**3GPP TSG-RAN WG4 Meeting # 112 R4-2412829**

**Maastricht, Netherlands, 19th ‒ 23rd August, 2024**

**Agenda item:** 8.8.5

**Source:** Moderator (Samsung)

**Title:** Topic summary for [112][127] NR\_IoT\_NTN\_HPUE

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

In the RAN#103 meeting, a new WID on enhanced requirements and test methodology for NR and IoT NTN was approved in RP-240857 and it was revised in RAN #104 meeting to RP-241281. The WID include the working areas of High power UE (HPUE) for NTN, NTN testing for Non-Geostationary Orbit (NGSO) and less than 5MHz for NR-NTN.

This document is provided for the moderator summary on the general aspects and work plan, coexistence study for example bands, Tx requirements for NTN HPUE and Rx requirements for NTN HPUE parts of this WI. The covered agenda items are highlighted below:

|  |
| --- |
| * 1. Enhanced requirements and conductive test methodology for NR NTN and IoT NTN [NR\_IoT\_NTN\_req\_test\_enh]      1. General aspects and work plan [NR\_IoT\_NTN\_req\_test\_enh]      2. UE RF requirements for NTN HPUE [NR\_IoT\_NTN\_req\_test\_enh-Core]         1. Coexistence study for example bands [NR\_IoT\_NTN\_req\_test\_enh-Core]         2. Tx requirements [NR\_IoT\_NTN\_req\_test\_enh-Core]         3. Rx requirements [NR\_IoT\_NTN\_req\_test\_enh-Core]      3. Less than 5MHz for NTN [NR\_IoT\_NTN\_req\_test\_enh-Core]         1. System parameters [NR\_IoT\_NTN\_req\_test\_enh-Core]         2. UE RF requirements [NR\_IoT\_NTN\_req\_test\_enh-Core]         3. SAN RF core requirements [NR\_IoT\_NTN\_req\_test\_enh-Core]         4. RRM core requirements [NR\_IoT\_NTN\_req\_test\_enh-Core]      4. NTN testing for NGSO [NR\_IoT\_NTN\_req\_test\_enh-Core/Perf]      5. Moderator summary and conclusions [NR\_IoT\_NTN\_req\_test\_enh] |

Please be noted that the corresponding proposals submitted in Tdoc R4-2411467 will be treated in topic thread [216] and [329].

And the following issues are recommended to be treated in the online session with priority order:

Workplan:

Issue 1-1: Work Plan for NR\_IoT\_NTN\_req\_test\_enh

Co-existence:

Issue 2-1: General starting point for co-ex assumptions and scenarios

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

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

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

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

UE RF:

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

Issue 3-1-3: Consideration of power classes

Issue 3-1-5: Consideration of HPUE Architecture

Issue 3-3-4: SAR for handheld

Co-existence (if still have time):

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

Issue 2-3-2 TN network topology

Issue 2-3-3 NTN UE dropping methods

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

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

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

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

# Topic #1: General aspects and work plan

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2412554 | Samsung, Xiaomi | Work plan for enhanced requirements and test methodology for NR and IoT NTN. |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

**Issue 1-1: Work Plan for NR\_IoT\_NTN\_req\_test\_enh**

* Below plan is proposed for objectives approved in WID

Table 1: WI plan for Enhanced requirements and conductive test methodology for NR NTN and IoT NTN

