**3GPP TSG-RAN WG4 Meeting #112 R4-2414275**

**Maastricht, Netherlands, August 19 – August 23, 2024**

**Title:** WF on UE RF requirements for NTN HPUE

**Agenda Item:** 8.8.5

**Source: Samsung**

**Document for:** Approval

# 1. NTN HPUE Co-existence study

## 1.1 General starting point

**General starting point for co-ex assumptions and scenarios**

**Agreement:**

* Agree to use TR 38.863 and WF R4-2217473 for NR-NTN and IoT-NTN HPUE coex study assumptions and scenarios as starting point.
  + The detailed modifications to these references will be discussed and agreed in case-by-case manner.

## 1.2 Scenarios for coexistence study

**Issue 2-2-1: NTN scenarios for co-ex study**

**Agreement:**

* For the scenario, consider the scenarios in TR 38.863 as a baseline
  + Prioritize GEO and LEO1200 for co-existence evaluation
    - LEO600 is not precluded for the requirements and the conclusion for LEO1200 can be applied to LEO600

**Issue 2-2-2: TN scenarios for co-ex study**

* **Agreement**: Prioritize Urban Macro for Scenario 4 and Rural Macro for Scenario 5

**Issue 2-2-3: Co-ex scenario # to be studied**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Combination | Aggressor | Victim | Notes | Study Phase |
| 1 | TN with NTN | TN DL | NTN DL | Applicable for satellite operating in e.g. S-band, for e.g. coexistence with n1 FDD. | Phase 1 |
| 2 | TN with NTN | TN UL | NTN UL | Applicable for satellite operating in e.g. S-band, for e.g. coexistence with n1 FDD. | Phase 1 |
| 3 | TN with NTN | NTN DL | TN DL | Applicable for satellite operating in e.g. S-band, for e.g. coexistence with n1 FDD. | Phase 1 |
| 4 | TN with NTN | NTN UL | TN UL | Applicable for satellite operating in e.g. S-band, for e.g. coexistence with n1 FDD. | Phase 1 |
| 5 | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S-band, for e.g. coexistence with n34 TDD. | Phase 1 |
| 6 | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S-band, for e.g. coexistence with n34 TDD. | Phase 1 |

**Agreement:**

* Consider both Scenario 4 and 5 for co-existence study
  + Prioritize scenario 4 since it is the worst case
* Do not consider Scenario 1, 2, 3 and 6

## 1.3 Deployment and layout

**Issue 2-3-1 NTN and TN network isolation distance**

**Agreement:**

* Consider isolation distance in scenario 4 and 5 for both NR-NTN HPUE coex and IoT-NTN HPUE coex.
  + Use the isolation distance 1.5km as the starting point
  + Other values for isolation distance are not precluded

**Issue 2-3-2 TN network topology**

* **Agreement**: Reuse existing method from TR 38.863 as baseline, and encourage companies to further evaluate any performance impact with and w/o wrap-around functionality.

**Issue 2-3-3 NTN UE dropping methods**

* **Agreement**: Random dropping on circle, and to use uniform distribution for random.

**Issue 2-3-4 Observed TN cells for Scenario 4 evaluation in Table 6.2.1.1-1 in TR 38.863**

| No. | Combination | Aggressor | Victim | Which NTN cell/UE to observe? | Which TN/UE to observe? | Which TN cells in a TN to observe? |
| --- | --- | --- | --- | --- | --- | --- |
| 4 | TN with NTN satellite | NTN UL | TN UL | NTN cell:  Nadir point.  NTN UE:  NTN UEs dropped at the edge of TN clusters | TN randomly placed in this NTN beam | **Option 1: All active TN clusters which has the NTN UE(s) at its edge.**  **Option 2: Only the TN sectors which have NTN UE(s) at their edges.**  **Option 1 is the baseline and it is not precluded companies can follow Option 2 to bring results** |
| 5 | TN with NTN satellite | NTN UL | TN DL | NTN cell:  Nadir point  NTN UE:  NTN UEs dropped at the edge of TN clusters | TN clusters randomly placed in this NTN beam | All active TN clusters which has the NTN UE(s) at its edge |
| NTN cell:  NTN cell with satellite at low elevation (45° for GEO and LEO，Interested companies can bring analysis and results for other values).  NTN UE:  NTN UEs dropped at the edge of TN clusters | TN clusters randomly placed in this NTN beam | All active TN clusters which has the NTN UE(s) at its edge. |

Moderator note: The table from TR 38.863 v18.2.0 is provided here to help discussion.

