion Discussion on NTN handover enhancements OPPO
* R2-2302545 discussion Discussion on NTN handover enhancements OPPO
* R2-2302563 discussion Discussion on PCI Unchanged Scenario CATT
* R2-2302564 discussion Discussion on NTN HO Enhancements CATT
* R2-2302678 discussion Handover Enhancement in Earth Moving Cells MediaTek Inc.
* R2-2302697 discussion Discussion on NTN 2-step handover Intel Corporation
* R2-2302698 discussion Discussion on NTN RACH-less handover Intel Corporation
* R2-2303038 discussion RACH-less handover for NTN Qualcomm Incorporated
* R2-2303039 discussion Further handover enhancement for NTN Qualcomm Incorporated
* R2-2303076 discussion Consideration of HO common signaling gain in NTN China Telecom
* R2-2303087 discussion Signaling overhead reduction and group handover during NTN-NTN HOs Sony
* R2-2303099 discussion Discussion on NTN handover enhancements Huawei, HiSilicon, Turkcell
* R2-2303141 discussion Consideration on HO enhancements in NTN ZTE Corporation, Sanechips
* R2-2303142 discussion Consideration on RACH-less HO in NTN ZTE Corporation, Sanechips
* R2-2303160 discussion Discussion on NTN handover enhancements TCL Communication Ltd.
* R2-2303170 discussion Even Further Aspects on Connected-mode Mobility in Rel-18 NTN Nokia, Nokia Shanghai Bell
* R2-2303256 discussion Considerations on supporting RACH-less HO in NTN Lenovo
* R2-2303258 discussion Discussion on Handover enhancements for NTN Fujitsu Limited
* R2-2303327 discussion On handover enhancement for signalling overhead reduction in NR NTN vivo
* R2-2303331 discussion Satellite switch\_PCI change without L3 handover NEC
* R2-2303332 discussion Support RACH-less HO and CHO NEC
* R2-2303417 discussion Signaling optimization on common HO configuration Apple
* R2-2303418 discussion NTN specific handover enhancement Apple
* R2-2303441 discussion Discussion on handover enhancements for NTN-NTN mobility Xiaomi
* R2-2303459 discussion On handover enhancement for signalling overhead reduction in NR NTN vivo
* R2-2303478 discussion Discussion on NR NTN-NTN handover enhancements Transsion Holdings
* R2-2303526 discussion Discussion on common (C)HO configuration, RACH-less HO and group HO for NTN CMCC
* R2-2303730 discussion NTN mobility enhancements for RRC\_CONNECTED InterDigital
* R2-2303734 discussion Handover enhancements Ericsson
* R2-2303768 discussion Discussion on NTN handover enhancements Samsung Research America
* R2-2303802 discussion Further discussion on PCI unchanged CMCC
* R2-2303932 discussion Discussion on RACH-less handover for NTN ASUSTeK
* R2-2303933 discussion Discussion on handover enhancement with common signalling ASUSTeK
* R2-2303977 discussion Discussion on handover enhancements LG Electronics France
* R2-2304079 discussion Discussion on handover enhancements Sharp
* R2-2304134 discussion NTN-NTN handover enhancements Sequans Communications
* R2-2304137 discussion HO/CHO Signaling Overhead Reduction by NTN-config omission Sequans Communications
* R2-2304147 discussion Considerations on unchanged PCI solution Sequans Communications
* R2-2304248 discussion Report of [AT121bis-e][108][NR NTN Enh] Common (C)HO configuration (Ericsson) Ericsson
* R2-2304249 discussion Report of [AT121bis-e][109][NR NTN Enh] RACH-less HO (Samsung) Samsung
* R2-2304250 LS out DRAFT LS to RAN1 on unchanged PCI CATT

**RAN2#122 Incheon, Korea, May 22th – 26th, 2023:**

* R2-2305391 Work Plan R18 WI NR-NTN-enh work plan at RAN1, 2 and 3 THALES
* R2-2305407 draftCR Stage 2 running CR for TS 38.300 for Rel-18 NTN THALES