|  |  |
| --- | --- |
| **Schedule and TU** | **Work plan** |
| August, 2024  RAN4#112  (Core: 1 + 0.25 TU)  (Perf: 0.25 TU) | **High power UE (HPUE) for NTN (Core):**   * Start discussion on coexistence analysis based on TR 38.863 for the above example bands and corresponding power classes   + Discuss and identify baseline coexistence scenarios and cases   + Discuss and agree on the baseline topologies, assumptions and methodologies for co-ex studies * Start discussion on HPUE RF requirements for NR-NTN and IoT-NTN in corresponding FR1-NTN and LTE NTN bands for single UL carrier scenario   + Discuss RF requirements scope   **Less than 5MHz for NTN:**   * Initial discuss and agree the specification impact on system parameter requirements, UE RF core requirements, SAN RF core requirements and RRM core requirements for less than 5MHz for NTN.   **NTN testing for NGSO (Perf):**   * Start discussion on TE-emulated channel model with varying Doppler and delay shifts for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands   + Start discussing the NTN channel models to match the satellite motion trajectory based on the ephemeris for NGSO (Non-Geostationary Orbit) scenarios |
| October, 2024  RAN4#112bis  (Core: 1 + 0.25 TU)  (Perf: 0.25 TU) | **High power UE (HPUE) for NTN (Core):**   * Continue discussion on coexistence analysis based on TR 38.863 for the above example bands and corresponding power classes   + Start collecting co-ex results and observations for the baseline scenarios and assumptions;   + Continue discussion on the remaining open assumptions; * Continue discussion on HPUE RF requirements for NR-NTN and IoT-NTN in corresponding FR1-NTN and LTE NTN bands for single UL carrier scenario   + Start discuss the NR-NTN HPUE RF requirements with initial co-ex results, if any.   + Start discuss the IoT-NTN HPUE RF requirements with initial co-ex results, if any.   **Less than 5MHz for NTN:**   * Discuss and potentially agree the necessary changes to RAN4 requirements including system parameters, UE RF， SAN RF and RRM core requirements for less than 5MHz for NTN. * Figure out which NS values need define A-MPR for less than 5MHz for NTN.   **NTN testing for NGSO (Perf):**   * Continue discussion on TE-emulated channel model with varying Doppler and delay shifts for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands   + Continue discussing the NTN channel models to match the satellite motion trajectory based on the ephemeris for NGSO (Non-Geostationary Orbit) scenarios   + Inform RAN5 to assist specifying RF frequency error tests, if needed. |
| November, 2024  RAN4#113  (Core: 1 + 0.25 TU)  (Perf: 0.25 TU) | **High power UE (HPUE) for NTN (Core):**   * Continue discussion on coexistence analysis based on TR 38.863 for the above example bands and corresponding power classes   + Conclude on coex scenarios and assumptions discussions;   + Continue collecting co-ex results and observations for all agreed scenarios and assumptions;   + Start discussion on co-existence conclusions and suggested RF requirements. * Continue discussion on HPUE RF requirements for NR-NTN and IoT-NTN in corresponding FR1-NTN and LTE NTN bands for single UL carrier scenario   + Continue discussion on the NR-NTN HPUE RF requirements with co-ex results, if any.   + Continue discussion on the IoT-NTN HPUE RF requirements with co-ex results, if any.   **Less than 5MHz for NTN:**   * Discuss and potentially agree the necessary changes to RAN4 requirements including system parameters, UE RF， SAN RF and RRM core requirements for less than 5MHz for NTN. * Figure out which NS values need define A-MPR for less than 5MHz for NTN. * Provide necessary simulation / measurements results for defining UE RF requirements such as MPR, A-MPR for less than 5MHz for NTN.   **NTN testing for NGSO (Perf):**   * Continue discussion on TE-emulated channel model with varying Doppler and delay shifts for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands   + Continue discussing the NTN channel models to match the satellite motion trajectory based on the ephemeris for NGSO (Non-Geostationary Orbit) scenarios   + Start discussing impacts on uplink timing UE RRM performance test for NGSO based on concluded channel models. |
