3GPP TSG-RAN WG4 Meeting #111 R4-24xxxxx

Fukuoka City, Fukuoka , Japan, 20th – 24th May, 2024

**Agenda item:** 7.16.9

**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:*

*7.16.6 RRM core requirements [NR\_NTN\_enh-Core]*

*7.16.6.1 NR-NTN RRM requirements in above 10 GHz bands [NR\_NTN\_enh-Core]*

*7.16.6.2 Network verified UE location [NR\_NTN\_enh-Core]*

*7.16.6.3 NTN-TN and NTN-NTN mobility and service continuity enhancements [NR\_NTN\_enh-Core]*

*7.16.7 RRM performance requirements [NR\_NTN\_enh-Perf]*

*7.16.7.1 NR-NTN RRM performance requirements in above 10 GHz bands [NR\_NTN\_enh-Perf]*

*7.16.7.2 Network verified UE location [NR\_NTN\_enh-Perf]*

*7.16.7.3 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: (online)**

* In Case-2, remove the below side condition for requirement applicability.
	+ The requirements are applicable only if the ephemeris information be refreshed (i.e. update rate of ephemeris information in SIB19) at least every [7] seconds.

**<Please check 1>Issue 1-11: Additional enhancements (for Case-3)**

**Note**

* Based on the existing gradual timing adjustment UE requirement, i.e. UL timing is supposed to be gradually adjusted (subject to Tp and Tq) upon GNSS location update, the issue is closed. No further discussion.

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

**Issue 2-4: RRC Re-establishment**

**Agreement: (online)**

* For Type 2 UE, RRC re-establishment requirements do not apply when the cause for the RRC re-establishment is an inter-satellite HO failure.

# Topic #3: Network verified UE location

**<Please check 2>Issue 3-2: Measurement period and accuracy requirements on RTD**

**Agreement: (Moderator’s WF)**

* Remove following applicability rule for UE Rx-Tx measurement requirements:
	+ 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.

**<Please check 3>Issue 3-4: Measurement accuracy requirements on UL timing drift**

**Agreement: (Moderator’s WF)**

* No new applicability condition for UE Rx-Tx measurement requirements related to amount of variation in the applied TA during measurement period.

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

**Agreement: (online)**

* When UE switches to a new cell with different PCI, UE stops the PRS measurement for the source cell after HO occurs and starts new PRS measurement for the target cell after SRS reconfiguration on the target cell is complete.
	+ Further discuss how to capture “starts new measurement” in the CR.
* When UE switches to a new cell with same PCI through hard and soft satellite switch with re-sync, UE stops the PRS measurement at whichever point occurs earlier between t-Service and t-ServiceStart and starts new measurement for the UE Rx-Tx time difference after switch is complete.
	+ Further discuss how to capture “starts new measurement” in the CR.

# Topic #4: Idle/Inactive mode mobility enhancements

**Issue 4-1: TN to NTN cell reselection**

**Agreement: (online)**

* It is a common understanding that location-based measurement triggering parts are not applicable for cell reselection from TN to NTN. Whether/How to implement this in RAN4 spec is left to CR.
* If both TN and NTN carriers are broadcasted for neighbour cells measurement in IDLE/Inactive mode,
	+ For NTN capable UE, the cell reselection requirements (i.e., the TN to NTN reselection requirement agreed in RAN4 #110) are applied to both TN and NTN target cells/carriers.
	+ FFS: For NTN incapable UE, the existing TN-to-TN cell reselection requirements are applied.
		- Further check does UE know whether it is a TN carrier or NTN carrier

**Issue 4-2: NTN to TN cell reselection**

**Agreement: (online)**

* Clarify the requirements related to TN measurement skipping as follows:
	+ UE shall perform TN measurement if its estimated distance to tn-ReferenceLocation is smaller than tn-DistanceRadius. The requirements apply provided that the actual distance between UE to tn-ReferenceLocation is smaller than tn-DistanceRadius – 50m.