* R2-2305933 draftCR Stage 3 NTN running CR for 38.321 - RAN2#121bise InterDigital
* R2-2304634 LS in LS on the system parameters for NTN above 10 GHz (R4-2305926; contact: CATT) RAN4
* R2-2306294 draftCR Stage 3 running 38.304 CR for NTN ZTE corporation, Sanechips
* R2-2306468 CR Stage 3 Running RRC CR for NR NTN Rel-18 Ericsson
* R2-2305506 discussion Discussion on NR NTN UE capabilities Intel Corporation
* R2-2305508 draftCR Draft 331 CR for NR NTN UE capabilities Intel Corporation
* R2-2305507 draftCR Draft 306 CR for NR NTN UE capabilities Intel Corporation
* R2-2304743 discussion Discussion on PUCCH enhancement for Msg4 HARQ-ACK in NR NTN OPPO
* R2-2305744 discussion Discussion on coverage enhancement Xiaomi
* R2-2305673 discussion Discussion on network verified UE location Xiaomi
* R2-2305790 discussion Remaining issues on Network Verified UE Location Samsung Shenzhen
* R2-2305393 discussion Discussion on NTN NW verified UE location Lenovo
* R2-2305249 discussion Discussion on multiple-RTT based positioning in NTN Quectel
* R2-2305596 discussion Network verified UE location CMCC
* R2-2304735 discussion On Network Verified UE Location in NR NTN MediaTek Inc.
* R2-2304811 discussion Discussion on the network verfied UE location Huawei, Turkcell, HiSilicon
* R2-2305194 discussion Single satellite Multi-RTT based positioning Qualcomm Incorporated
* R2-2305033 discussion Discussion on network verified UE location Ericsson
* R2-2305940 discussion On Network verified UE location Nokia, Nokia Shanghai Bell
* R2-2305408 discussion Discussion on network verified UE location in NR NTN THALES
* R2-2306377 discussion Discussion on Network Verified UE Location TCL Communication Ltd.
* R2-2306244 discussion Consideration on NW verified UE location and CE ZTE Corporation, Sanechips
* R2-2306153 discussion NTN-TN Cell Reselection Enhancement Apple
* R2-2306070 discussion Discussion on the NTN-TN cell reselection enhancements Huawei, HiSilicon, Turkcell
* R2-2306324 discussion Remaining issues on NTN-TN Cell Reselection Enhancements Samsung Research America
* R2-2306352 discussion Discussion on TN area information for the NTN-TN cell re-selection enhancements ETRI
* R2-2306389 discussion Discussion on NTN-TN Cell re-selection ITL
* R2-2306467 discussion TN NTN mobility enhancements Ericsson
* R2-2306031 discussion Discussion on providing TN coverage area information LG Electronics France
* R2-2305994 discussion NTN-TN Mobility Cell Reselection and PCI Values SHARP Corporation
* R2-2305048 discussion Discussion on NTN-TN cell reselection enhancements Continental Automotive
* R2-2304897 discussion Discussion on the mechanism for providing TN coverage information CATT
* R2-2305195 discussion TN cell coverage info and measurement relaxation Qualcomm Incorporated
* R2-2304783 discussion Considerations on the NTN-TN cell re-selection enhancements Telit Communications S.p.A.
* R2-2304834 discussion Further discussion on power saving for NTN-TN mobility vivo
* R2-2304744 discussion Discussion on NTN-TN cell reselection enhancement OPPO
* R2-2304696 discussion Discussion on TN-NTN cell reselection enhancements CAICT
* R2-2305597 discussion Discussion on NTN-TN cell reselection enhancements CMCC
* R2-2305373 discussion Discussion on remaining issues of NTN-TN cell reselection enhancements Transsion Holdings
* R2-2305934 discussion NTN-TN mobility and service continuity InterDigital
* R2-2305893 discussion Discussion on the TN Coverage Information Google Inc.
* R2-2305866 discussion Details of the TN coverage data signalling NEC Telecom MODUS Ltd.