| February, 2025  RAN4#114  (Core: 1 + 0.25 TU)  (Perf: 0.25 TU) | **High power UE (HPUE) for NTN (Core):**   * Concluding discussion on coexistence analysis based on TR 38.863 for the above example bands and corresponding power classes   + Finalize collecting co-ex results and observations for all agreed scenarios and assumptions;   + Concluding on co-existence conclusions and suggested RF requirements. * Continue discussion on HPUE RF requirements for NR-NTN and IoT-NTN in corresponding FR1-NTN and LTE NTN bands for single UL carrier scenario   + Continue discussion on the NR-NTN HPUE RF requirements with co-ex results and conclusions.   + Continue discussion on the IoT-NTN HPUE RF requirements with co-ex results and conclusions. * Discuss and, if necessary, specify necessary signalling to support NR-/IoT-NTN HPUE.   **Less than 5MHz for NTN:**   * Discuss and potentially agree the necessary changes to RAN4 requirements including system parameters, UE RF， SAN RF and RRM core requirements for less than 5MHz for NTN. * Provide necessary simulation / measurements results for defining UE RF requirements such as MPR, A-MPR for less than 5MHz for NTN.   **NTN testing for NGSO (Perf):**   * Concluding on TE-emulated channel model with varying Doppler and delay shifts for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands, if required.   + Concluding discussing the NTN channel models to match the satellite motion trajectory based on the ephemeris for NGSO (Non-Geostationary Orbit) scenarios   + Continue discussing impacts on uplink timing UE RRM performance test for NGSO based on concluded channel models. |
| April, 2025  RAN4#114bis  (Core: 0.75 + 0.25 TU)  (Perf: 0.75 + 0.25 TU) | **High power UE (HPUE) for NTN (Core):**   * Continue discussion on co-ex aspects.   + Discuss the CR skeleton and work split for NR-NTN coex study to TR, if required.   + Discuss the CR skeleton and work split for IoT-NTN coex study to TR, if required. * Continue discussion on HPUE RF requirements for NR-NTN and IoT-NTN in corresponding FR1-NTN and LTE NTN bands for single UL carrier scenario   + Concluding on the NR-NTN HPUE RF requirements.   + Discuss the CR drafting scope and work split for NR-NTN HPUE.   + Concluding on the IoT-NTN HPUE RF requirements.   + Discuss the CR drafting scope and work split for IoT-NTN HPUE.   **Less than 5MHz for NTN(Core):**   * Discuss and potentially agree the necessary changes to RAN4 requirements including system parameters, UE RF， SAN RF and RRM core requirements for less than 5MHz for NTN. * Provide necessary simulation / measurements results for defining UE RF requirements such as MPR, A-MPR for less than 5MHz for NTN. * Discuss and agree on the CR for system parameters, UE RF, SAN RF and RRM core requirements for less than 5MHz for NTN.   **Less than 5MHz for NTN(Perf):**   * Initial discuss and specify the specification impact on UE and SAN performance requirements. * Initial discuss and agree on simulation assumptions for UE and SAN performance requirements.   **NTN testing for NGSO (Perf):**   * Continue concluding on TE-emulated channel model with varying Doppler and delay shifts for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands, if required. * Discuss to specify UE RRM performance test of uplink timing for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded model * Discuss to specify UE demodulation performance requirement(s) of PDSCH for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded channel model * Discuss to specify applicability of the tests under the TE-emulated channel model |
| May, 2025  RAN4#115  (Core: 0.75 + 0.25 TU)  (Perf: 0.75 + 0.25 TU) | **High power UE (HPUE) for NTN (Core):**   * Continue discussion on co-ex aspects.   + Collecting and endorsing draft CRs for NR-NTN coex study to TR, if required.   + Collecting and endorsing draft CRs for IoT-NTN coex study to TR, if required. * Continue discussion on HPUE RF requirements for NR-NTN and IoT-NTN in corresponding FR1-NTN and LTE NTN bands for single UL carrier scenario   + Concluding on the remaining NR-NTN HPUE RF requirements, if any.   + Collecting and endorsing draft CRs for NR-NTN HPUE.   + Concluding on the remaining IoT-NTN HPUE RF requirements, if any.   + Collecting and endorsing draft CRs for IoT-NTN HPUE. * Discuss and, if necessary, specify necessary signalling to support NR-/IoT-NTN HPUE.   **Less than 5MHz for NTN(Core):**   * Discuss and potentially agree the necessary changes to RAN4 requirements including system parameters, UE RF， SAN RF and RRM core requirements for less than 5MHz for NTN. * Provide necessary simulation / measurements results for defining UE RF requirements such as MPR, A-MPR for less than 5MHz for NTN. * Discuss and agree on the CR for system parameters, UE RF, SAN RF and RRM core requirements for less than 5MHz for NTN.   **Less than 5MHz for NTN(Perf):**   * Further discuss UE and SAN performance requirements. * Discuss and agree on simulation assumptions for UE and SAN demodulation performance requirements. * Provide the initial simulation results for UE and SAN performance requirements.   **NTN testing for NGSO (Perf):**   * Continue to specify UE RRM performance test of uplink timing for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded model * Continue to specify UE demodulation performance requirement(s) of PDSCH for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded channel model * Continue to specify applicability of the tests under the TE-emulated channel model |