* **Agreement**: Option 1 as baseline assumption, other options not precluded.

**Issue 2-3-5 NTN HPUE ratio**

* **Agreement**
  + Assuming all NR-NTN/IoT-NTN UEs are HPUE, i.e. 100% HPUE ratio as baseline.
  + FFS other ratio values

**Issue 2-3-6: NR and NR-NTN channel bandwidth**

* **Agreement**
  + Consider 20MHz system bandwidth for NR-NTN and NR in co-existence study.

## 1.4 Detailed parameters modifications

**Issue 2-4-1: NR-NTN SAN parameter set**

* **Agreement:** To use Set-1 as NTN SAN parameters.

**Issue 2-4-2: IoT-NTN UL UE number and SCS**

* **Agreement**
  + Consider 9 UEs for 15kHz, 18 and 36UEs for 3.75kHz single tone as starting point
  + FFS whether to down scope.

**Issue 2-4-3: NR-NTN UE parameter for PC2**

* **Agreement**
  + Baseline: Use NF as 9dB, and Tx power 26/29/31 dBm for PC2/1.5/1 NTN HPUE
  + FFS option of 7dB NF for PC2 and LEO600.

**Issue 2-4-4: NTN HPUE uplink power control**

* **Agreement**
  + To update the existing uplink power control parameters considering different power classes and bandwidth (Samsung, Qualcomm, Huawei)
    - Update Pmax to 26/29/31 for PC2/1.5/1;
    - Update Rmin to -66/-69/-71 assuming Pmin as -40;
    - Update BW to corresponding transmission BW.
  + Agree on the following detailed parameters
* 

where:

- Pmax = 26dBm for PC2, 29 dBm for PC1.5, 31 dBm for PC1.

- Rmin = -66 dB for PC2, -69 dB for PC1.5, -71 dB, assuming -40dBm minimum output power,

- CLx-ile and γ are set as following:

- CLx-ile = 10\*log10(Pmax) – (SNRtarget + 10\*log10(kTB) + NF ),

* + Where:
  + SNRtarget and BW

For NR-NTN HPUE:

* + - Option 1: 3 dB SNR target and 5MHz UL BW (One company proposed for LEO only)
    - Option 2: 15 dB SNR target and 2RB UL BW as baseline assumption
  + NF is the SAN noise figure, i.e. 4.3dB.
  + 10log10(kT) = -174dBm/Hz.
  + γ = 1 For uplink scenario.

## 1.5 Other considerations

**Issue 2-5-1: Power classes for co-ex study**

* **Agreement**
  + All power classes listed in WID will be considered for co-existence study.

**Issue 2-5-2: Handheld and non-handheld type**

**Agreement:**

* To use TR 38.863 UE characteristics as starting point for NTN HPUE co-ex studies.

## 1.6 Others

**Issue 2-6-1: Preliminary results and observations**

* **Agreement**
  + Please take submitted results and analysis for information
  + Encourage companies to follow work plan and submit co-ex results starting from next meeting.

**Issue 2-6-2: Running document to capture assumptions**

* **Agreement**
  + To revise the R4-2412557 in this meeting to capture agreements for information.

# 2. NTN HPUE UE RF – Tx requirements

## 2.1 General considerations

**Issue 3-1-1: General considerations**

* **Agreement**
  + The study of NTN HPUE Tx requirements generally would have to consider co-existence results, UE implementation feasibility, and existing HPUE requirements.