* R2-2305882 discussion Resolving Open Issues on TN Coverage Definition Nokia, Nokia Shanghai Bell
* R2-2305674 discussion Cell reselection enhancements for NTN-TN mobility Xiaomi
* R2-2305715 discussion Further discussions on indication of TN coverage information Lenovo
* R2-2305716 discussion Neighbour cell measurement triggering in NTN moving cells Lenovo
* R2-2305675 discussion Cell reselection enhancements for NTN-NTN mobility Xiaomi
* R2-2305666 discussion Proposals for completing the decisions from last RAN2 meeting #121bis-e PANASONIC
* R2-2305561 discussion Discussion on NTN-NTN mobility enhancements Spreadtrum Communications
* R2-2305935 discussion Cell reselection enhancements for Earth moving cell InterDigital
* R2-2305374 discussion Discussion on remaining issues of NTN-NTN reselection enhancements Transsion Holdings
* R2-2305598 discussion Discussion on NTN-NTN reselection CMCC
* R2-2304745 discussion Discussion on NTN-NTN cell reselection enhancement OPPO
* R2-2304698 discussion Discussion on NTN-NTN cell reselection enhancements CAICT
* R2-2304835 discussion Further discussion on cell reselection enhancments for earth-moving cell vivo
* R2-2304898 discussion Discussion on the cell reselection enhancement for earth-moving cell CATT, IPLOOK
* R2-2306032 discussion Discussion on NTN-NTN cell reselection enhancements LG Electronics France
* R2-2306470 discussion NTN NTN mobility enhancements Ericsson
* R2-2306325 discussion Discussion on NTN-NTN Cell Reselection Enhancements Samsung Research America
* R2-2306154 discussion NTN-NTN Cell Reselection Enhancement Apple
* R2-2306295 discussion Consideration on cell reselection enhancements for NTN-NTN ZTE corporation, Sanechips,Intel Corporation
* R2-2306296 discussion Consideration on HO enhancements in NTN ZTE corporation, Sanechips
* R2-2306155 discussion Signaling optimization on common HO configuration Apple
* R2-2306156 discussion NTN specific handover enhancement Apple
* R2-2306122 discussion Discussion on handover enhancement with common signalling ASUSTeK
* R2-2306123 discussion Discussion on RACH-less handover for NTN ASUSTeK
* R2-2306071 discussion Remaining issues on RACH-less HO in NTN Huawei, HiSilicon, Turkcell
* R2-2306072 discussion Discussion on the Common (C)HO configuration Huawei, HiSilicon, Turkcell
* R2-2306033 discussion Discussion on handover enhancements LG Electronics France
* R2-2306326 discussion Discussion on NTN Handover Enhancements Samsung Research America
* R2-2306370 discussion Discussion on handover enhancements Sharp
* R2-2306351 discussion Discussion on the SMTC and Measurement Gap Enhancements Google Inc.
* R2-2306465 discussion Handover enhancements Ericsson
* R2-2306453 discussion NTN-NTN handover enhancements Sequans Communications
* R2-2306517 discussion “Unchanged PCI” solution vs “PCI change only” solution Sequans Communications
* R2-2304899 discussion Discussion on unchanged PCI scenario CATT
* R2-2304900 discussion Discussion on common (C)HO configuration and RACH-less CATT
* R2-2305049 discussion Discussion on NTN-NTN handover enhancements Continental Automotive
* R2-2305196 discussion RACH-less handover for NTN Qualcomm Incorporated
* R2-2305197 discussion Satellite switch enhancements for NTN Qualcomm Incorporated
* R2-2305152 discussion Satellite switch\_PCI change without L3 handover NEC
* R2-2305153 discussion Support RACH-less CHO NEC
* R2-2304836 discussion Further discusison on service link switching with unchanged PCI vivo
* R2-2304833 discussion Discussion on handover enhancement with common HO configuration in NR NTN vivo
* R2-2304753 discussion Discussion on NTN handover enhancements OPPO
* R2-2304736 discussion Enabling Group Handover in NR-NTN MediaTek Inc.
* R2-2304734 discussion Handover Enhancements in Earth Moving Cells MediaTek Inc.