| August, 2025  RAN4#116  (Core: 0.75 + 0.25 TU)  (Perf: 0.75 + 0.25 TU) | **High power UE (HPUE) for NTN (Core):**   * Finalize discussion on co-ex aspects.   + Endorsing all draft CRs, and agree on bigCR for NR-NTN coex study to TR, if required.   + Endorsing all draft CRs, and agree on bigCR for IoT-NTN coex study to TR, if required. * Finalize discussion on HPUE RF requirements for NR-NTN and IoT-NTN in corresponding FR1-NTN and LTE NTN bands for single UL carrier scenario   + Endorsing all draft CRs, and agree on bigCR for NR-NTN HPUE.   + Endorsing all draft CRs, and agree on bigCR for IoT-NTN HPUE. * Finalize discuss and, if necessary, specify necessary signalling to support NR-/IoT-NTN HPUE.   **Less than 5MHz for NTN(Core):**   * Agree on the CR for system parameters, UE RF， SAN RF and RRM core requirements for less than 5MHz for NTN. * Finalize the system parameters, UE RF, SAN RF and RRM core requirements for less than 5MHz for NTN.   **Less than 5MHz for NTN(Perf):**   * Further discuss UE and SAN performance requirements. * Align the simulation results based on the agreed simulation assumptions   **NTN testing for NGSO (Perf):**   * Continue to specify UE RRM performance test of uplink timing for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded model   + Discuss the CR scope and work split for RRM performance tests. * Continue to specify UE demodulation performance requirement(s) of PDSCH for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded channel model   + Discuss the CR scope and work split for demodulation performance tests. * Continue to specify applicability of the tests under the TE-emulated channel model |
| October, 2025  RAN4#116bis | **Less than 5MHz for NTN(Perf):**   * Further discuss UE and SAN performance requirements. * Align the simulation results based on the agreed simulation assumptions. * Discuss and agree on the CR for UE and SAN performance requirements.   **NTN testing for NGSO (Perf):**   * Continue to specify UE RRM performance test of uplink timing for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded model   + Discuss the CR scope and work split for RRM performance tests. * Continue to specify UE demodulation performance requirement(s) of PDSCH for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded channel model   + Discuss the CR scope and work split for demodulation performance tests. * Continue to specify applicability of the tests under the TE-emulated channel model |
| November, 2025  RAN4#117 | **Less than 5MHz for NTN(Perf):**   * Further discuss UE and SAN performance requirements. * Align the simulation results based on the agreed simulation assumptions * Discuss and agree on the CR for UE and SAN performance requirements   **NTN testing for NGSO (Perf):**   * Continue to specify UE RRM performance test of uplink timing for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded model   + Start to endorse draft CRs and continue discussing remaining points. * Continue to specify UE demodulation performance requirement(s) of PDSCH for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded channel model   + Start to endorse draft CRs and continue discussing remaining points.. * Continue to specify applicability of the tests under the TE-emulated channel model |
| January, 2026  RAN4#118 | **Less than 5MHz for NTN(Perf):**   * Agree on the CR for UE and SAN performance requirements. * Finalize UE and SAN performance requirements.   **NTN testing for NGSO (Perf):**   * Finalize specify UE RRM performance test of uplink timing for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded model   + Endorse all draft CRs and agree on big CR for RRM performance tests. * Finalize specify UE demodulation performance requirement(s) of PDSCH for NGSO for NR-NTN and IoT-NTN in the FR1-NTN bands and the corresponding LTE bands based on the concluded channel model   + Endorse all draft CRs and agree on big CR for demodulation performance tests. * Finalize specify applicability of the tests under the TE-emulated channel model |