# Topic #5: Connected mode mobility enhancements

**<Please check 4>Issue 5-1: NTN to NTN RACH-less (C)HO**

**Agreement: (Moderator’s WF)**

* For RACH-less HO/CHO, TIU is the interruption uncertainty in acquiring the first UL transmission resource, which can be a configured grant based PUSCH or dynamic grant based PUSCH according to NW configuration and scheduling.

**Issue 5-2: NTN to NTN Satellite switching without PCI change**

**Agreement: (online)**

* In response to RAN2 LS (R4-2407009\_R2-2403771), RAN4 to confirm that it is feasible to adopt the gNB as the reference point of ssb-TimeOffset for both soft and hard satellite switch scenarios.

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

**Agreement: (online)**

* Do not define known case for soft satellite switch.
	+ It does not mean RAN4 will define the “known” or “unknown” case in the spec for soft satellite switching.

# Topic #6: Performance requirements

**<Please check 5>Issue 6-2-1: (FR2-NTN) Test set-up and applicability rule**

**Note**

* Based on UE capability and VSAT class defined in Table 9.2.1.0-1 of TS38.101-5, the below proposed applicability rue is evident. Therefore, no separate agreement is pursued.
* Proposal: Mobile UE does not need to pass the TCs with NGSO. Fixed UE needs to pass the TCs with either GSO or NGSO depending on UE capability.

**Issue 6-2-2: (FR2-NTN) Rx beam gain**

**Agreement: (ad-hoc + online)**

* The existing absolute measurement accuracy requirement and relative measurement accuracy requirement of TN FR2 (including intra-frequency and inter-frequency) can be applied for NTN UE above 10GHz with [1]dB relaxation.
	+ Note: Companies are encouraged to further evaluate the performance loss due to single polarization assumption on FR2 Ka band VSAT UE. It’s not precluded to further update the tentative relaxation value in future RAN4 meeting.
* Remove an RF margin for different RX beams in the relative accuracy.
* Define the minimum SSB\_RP condition for accuracy requirement of five UE types specified in table 9.2.1.0-1 of TS38.101-5. Minimum SSB\_RP\_NTN\_FR2 for Rx Beam Peak angle of arrival = Reference sensitivity UE type, n512, 50MHz +Y -10Log10(PRBRefsens x 12) – SNRRefsens + SSB Ês/Iot + ∆MBP,n, where,
	+ Reference sensitivity UE type, n512, 50MHz is the reference sensitivity value in dBm specified for a specific UE type in Band n512 for 50 MHz Channel bandwidth in Table 10.3.2-1 and section 10.3.3-1 of TS 38.101-5.
	+ PRBRefsens is NRB associated with subcarrier spacing 120 kHz for 50MHz in TS 38.101-5 Table 5.3.2-2, and is 32;
	+ SNRRefsens is the SNR used for simulation of Refsens and EIS spherical coverage, and is -1 dB;
	+ SSB Ês/Iot is the minimum value required by the UE to perform measurements, and is -6 dB for intra-frequency measurements and -4 dB for inter-frequency measurements. The only contribution to Iot is the UE internal noise;
	+ ∆MBP,n is 0.
* For the minimum SSB\_RP condition,
	+ The gain difference between fine and rough beams is YdB:
		- For mechanical steering antenna, Y=0
		- For electronic steering antenna, FFS Y
* Do not define separate spherical coverage unless spherical coverage is introduced in RF session.
* FFS: Gmin and Gmax
* Note: If anything above inconsistent with RF requirement is identified, RAN4 to make updates to those aspects accordingly.

**Issue 6-2-3: (FR2-NTN) UL timing accuracy**

**Agreement: (ad-hoc)**

* The value for $T\_{GNSS\\_margin}$ for mobile and fixed UEs shall be introduced for uplink timing error requirements for FR2 NTN (Ka band introduced in Rel-18 )
	+ Further discuss the exact values:
		- Option 1: X = [$(T\_{e\\_NTN}-T\_{e})/2$]
		- Other options not precluded
* In the test case of UE transmission timing accuracy for Case-3 (120kHz SCS) (Mobile UE for GSO):
	+ UE mobility is not considered before the testability issue is resolved. And without consideration of UE mobility during test, UE test requirement for Case-3 will be further discussed considering necessary margin.
	+ It’s not precluded to further update test case including test requirements for case -3 if testability issue on UE mobility resolved in future release.