* R2-2305599 discussion Discussion on handover enhancements for NTN CMCC
* R2-2305518 discussion Signaling overhead reduction and group handover during NTN-NTN HOs Sony
* R2-2305375 discussion Discussion on NTN-NTN handover enhancements Transsion Holdings
* R2-2305380 discussion Discussion on NTN handover enhancements TCL Communication Ltd.
* R2-2305238 discussion Support of broadcasting HO signaling in NTN China Telecom
* R2-2305936 discussion NTN mobility enhancements for RRC\_CONNECTED InterDigital
* R2-2305937 discussion Satellite switching without PCI change InterDigital
* R2-2305883 discussion Open Aspects on RACH-less HO in Rel-18 NTN Nokia, Nokia Shanghai Bell
* R2-2305884 discussion On Common and Conditional Handover Signalling in Rel-18 NTN Nokia, Nokia Shanghai Bell
* R2-2305676 discussion Discussion on handover enhancements for NTN-NTN mobility Xiaomi
* R2-2305717 discussion Potential issues for RACH-less HO in NTN Lenovo

## 4.3 RAN3

**RAN3#119bis emeeting, April 17th - 27th, 2023:**

Submitted TDOCs:

* R3-231139 CR XnAP BLCR on NTN Functionality Huawei, Ericsson, Thales, ZTE, Omnispace, TTP, Nokia, Nokia Shanghai Bell, CATT, Hughes, EchoStar, CMCC
* R3-231140 draftCR (BLCR) Stage 2 BL CR for NR NTN Ericsson, CATT, Thales, Huawei, Samsung, ZTE, Nokia, Nokia Shanghai Bell, Qualcomm
* R3-231364 Work Plan R18 WI NR-NTN-enh work plan at RAN1, 2 and 3 THALES
* R3-231215 discussion Remaining open issues on service continuity enhancement for NTN Samsung
* R3-231255 discussion Cell ID over Xn for NTN Qualcomm Incorporated, CATT, Nokia, Nokia Shanghai Bell, NEC
* R3-231258 discussion Discussion on NTN Service Continuity Enhancements Qualcomm Incorporated
* R3-231387 discussion Discussion on Mobility and Service Continuity Enhancements for NTN NEC
* R3-231417 other NGAP Support for Time-Based HO in NTN Ericsson, Thales, Intelsat, Lockheed Martin, Hughes Network Systems, CATT, ESA
* R3-232093 other NGAP Support for Time-Based HO in NTN Ericsson, Thales, Intelsat, Lockheed Martin, Hughes Network Systems, CATT, ESA
* R3-232159 other NGAP Support for Time-Based HO in NTN Ericsson, Thales, Intelsat, Lockheed Martin, Hughes Network Systems, CATT, ESA
* R3-231418 CR Time-Based HO for NTN - NGAP Impacts Ericsson, Thales, ZTE, Omnispace, TTP, CATT, Hughes Network Systems, Huawei, Lockheed Martin, Intelsat, CATT, ESA
* R3-231419 discussion Time Margin for CHO in NR NTN Ericsson, Thales
* R3-231420 other Time Margin for CHO in NR NTN - XnAP Impact Ericsson LM
* R3-231476 discussion Discussion on the time-based trigger condition in NR NTN Nokia, Nokia Shanghai Bell
* R3-231477 CR Support time-based trigger condition in NG-HO Nokia, Nokia Shanghai Bell
* R3-231509 discussion Remaining issues on NTN mobility enhancement China Telecommunication
* R3-231669 discussion Discussion Mobility and Service Continuity Enhancements for NTN CATT
* R3-231691 discussion Further discussion on mobility issue for NR NTN ZTE
* R3-231697 other (TP for NTN BL CR 38.300) Cell ID for non-UE associated Xn procedures ZTE
* R3-231756 discussion Further discussion on cell ID usage and TAC Huawei
* R3-231757 discussion Further discussion on NG HO Huawei
* R3-231684 discussion Discussion on Mobility and Service Continuity Enhancements NEC Corporation
* R3-231892 discussion CB: # NTN1\_ServiceContinuity - Summary of email discussion Samsung - moderator
* R3-232123 other (TP for BL CR 38.300) data forwarding in HO with time-based trigger condition Nokia, Nokia Shanghai Bell, Ericsson, Samsung
