3GPP TSG-RAN WG4 Meeting #110bis R4-2406430

Changsha, China, 15th – 19th April, 2024

**Agenda item:** 6.16.9

**Source:** Moderator (Qualcomm Incorporated)

**Title:** WF on RRM requirements for NR\_NTN\_enh

**Document for:** Approval

# Introduction

*The summary covers the contributions submitted under the following AI:*

* *6.16.6 RRM core requirements [NR\_NTN\_enh-Core]*
  + *6.16.6.1 NR-NTN RRM requirements in above 10 GHz bands [NR\_NTN\_enh-Core]*
  + *6.16.6.2 Network verified UE location [NR\_NTN\_enh-Core]*
  + *6.16.6.3 NTN-TN and NTN-NTN mobility and service continuity enhancements [NR\_NTN\_enh-Core]*
* *6.16.7 RRM performance requirements [NR\_NTN\_enh-Perf]*
  + *6.16.7.1 NR-NTN RRM performance requirements in above 10 GHz bands [NR\_NTN\_enh-Perf]*
  + *6.16.7.2 Network verified UE location [NR\_NTN\_enh-Perf]*
  + *6.16.7.3 NTN-TN and NTN-NTN mobility and service continuity enhancements [NR\_NTN\_enh-Perf]*

# Topic #1: UL timing requirements in bands above 10 GHz

**Issue 1-6A: Te\_NTN for 60kHz and 120kHz in Case2**

**Agreement: (ad-hoc)**

* Further check and come back in next meeting

**Issue 1-6B: Te\_NTN for 60kHz and 120kHz in Case3**

**Agreement: (ad-hoc)**

* In Case-3, Te\_NTN [Ts] for 120kHz UL SCS is:
  + [10]

<Note: No update was made compared RAN4#110 agreement>

# Topic #2: RRM requirements in bands above 10 GHz

**No Agreement**

# Topic #3: Network verified UE location

**Issue 3-2: Measurement period and accuracy requirements on RTD**

**Agreement (online):**

* Remove factors related to multiple positioning frequency layers, multiple RX TEGs and Rx beam sweeping from the Rx-Tx requirements.
* Remove the below applicability rules from UE RX-TX time difference measurements:
  + FFS: When a serving cell change occurs during the measurement period, the UE shall continue and complete the UE Rx-Tx time difference measurement provided that the serving cell change does not impact SRS configuration for the UE Rx-Tx time difference measurement.
  + If UE uplink transmission timing changes due to the UE autonomous timing adjustment defined in clause 7.1C.2 during the UE Rx-Tx measurement period, then:
    - UE Rx-Tx measurement period requirements in this clause shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1C.1) for SRS transmission. The UE Rx-Tx time difference measurement period may be restarted in such case.
* Supporting Nsample = 1 is a component of NW verified location (FG 44-2), and it does not require UE to support reduced sample number for TN positioning measurement (FG 27-3-1).
  + HW to draft the LS to RAN1/2 about the information

**Issue 3-4: Measurement accuracy requirements on UL timing drift**

**FFS (ad-hoc):**

* No new applicability condition for UE Rx-Tx measurement requirements related to amount of variation in the applied TA during measurement period.
  + Including DL timing drift reporting as condition

**Issue 3-5: Other impact on RRM**

**Agreement (online):**

* When UE switches to a new satellite switch with same PCI (through HO, CHO or satellite switch with re-sync for both hard and soft satellite switch), select one option from:
  + Option 1a: UE stops the PRS measurement after t\_service and restart the UE Rx-Tx time difference measurement after switch is complete.
    - The PRS configuration of the two satellites with the same PCI follows RAN1/2 specficiaton, and no further restriction for gNB/LMF to be defined in RAN4.
    - The UE measurement accuracy requiremet does not apply if the PRS transmission from two satelliates overlap in time/frequency domain. Further clarify the definition of “overlapping” offline.
  + Option 1b: UE stops the PRS measurement after t\_servicestart and restart the UE Rx-Tx time difference measurement after switch is complete.
    - The PRS configuration of the two satellites with the same PCI follows RAN1/2 specficiaton, and no further restriction for gNB/LMF to be defined in RAN4.
  + Option 2: UE stops the PRS measurement after t\_service and until LMF triggers new measurement.

**FFS (online):**

* When UE switches to a new satellite switch with different PCI (through HO or CHO),
  + UE stops the PRS measurement for the source cell and re-start PRS measurement for the target cell after SRS (re)configuration on the target cell is complete.

# Topic #4: Idle/Inactive mode mobility enhancements

**No Agreement**

# Topic #5: Connected mode mobility enhancements

**Issue 5-2-S: Soft’ Satellite switch (5-2-S1 and -S2 from RAN4#110 are merged)**

**Agreement (online):**

* Scheduling restrictions over [t-ServiceStart ~ t-Service] for UE incapable of parallelMeasurementWithoutRestriction-r17 and/or [differentSCS between SSB and data]
  + Define scheduling restriction during soft satellite switch from UE perspective, i.e. scheduling restriction are allowed only during SSB occasions of the target satellite (same as 9.2C.5.3)
    - For the scheduling restriction: For RSRP measurement, 1 additional symbol before and after SSB block. For RSRQ measurement, 1 additional symbol before and after RSSI symbols.

**Agreement (online):**

* Optimization on measurements
  + UE is allowed to skip measurements other cells and satellites than the target satellite and source satellite from T-serviceStart to the satellite switch completion.