**Agreement: (ad-hoc)**

* Only define test case with UL SCS 120kHz and DL SSB SCS 120kHz

**<Please check 6>Issue 6-2-4: (FR2-NTN) Mobility**

**Note**

* The below proposal is expected to be reflected in relevant test cases as per the agreed core requirements without further agreements.
* Proposal: For mobility test cases involving UEs with mechanically steered beams,
	+ make a note that the timing requirement for the completion of the mobility procedure depends on the setup of the test case, considering UE “minimum steering speed” of 22 degrees/s.

**Issue 6-2-7: (FR2-NTN) Measurement accuracy**

* Note: Covered in Issue 6-2-2: (FR2-NTN) Rx beam gain

**<Please check 7>Issue 6-2-8: (FR2-NTN) Test case details**

**Note**

* The RMC configurations:
	+ Option 1: Use the TN table as baseline, and only specify the different ones (delta approach).
	+ Option 2: Copy the TN table, and update value which is different with TN configuration.

**Issue 6-2-9: (FR2-NTN) AoA setup**

**Agreement: (online)**

* Use the following AoA setup for test cases:
	+ Transmission timing accuracy: single AoA in Rx beam direction, if defined and applicable.
	+ Inter-satellite mobility: 2-AoA setup
		- Offset of relative angles of 2 AoAs from UE perspective is 30 degrees in Rel-18 test.
		- The AoA is set up with the corresponding UE RF requirements fulfiled.
		- The AoA and the epherimis information of two satellites are aligned.
	+ The rest test cases: single AoA in Rx beam direction, if defined and applicable

**Issue 6-3-2: (FR1-NTN) Idle mode mobility, NTN-TN inter-frequency cell reselection**

**Agreement: (ad-hoc)**

* In NTN-TN cell reselection test case,
	+ Set the distance between the UE and tn-ReferenceLocation as tn-DistanceRadius - 50m.
	+ Only one TN neighbour cell is configured.
	+ Note: Detailed test configurations and procedures are confirmed by the review and endorsement of relevant test case CR.
	+ Note: TN measurement skipping is not verified.

**Issue 6-3-3: (FR1-NTN) Connected mode mobility, Satellite switch**

**Agreement: (ad-hoc)**

* In the TCs for satellite switch,
	+ GSO test configuration is not applicable.
	+ (t-Service - t-serviceStart) > (Tsearch + T∆ + Tmargin)
* Note: Reflect above agreements into draft CRs

**<Please check 8>Issue 6-3-4: (FR1-NTN) Connected mode mobility, NTN to NTN time-based trigger CHO enhancements**

**Agreement: (Moderator’s WF)**

* In the TCs for NTN to NTN time-based trigger CHO enhancements,
	+ Define Rel-18 time-based CHO for GSO.

<Offline feedback: in Rel-17 time-based CHO test case is defined for GSO. With this, it seems okay to define Rel-18 time-based CHO test case for GSO>

* + The test configuration in the Rel-17 NTN test case of “A.14.2.1.4” can be reused.

**Issue 6-3-5: (FR1-NTN) Connected mode mobility, NTN to NTN RACH-less HO**

**Agreement: (ad-hoc)**

* NTN to NTN RACH-less HO test case is defined, and the detailed test configurations and procedures are confirmed by the review and endorsement of relevant test case CR.

**Issue 6-3-6: (FR1-NTN) Measurement procedure and accuracy, Network verified UE location**

**Agreement: (ad-hoc)**

* Do not define test case for network verified UE location.

# References

[1] R4-2408016, “Topic summary for [111][219] NR\_NTN\_enh,” 3GPP TSG-RAN WG4 Meeting #111

[2] R4-2410137, “Ad-hoc agenda for [111][219] NR\_NTN\_enh,” 3GPP TSG-RAN WG4 Meeting #111