* R3-231328 discussion Consideration on OAM requirements for UE location verification CATT
* R3-231421 discussion Latency Impact of Network Verified UE Location for NTN Ericsson, CATT, Huawei
* R3-231453 draftCR OAM Requirements for UE Location Verification Ericsson, CATT, Huawei
* R3-231670 LS out [Draft]LS on OAM requirements for UE location verification CATT
* R3-231758 other (TP to 38.300) OAM Requirements for UE Location Verification Huawei, Ericsson, CATT
* R3-231759 discussion Discussion on network verified UE location Huawei, Ericsson, CATT
* R3-231893 discussion CB: # NTN2\_LocationVerification - Summary of email discussion Huawei - moderator

**RAN3#120 Incheon, Korea, May 22th – 26th, 2023:**

* R3-232540 draftCR (BLCR to 38.300) Stage 2 BL CR for NR NTN Ericsson, CATT, Thales, Huawei, Samsung, ZTE, Nokia, Nokia Shanghai Bell, Qualcomm Incorporated
* R3-232541 CR XnAP BLCR on NTN Functionality Huawei, Ericsson, Thales, ZTE, Omnispace, TTP, Nokia, Nokia Shanghai Bell, CATT, Hughes, EchoStar, CMCC
* R3-233021 Work Plan R18 WI NR-NTN-enh work plan at RAN1, 2 and 3 THALES
* R3-232826 draftCR (BLCR to 38.300) Stage 2 BL CR for NR NTN Ericsson, CATT, Thales, Huawei, Samsung, ZTE, Nokia, Nokia Shanghai Bell, Qualcomm Incorporated
* R3-233181 discussion Further discussion on service continuity enhancement for NTN Samsung
* R3-232947 other NGAP Support for Time-Based HO in NTN Ericsson, Thales, Intelsat, Lockheed Martin, Hughes Network Systems, CATT, ESA, Nokia, Nokia Shanghai Bell
* R3-232948 CR Time-Based HO for NTN - NGAP Impacts Ericsson, Thales, ZTE, Omnispace, TTP, CATT, Hughes Network Systems, Huawei, Lockheed Martin, Intelsat, ESA
* R3-232967 discussion Time Margin for CHO in NR NTN Ericsson, Thales
* R3-232971 other Time Margin for CHO in NR NTN - XnAP Impact Ericsson LM
* R3-233088 discussion Further discussion on mobility issue for NR NTN ZTE
* R3-233089 other (TP for NTN BL CR 38.423) No exchange of TAC for non-UE associated Xn procedures ZTE
* R3-232930 other (TP for NR NTN BL CR TS38.300) Discussion on the time-based trigger condition in NR NTN Nokia, Nokia Shanghai Bell
* R3-232931 other (TP for NR NTN BL CR TS38.413) Support time-based trigger condition in NR NTN NG-HO Nokia, Nokia Shanghai Bell
* R3-233010 discussion Further discussion on network ID usage and time based handover in NTN China Telecommunication
* R3-232957 discussion Further discussion on cell ID usage and TAC Huawei
* R3-232958 discussion Further discussion on NG HO Huawei
* R3-232743 discussion Discussion on Mobility and Service Continuity Enhancements NEC
* R3-232787 discussion Discussion on NR NTN Service Continuity Enhancements Qualcomm Incorporated
* R3-232788 discussion Cell ID over Xn for NTN Qualcomm Incorporated, CATT, Nokia, Nokia Shanghai Bell, NEC
* R3-232798 other (TP for BL CR to TS 38.413/38.423) On Mobility and Service Continuity Enhancements for NTN CATT
* R3-232799 discussion Consideration on OAM requirements for UE location verification CATT,Ericsson, Huawei
* R3-232789 discussion Discussion on Network Verified UE Location for NTN Qualcomm Incorporated
* R3-232959 discussion Further discussion on network verified UE location Huawei, Ericsson, CATT
* R3-232960 other (TP to 38.300) OAM Requirements for UE Location Verification Huawei, Ericsson, CATT
* R3-232945 LS out [DRAFT] Reply LS on Latency impact for NTN verified UE location Ericsson, CATT, Huawei
* R3-232944 draftCR OAM Requirements for UE Location Verification Ericsson, CATT, Huawei
* R3-233205 discussion Discussion on NTN Network Verified UE Location TCL Communication Ltd.