* Recommended WF
  + Discuss the above work plan to see whether it can be approved or not

# Topic #2: HPUE co-existence study

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411066 | CATT | Proposal 1: For NR NTN HPUE coexistence study, the simulation scenario could consider the proposed Table 2.1-1 to Table 2.1-3 as a baseline.  Table 2.1-1: Proposed scenarios for NTN HPUE co-existence   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | FR1: 2GHz | | NTN | | | | | | | Set 1 | | | Set 2 | | | | GEO | LEO 600km | LEO 1200km | GEO | LEO 600km | LEO 1200km | | NR / NB-IoT | Rural | X | X | X | X | X | X | | Urban macro | X | X | X | X | X | X | | NOTE: Two sets of satellite parameters are listed in Table 6.2.2.1-2 and Table 6.2.2.1-3 according to TR 38.821 [2] | | | | | | | |   Table 2.1-3: Proposed frequency and bandwidth for co-existence study   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | Frequency | Bandwidth | Duplex mode | Frequency reuse factor | | TN Rural | 2 GHz | 20MHz | FDD, TDD | 1 | | TN Urban macro | 2 GHz | 20MHz | FDD, TDD | 1 | | GEO | 2 GHz | 5/10/15/20 MHz for FR1 | FDD | 1, 31 | | LEO | 2 GHz | 5/10/15/20 MHz for FR1 | FDD | 1, 31 | | NOTE: Only FRF=1 has been used in co-existence studies for simplification. | | | | |   Proposal 2: For NR NTN HPUE coexistence study, the network layout model for FR1 NTN coexistent study could be considered as baseline. Meanwhile, the ratio of NTN HPUE may need to be clarified. Proposal 3: For NR NTN HPUE coexistence study, the satellite parameters for FR1 NTN coexistent study could be considered as baseline.  Proposal 4: For NR NTN HPUE coexistence study, the handheld UE characteristic for FR1 NTN coexistent study could be considered as baseline with 26 dBm Tx power. For Non-handheld HPUE, the UE characteristic may need further discussion. |
| R4-2411505 | Mediatek India Technology Pvt. | Observation 1: When the aggressor NTN UE UL increases the maximum TX power (e.g., change TX power from PC3 to PC2), scenarios 4 and 5 are relevant to NTN UE ACLR requirement as indicated in TR 38.863 Table 6.5.1-3. Currently, in WI [1], it mentions that evaluation focuses on NTN UL aggressor to TN UL victim (i.e., scenario 4) and does not need evaluation about NTN UL aggressor to TN DL victim (i.e., scenario 5).  Observation 2: ACLR requirement evaluation for scenario 5 is also important for TN-bands DL protection. Scenario-5 ACLR value also affects UE-UE coexistence A-MPR results.  Proposal 1: To clarify whether ACLR evaluation for scenario 5 would be needed as well.   Observation 3: Scenario-1 evaluation is relevant to NTN UE ACS. Evaluation of scenarios 2 and 6 is relevant to NTN SAN ACS. Observation 4: In WI [1], it mentions that ACS evaluation would be needed. It is ambiguous whether the ACS evaluation would be for NTN UE ACS or NTN SAN ACS. Observation 5: Additionally, regarding NTN HPUE, the purpose is to evaluate the NTN-HPUE aggressor impact on the victim uplink performance of TN. It is ambiguous whether ACS evaluation would be necessary.  Proposal 2: Clarify whether the ACS evaluation would be for NTN-UE ACS or NTN-SAN ACS. Or clarify whether ACS evaluation would be necessary. |
| R4-2411549 | Inmarsat, Viasat | Not available. |
| R4-2411602 | Xiaomi | Proposal 1: The co-existence study should be done for PC1, PC1.5 and PC2 of NR-NTN and PC1 and PC2 of IoT NTN, whether PC1 and PC1.5 supported by handheld UEs can further evaluate based on the ACLR values. Proposal 2: The scenarios for NTN HPUE co-existence study should keep align with R-17 NR-NTN co-existence as listed in below table:  **Table 2-2: Scenarios for NTN HPUE co-existence study**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | FR1: 2GHz | | NTN | | | | Set 1 | | | | GEO | LEO 600km | LEO 1200km | | NR / NB-IoT | Rural | X | X | X | | Urban macro | X | X | X |   Proposal 3: Only the impact of NTN UL to NR TN UL should consider for NTN HPUE co-existence study. Proposal 4: The simulation assumptions can use TR 38.863 and WF R4-2217473 as the starting point for NR-NTN and IoT-NTN separately. |