**Agreement (online):**

* Impact on inter-satellite neighbour cell measurements
  + No optimization for the scenario of ‘(both hard and soft) satellite switch with re-sync’ on inter-satellite neighbor cell measurements

# Topic #6: Performance requirements

**Issue 6-2: Above 10 GHz, Test case list**

**Agreement: (ad-hoc)**

* Define test cases for the below cases for both Type 1 and Type 2 UEs. Detailed configurations are to be discussed separately.
  + UL timing accuracy
  + Mobility in RRC Idle/Inactive mode
  + Mobility in RRC Connected mode
    - Intra-satellite
    - Inter-satellite (blind mobility)
  + RLM
  + L1-RSRP
  + L3 measurements
  + Measurement accuracy
    - If measurement accuracy requirements specified in Rel-18

**Issue 6-2-2: Above 10 GHz, Rx beam gain**

**Agreement: (ad-hoc)**

* FFS whether the RF margin for different RX beams in existing TN FR2-1 intra-frequency relative accuracy requirements can be removed or not
* Existing absolute measurement accuracy requirement of TN FR2 (including intra-frequency and inter-frequency) can be applied for NTN UE above 10GHz.
* Further discuss the minimum SSB\_RP condition on accuracy requirements

**Issue 6-2-3: Above 10 GHz, UL timing accuracy**

**Agreement: (ad-hoc)**

* Define UL timing test cases at least for following configuration:
  + UL SCS 120kHz with DL SSB SCS: 120kHz
* FFS whether any other configuration need to be considered or not
* For UL SCS is 120kHz,
  + Transmit Timing Test covering
    - Case 1,2,3
  + Timing advance adjustment accuracy covering
    - Case 1,2,3
* Note:
  + Case-1: Stationary UE for GSO
  + Case-2: Stationary UE for LEO
  + Case-3: Mobile UE for GSO

**Issue 6-3-1: Below 10 GHz, Test set-up and applicability rule**

**Agreement: (ad-hoc)**

* NTN-TN inter-frequency cell reselection (Intra-RAT to NR TN and Inter-RAT to LTE TN)
  + For earth-moving cell, time-/location-based measurement initiation for cell reselection:
    - No test case
  + For earth fixed cell:
    - Define test cases
* NTN to NTN time-based measurement initiation for cell reselection in earth-moving cell
  + Not define test case
* NTN to NTN location-based measurement initiation for cell reselection in earth-moving cell
  + Not define test case

**Agreement: (online)**

* Define two TCs:
  + RACH-less for soft satellite switch
  + RACH-based for hard satellite switch

**FFS:**

* NTN to NTN RACH-less (C)HO
* NTN to NTN time-based trigger CHO enhancements
* NTN to NTN location- based trigger CHO enhancements
* Network verified UE location

# CR split

**Agreement: (online)**

The test configurations in [] are the baseline. Other configurations can be considered if consensus can be reached in the next meeting, proponents of other configurations to bring the corresponding CR in the next meeting.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Band** | **Category** | **Test case** | **Configuration** | **Company** |
| Above 10 GHz | UL transmission timing | 1. Transmit Timing  2. Timing advance adjustment accuracy | UL SCS: 120kHz  DL SSB SCS: 120kHz  Case 1,2,3 |  |
| Above 10 GHz | Connected mode mobility | 1. Intra-satellite handover  2. Inter-satellite (blind mobility) | Type 1 and Type 2  [Intra-frequency] |  |
| Above 10 GHz | Signaling | RLM [Out-of-sync, In-sync] | Type 1 and Type 2  [Non-DRX, SSB] |  |
| Above 10 GHz | Measurement procedure | L3-RSRP [Intra-satellite] | Type 1 and Type 2  [Without gap, Intra-frequency, SSB, non-DRX, SSB index reading] |  |
| Above 10 GHz | Measurement procedure | L1-RSRP | Type 1 and Type 2  [SSB, non-DRX] |  |
| Above 10 GHz | Measurement accuracy | L3-RSRP | Type 1 and Type 2  [Without gap, Intra-frequency, SSB, non-DRX, SSB index reading] |  |
| Above 10 GHz | Measurement accuracy | L1-RSRP | Type 1 and Type 2  [SSB, non-DRX] |  |
| Below 10 GHz | Idle mode mobility | 1. NTN-TN inter-frequency cell reselection (Intra-RAT to NR TN)  2. NTN-TN inter-frequency cell reselection (Inter-RAT to LTE TN) | Earth fixed cell |  |
| Below 10 GHz | Connected mode mobility | 1. RACH-less for soft satellite switch  2. RACH-based for hard satellite switch | Earth fixed cell |  |
| Below 10 GHz | Connected mode mobility | NTN to NTN RACH-less HO | Earth fixed cell  [Inter-satellite, without MG] |  |
| Below 10 GHz | Connected mode mobility | NTN to NTN time-based trigger CHO enhancements  Note: not test earth-moving cell |  |  |
| ~~Below 10 GHz~~ | ~~Connected mode mobility~~ | ~~[NTN to NTN location-based trigger CHO enhancements]~~  ~~Note: not test earth-moving cell~~ |  |  |
| ~~Below 10 GHz~~ | ~~Measurement procedure and accuracy~~ | ~~[Network verified UE location]~~ |  |  |
| Note1   * Type 1: fully electronically-steered beam UEs * Type 2: fully mechanically-steered beam UEs   Note2   * Case-1: Stationary UE for GSO * Case-2: Stationary UE for LEO * Case-3: Mobile UE for GSO | | | | |

# References

[1] R4-2404832, “Topic summary for [110bis][221] NR\_NTN\_enh,” 3GPP TSG-RAN WG4 Meeting #110b

[2] R4-2406292, “Ad-hoc minutes on RRM requirements for NR\_NTN\_enh,” 3GPP TSG-RAN WG4 Meeting #110b