## 4.4 RAN4

**RAN4#106bis emeeting, April 17th - 27th, 2023:**

Submitted TDOCs:

* R4-2305831 discussion Discussion on system parameters for above 10 GHz THALES
* R4-2305417 other Further discussion on system parameter for NTN in Ka band ZTE Corporation
* R4-2304567 other NTN enhancement: System parameters Ericsson
* R4-2304439 other Further discussion on NTN system parameters CATT
* R4-2304938 other Discussion on above 10GHz NTN bands Nokia, Nokia Shanghai Bell
* R4-2304566 discussion NTN enhancement: Regulatory aspects Ericsson
* R4-2305832 discussion Discussion on RAN LS to RAN1 for NTN above 10 GHz THALES
* R4-2305834 discussion NTN Simulation Parameters for above 10 GHz Coexistence Studies THALES, Magister Solutions Ltd
* R4-2305847 discussion Updated NTN Simulation Parameters for above 10 GHz Coexistence Studies and Initial Simulation Results THALES, Magister Solutions Ltd
* R4-2304568 other NTN enhancement: coexistence simulations Ericsson
* R4-2304614 discussion Simulation assumptions and preliminary co-existence study for above 10GHz NTN co-existence study Samsung Electronics Nordic AB
* R4-2304615 discussion Simulation assumptions and preliminary co-existence study for above 10GHz NTN co-existence study Samsung Electronics Nordic AB
* R4-2304443 other Further discussion on remaining issues about simulation assumptions for above 10GHz NTN co-existence study CATT
* R4-2304363 discussion Frequency ranges of GSO and NGSO ESIMs and coexistence requirements Verizon Denmark
* R4-2304364 discussion Off-Axis EIRP requirement Verizon Denmark
* R4-2304680 other Simulation assumptions for co-existence study for above 10GHz bands Qualcomm Incorporated
* R4-2305383 other Discussion on Rel-18 NTN coexistence study assumption Huawei, HiSilicon
* R4-2305418 other Further discussion on SAN RF requirements for NTN in Ka-band ZTE Corporation
* R4-2304444 other Further discussion on SAN RF requirements for above 10GHz bands CATT
* R4-2304569 other NTN enhancement: SAN RF requirements Ericsson
* R4-2304570 other NTN enhancement: NTN UE requirements Ericsson
* R4-2305065 discussion On Beam Tracking Capabilities for measurements Nokia, Nokia Shanghai Bell
* R4-2305419 other Further discussion on UE RF requirements for NTN in Ka-band ZTE Corporation
* R4-2305384 other Discussion on Ka band NTN UE Huawei, HiSilicon
* R4-2305844 discussion NTN UE terminal reference architecture for above 10 GHz THALES, Hughes/EchoStar
* R4-2305845 discussion Discussion on RAN LS to RAN1 for NTN above 10 GHz THALES
* R4-2305340 discussion Discussion on RRM requirements for Rel-18 NTN Huawei, HiSilicon
* R4-2305031 other Discussion on RRM requirements for NTN enhancement ZTE Corporation
* R4-2305055 discussion Discussion on RRM requirements for NTN enhancement vivo
* R4-2305195 discussion RRM requirements for NR NTN enhancement Ericsson
* R4-2304646 discussion Discussion on RRM core requirements for NR NTN enhancement CMCC
* R4-2304769 discussion Discussion on RRM requirements for Rel-18 NTN Xiaomi
* R4-2304745 discussion Discussion on RRM impacts on NTN enhancement Samsung
* R4-2304911 discussion General views on NR NTN enhancement LG Electronics UK
* R4-2304818 discussion Discussion on RRM requirements for NTN enhancement MediaTek inc.