| R4-2411771 | CMCC | Proposal 1: it’s suggested to focus on scenario 4 from NTN UL to TN UL as in TR 38.863. Proposal 2: for the TN BS ACLR and ACS are listed as above.   |  |  |  |  | | --- | --- | --- | --- | | TN | | NR | NB-IoT | | BS | ACLR | 45dB | 40dB | | ACS | 46dB | 46dB |   Proposal 3: it’s suggested to use following parameter as baseline. l For co-existence between NR NTN and TN, use the parameter as in TR 38.863 for baseline l For co-existence between IoT NTN and TN, use the parameter as in R4-2217473 for baseline Observation 1: we can use 1dB as ACLR enhancement step for NTN and IoT NTN HPUE. |
| R4-2412071 | vivo | Observation 1: For NTN HPUE, only the case 4 and case 5 need to be re-evaluated.   Observation 2: In the previous PC3 NTN co-existence study, NTN GEO UL interferer Uma TN UL is the worst case for NTN UL interferer TN.   Proposal 1: Only the NTN GEO UL interferer Uma TN UL need to be evaluated for NTN HPUE.  Proposal 2: For NR NTN HPUE, the simulation assumptions in TR38.863 can be used and for IoT NTN HPUE, the assumptions in WF R4-2217473 can be used.  Proposal 3: All PC1/PC1.5/PC2 are suggested to be evaluated   Proposal 4: It is suggested to discuss the ratio of NTN HPUE in all NTN UE in the simulation assumption. |
| R4-2412125 | Ericsson | Observation 1 PC1.5 and PC1 are mentioned for both NR and IoT NTN, whereas PC1 only for IoT-NTN  Proposal 1 Since PC1.5 is specified for TN TDD bands only, unless there is a specific need to introduce PC1.5 for FR1-NTN bands n256, n255 and n254 (which are all FDD bands), we propose to remove PC1.5 from the scope of this WI. Proposal 2 RAN4 to prioritize support of PC2 for NTN UE and support PC1 based on the feasibility studies. Proposal 3 Similar to FR1 TN, PC1 should be targeted for non-handheld UEs only for both FR1-NTN and IoT-NTN. Proposal 4 RAN4 should discuss whether Dense Urban scenarios are needed for simulations, considering higher transmit power and higher antenna gain for UEs, to address coverage challenges. Proposal 5 RAN4 to collect information on Non-handheld UE characteristics needed for co-existence evaluation. Proposal 6 RAN4 to consider the above parameters at LEO-600 for discussion on Non-handheld UE characteristics as starting point, and further investigate for GEO and LEO-1200 scenarios. |
| R4-2412463 | Mediatek India Technology Pvt. | Proposal 1: According to coexistence study in TR 38.863 for NTN UL interfering TN UL, we assume that the most stringent case is GEO UL interfering the NR UL equipped with both AAS and non-AAS antenna for both NR-NTN and IoT NTN. Observation 1: Based on the simulation results in Table 2: • No tighten ACIR requirement since NTN UL interference to TN UL with a required ACIR < 26 dB. Proposal 2: Based on the simulation results in Table 2, there is no interference impact or tighten ACIR requirement from NTN UL to TN UL for NR NTN HPUE. |
| R4-2412555 | Samsung | Proposal 1: According to the WID, it is proposed to adopt the assumptions, topologies, parameters and models from TR 38.863 as baseline for HPUE NR -NTN co-existence studies. The changes to this baseline can be made for the purpose of studying new power classes. Proposal 2: It is proposed to adopt the assumptions, topologies, parameters and models from WF-2217473, whcih is also based on TR 38.863, as baseline for HPUE IoT-NTN co-existence studies. The changes to this baseline can be made for the purpose of studying new power classes.  Observation 1: Introducing HPUE would not impact the co-ex study results for scenario 1 and 3. Hence these scenarios are out of scope of this WI.  Observation 2: The WID is not intended to change any SAN requirements, by introducing HPUE. Hence, the scenario 2, 3 and 6 are out of scope of this WI. Observation 3: In Rel-17 NR-NTN and Rel-18 IoT-NTN studies, when considering NTN UE Tx as aggressor, the Scenario 4 (NTN UL interfering TN UL) with TN gNB assuming AAS antenna and NTN SAN assuming GEO is the most critical scenario. Proposal 3: It is proposed that scenario 1, 2, 3 and 6 to be down scoped for this HPUE coex studies for both NR-NTN and IoT-NTN.  Proposal 4: It is proposed to focus co-ex studies for Scenario 4, with NTN UL communicating with GEO as aggressor, and interfering TN UL with AAS gNB for both HPUE NR-NTN and IoT-NTN co-existence studies. And scenario 5 can be deprioritized unless companies later identified even worse findings for co-ex.  Proposal 5: It is propose to begin co-ex studies with TR 38.863 baseline option 1, which is to observe all active TN clusters which has the NTN UE(s) at its edge, and rest unchanged for deployment assumptions.   