**Issue 3-1-2: Consideration of band(s)**

**Agreement:**

* Use 2GHz for the co-existence study
* WI can be completed when the band specific requirements for one pair of {n256,256}and {n255, 255} are completed in this WI
* Specify the band specific requirements for other potential NTN bands in the separate spectrum WI

**Issue 3-1-3: Consideration of power classes**

* **Agreement**
  + All power classes in WID, including Power class 1/1.5/2 for NR-NTN and Power class 1/2 for IoT-NTN, will be further discussed

**Issue 3-1-4: Consideration of regulation(s)**

* **Agreement**
  + Applicable regulations should be taken into account for requirements discussions.
  + If any identified corrections to be made for PC3, those should be considered in another work item, it is not in the current scope of this WI.

**Issue 3-1-5: Consideration of HPUE Architecture**

* **Agreement:**
  + For PC2 (NR NTN), 1 Tx and 2 Tx, are to be considered for requirements.
  + For PC2 IoT NTN, at least 1Tx shall be considered
  + For other PCs (both IoT NTN and NR NTN), FFS

## 2.2 Feasibility

**Issue 3-2-1: NR-NTN HPUE feasibility for different power classes**

**Issue 3-2-2: NB-IoT based IoT-NTN HPUE feasibility for different power classes**

**Issue 3-2-3: eMTC based IoT-NTN HPUE feasibility for different power classes**

* **Agreement:**
  + For PC2, it is feasible to support both handheld and non-handheld devices.
  + FFS other power classes for applicable device type.

## 2.3 Detailed requirements

**Issue 3-3-1: Maximum output power**

* **Agreement**
  + Re-use NR TN TS 38.101-1 nominal MOP and +2/-3 tolerance can be considered as starting point for PC2/1.5/1 for NTN HPUE including NR-NTN and IoT-NTN.

**Issue 3-3-2: MPR**

* **Agreement:**
  + FFS the MPR requirements. Following potential factors to be further discussed:
    - ACLR from co-existence study
    - Current TN MPR requirements
    - MPR simulation assumptions
    - Other factors not precluded if identified.

**Issue 3-3-3: A-MPR**

* **Agreement**
  + FFS A-MPR requirements. Following potential factors to be further discussed:
    - Simulation reduction by not considering large RB allocations, CP-OFDM, higher-order modulations
    - A-MPR simulation assumption including ACLR from co-existence study
    - Applicable bands
    - Regional requirements for A-MPR
    - Other factors

**Issue 3-3-4: SAR for handheld**

**Agreement:**

* Using P-MPR as the starting point
* The other solutions are not precluded
  + E.g., the solution similar to TN duty cycle based on UE capability and network scheduling

**Issue 3-3-5: SEM**

* **Agreement:**
  + For NR-NTN: further discuss whether to reuse existing SEM requirements from PC3 to other PCs
  + For IoT-NTN: further discuss whether to reuse existing SEM requirements from PC3 to other PCs

**Issue 3-3-6: ACLR**

* **Agreement:**
  + The ACLR requirements will depend on co-existence study outcomes.

# 3. NTN HPUE UE RF – Rx requirements

**Issue 4-1: General considerations**

* **Agreement**
  + Rx RF requirements including Max input level, ACS, blocking characteristics, spurious response, intermodulation characteristics, Rx spurious emissions in existing spec can be applied to other power class.

**Issue 4-2: RSD for NR-NTN**

* **Agreement**
  + Reference sensitivity degradation (RSD) requirements is needed for NTN HPUE.
    - Further discuss the following aspects:
      * Use similar way in TN spec by introducing a new table of RSD compared to the PC3
      * Whether default Tx-Rx frequency separation is used for test point

**Issue 4-3: RSD for IoT-NTN**

* **Agreement:**
  + For NB-Iot based Iot-NTN, no RSD needed for HPUE
  + For eMTC based Iot-NTN with half duplex, no RSD needed for HPUE
  + For eMTC based Iot-NTN with full duplex, further discuss RSD impact