* R4-2304501 discussion Discussion on applicability of SCS for NTN above 10 GHz Nokia, Nokia Shanghai Bell
* R4-2304425 discussion Discussion on RRM requirements for NTN enhancement CATT
* R4-2304368 other NTN support for frequency band above 10GHz Qualcomm Korea
* R4-2304154 discussion RRM impacts overview for eNTN Apple
* R4-2306358 other WF on NR NTN enhancement RRM requirements Qualcomm Incorporated
* R4-2306359 LS out LS on NR-NTN deployment in above 10 GHz Nokia
* R4-2306624 other WF on NTN UE RF requirements in Ka-band ZTE Corporation
* R4-2306169 other Topic summary for [106-bis-e][221] NR\_NTN\_enh Moderator (Qualcomm)
* R4-2305925 other WF on NTN enhancement - [106bis-e][309] NR\_NTN\_enh\_Part1 Thales
* R4-2305926 LS out LS on System Parameters for NTN above 10 GHz CATT
* R4-2305927 other WF on SAN RF requirements Ericsson
* R4-2305928 other WF on [311] NR\_NTN\_enh\_Part3 Samsung
* R4-2305929 other Calibration table for NTN co-existence study in above 10GHz band Samsung
* R4-2305930 other Assumptions for NTN co-existence study in above 10GHz band Samsung
* R4-2306219 other Topic summary for [106-bis-e][140] NR\_NTN\_enh\_UERF Moderator (ZTE)
* R4-2305979 other Topic Summary [106bis-e][309] NR\_NTN\_enh\_Part1 Moderator (Thales)
* R4-2305980 other Topic Summary [106bis-e][310] NR\_NTN\_enh\_Part2 Moderator (Ericsson)
* R4-2305981 other Topic Summary [106bis-e][311] NR\_NTN\_enh\_Part3 Moderator (Samsung)
* R4-2306002 other WF on [311] NR\_NTN\_enh\_Part3 Samsung
* R4-2306003 other Assumptions for NTN co-existence study in above 10GHz band Samsung
* R4-2305856 other Topic Summary [106bis-e][309] NR\_NTN\_enh\_Part1 Moderator (Thales)
* R4-2305857 other Topic Summary [106bis-e][310] NR\_NTN\_enh\_Part2 Moderator (Ericsson)
* R4-2305858 other Topic Summary [106bis-e][311] NR\_NTN\_enh\_Part3 Moderator (Samsung)
* R4-2306302 other Topic summary for [106-bis-e][140] NR\_NTN\_enh\_UERF Moderator (ZTE)
* R4-2306252 other Topic summary for [106-bis-e][221] NR\_NTN\_enh Moderator (Qualcomm)
* R4-2304427 LS out Further response on enhanced cell reselection requirements in NTN CATT
* R4-2304505 LS out LS Reply on follow-up of NTN Cell Reselection Nokia, Nokia Shanghai Bell
* R4-2304506 CR DraftCR on Cell Reselection for RRC Inactive in NTN Nokia, Nokia Shanghai Bell
* R4-2305189 LS out Reply LS on enhanced cell reselection requirements in NTN in Agenda 7.1.2 Ericsson
* R4-2305063 draftCR DraftCR to TS 38.133 on Cell Reselection for RRC Inactive in NTN (Rel-17) Nokia, Nokia Shanghai Bell
* R4-2305064 draftCR DraftCR to TS 38.133 on Cell Reselection for RRC Inactive in NTN (Rel-18) Nokia, Nokia Shanghai Bell
* R4-2305036 other LS to RAN2 on enhanced cell re-selection requirements in NTN ZTE Corporation
* R4-2304771 discussion Reply LS on enhanced cell reselection requirement for NTN Xiaomi
* R4-2304910 discussion Discussion on enhanced cell reselection requirements in NTN LG Electronics UK
* R4-2305348 LS out Reply LS on enhanced cell reselection requirements in NTN Huawei, HiSilicon

**RAN4#107 Incheon, Korea, May 22th – 26th, 2023:**

* R4-2308535 other NTN enhancement: System parameters Ericsson
* R4-2309182 other Further discussion on system parameter for NTN in Ka band ZTE Corporation
* R4-2307392 discussion Discussion on NTN system parameters CATT
* R4-2307318 other Discussion on above 10GHz NTN bands Nokia, Nokia Shanghai Bell
* R4-2307046 discussion Discussion on system parameters for above 10 GHz NYCU
* R4-2307381 other Further discussion on remaining issues about simulation assumptions for above 10GHz NTN co-existence study CATT
* R4-2309248 other Calibration simulation results for above 10GHz bands Qualcomm Incorporated
* R4-2308417 discussion Collection table for NTN co-existence in above 10GHz calibration results Samsung Electronics Nordic AB
* R4-2308414 discussion Discussion of simulation assumptions for above 10GHz NTN co-existence study Samsung Electronics Nordic AB
* R4-2308536 other NTN enhancement: coexistence simulations assumptions Ericsson
* R4-2308537 other NTN enhancement: coexistence simulations results Ericsson
* R4-2308577 other Discussion on Rel-18 NTN coexistence study assumption Huawei, HiSilicon
* R4-2309700 discussion Initial NTN calibration results for above 10 GHz Coexistence Studies THALES, Magister Solutions Ltd
* R4-2307382 other Further discussion on SAN RF requirements for above 10GHz bands CATT
* R4-2309717 discussion Updates for NTN UE terminal requirements discussion in above 10 GHz THALES
* R4-2307319 other Discussion on above 10GHz NTN UEs Nokia, Nokia Shanghai Bell
* R4-2308784 discussion Discussions on NTN UE RF Samsung
* R4-2308578 other Discussion on Ka band NTN UE Huawei, HiSilicon
* R4-2308538 other NTN enhancement: NTN UE requirements Ericsson
* R4-2309508 other Ka band UE noise figure and reference sensitivity Qualcomm Incorporated
* R4-2309509 other More on FR2 NTN UE reference architectures Qualcomm Incorporated
* R4-2309053 discussion On DMRS bundling with doppler pre-compensation for NTN Apple
* R4-2309183 other Further discussion on UE RF requirements for NTN in Ka-band ZTE Corporation
* R4-2309381 discussion Coexistence and off-Axis EIRP requirements for NTN-TN NR-Uu interface Verizon Denmark
* R4-2308361 discussion Discussion on NTN operation on frequencies above 10 GHz Nokia, Nokia Shanghai Bell
* R4-2308517 discussion Discussion on RRM impacts on NTN enhancement Samsung
* R4-2308673 discussion Discussion on RRM requirements for Rel-18 NTN Huawei, HiSilicon
* R4-2307327 discussion RRM for eNTN Apple
* R4-2307418 discussion Discussion on RRM requirements for NR NTN enhancement CATT
* R4-2307599 discussion Discussion on RRM core requirements for NR NTN enhancement CMCC
* R4-2307278 other NTN support for frequency band above 10GHz Qualcomm Incorporated
* R4-2308046 other Discussion on RRM requirements for NTN enhancement ZTE Corporation
* R4-2307709 discussion Discussion on RRM requirements for NTN enhancement vivo
* R4-2307952 discussion Discussion on RRM requirements for Rel-18 NTN Xiaomi
* R4-2307904 discussion RRM requirements for NR NTN enhancement Ericsson
* R4-2307902 discussion General views on NR NTN enhancement LG Electronics UK
* R4-2307892 discussion Discussion on RRM requirements for NTN enhancement MediaTek inc.
* R4-2309971 other Topic summary for [107][226] NR\_NTN\_enh Moderator (Qualcomm)
* R4-2310026 other Topic summary for [107][143] NR\_NTN\_enh\_UERF Moderator (ZTE)
* R4-2310448 other Summary for [107][309] NR\_NTN\_enh\_Part1 Moderator, Thales
* R4-2310449 other Summary for [107][311] NR\_NTN\_enh\_Part3 Moderator, Samsung
* R4-2309725 discussion New WID on the extension to 30 MHz Channel Bandwidth for NR NTN in FR1 THALES
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* R4-2308643 CR CR on mobility requirements for NTN Huawei, HiSilicon
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