Observation 4: For both Rel-17 NR-NTN and Rel-18 IoT-NTN co-ex studies, Set-1 satellite parameters were focused. Proposal 6: It is proposed to focus on Set-1 satellite parameters for both NR-NTN and IoT-NTN HPUE coex studies. And set-2 parameters can be deprioritized unless companies later identified even worse findings for co-ex.  Proposal 7: For IoT-NTN HPUE co-ex, following WF R4-2217473, to use 180kHz as bandwidth assumption. Proposal 8: For IoT-NTN HPUE co-ex, following WF R4-2217473, to start with following 3 options for UL UE number and SCS combinations.  - Option 1: 9 UL UE with 18kHz SCS single tone - Option 2: 18 UL UE with 3.75kHz SCS single tone; - Option 3: 36 UL UE with 3.75kHz SCS single tone; Observation 5: From the preliminary results in R4-2412556, the 36 UL UE with 3.75kHz SCS single tone will create worst interference from IoT-NTN to NR TN.   Proposal 9: It is proposed to update UE max Tx power assumptions in [3] and [4] for NR-NTN and IoT-NTN with 23/26/29/31 dBm for PC 3/2/1.5/1 respectively. And keep the UE min Tx power as -40 dBm for all power classes. Proposal 10: It is propose to update the uplink power control parameters accordingly, i.e. to update the Rmin in [3] and [4] to “Rmin = -63/-66/-69/-71 dB for PC3/2/1.5/1 respectively”.  Proposal 11: It is propose to take this R4-2412557 as an informational running document to update and capture latest agreed simulation assumptions in each meeting. |
| R4-2412556 | Samsung | Preliminary coex study results for information. |
| R4-2412557 | Samsung | Running document to update and capture latest agreed simulation assumptions for information. |
| R4-2412718 | ZTE Corporation, Sanechips | Proposal 1: regarding the coexistence study for Rel-19 NTN HPUE, to focus on case 4 and case 5. Proposal 2: regarding the simulation assumption for NTN NR HPUE, the simulation assumptions for FR1 NTN PC3 in TR 38.863 could be reused.  Proposal 3: regarding the simulation assumption for NTN Iot HPUE, the simulation assumptions as agreed in R4-2217473 could be reused. |
| R4-2412838 | China Telecom | Observation 1: Only the scenario of NTN UE UL transmission as aggressor systeme and TN BS UL reception on adjacent channel as victim systeme should be considered in this study.  Observation 2: Since the example band is S-band(n256/256) and L-band (n255/255) introduced in Release-17,the carrier frequency of 2GHz, which is the same to Release-17 NTN co-existence study, should be reused to comply with legacy study.  Observation 3: PC1 and PC2 for IoT NTN should be considered according to WI scope.  Observation 4: PC1, PC1.5 and PC2 for NR NTN should be considered. If any concern on work load, then at least PC1 and PC1.5 should be analysised as worst case.  Observation 5: ACLR defined for TN UE supporting corresponding power class should be applied for NTN UE as baseline in co-existence simulation.  Observation 6: ACS specified for TN-BS should be applied in co-existence simulation.  Observation 7: Legacy NTN UE antenna pattern can be baseline for co-existence simulation. However, NTN HPUE is studied with aim to optimize performance and improve NTN UL coverage from RAN4 perspective. Hence better antenna performance, if possible, is desired together with high power class to improve UL linkbudget in case of NTN. And it should be allowed and encouraged for companies to bring additional improved antenna pattern during evaluation to verify the impact on interference to victim system. |
| R4-2412922 | Qualcomm Incorporated | Proposal 1: The coexistence simulation scenarios for NR NTN and IoT NTN HPUE should focus on Scenario 4 and Scenario 5 as described in TR 38.863. The example carrier frequency in the simulation is 2GHz. Proposal 2: Wraparound function should be disabled for Scenario 4 and 5 in Rel-19 NTN HPUE coexistence study. Proposal 3: RAN4 to conduct coexistence study for PC2, PC1.5 and PC1 for NR NTN and IoT NTN. The power control sets for PC2, PC1.5 and PC1 for NTN HPUE in below equation should be used. For TN, PC3 UE is assumed which is the worst case.   Where,  - Pmax = maximum UE Tx power, i.e. 26 dBm for PC2, 29dBm for PC1.5 and 31dBm for PC1 NR NTN and IoT NTN UE; - Rmin = minimum power reduction ratio, i.e. -66/-69/-71 dB by assuming NTN UE PC2/PC1.5/PC1 min Tx power as -40dBm; - CLx-ile and γ are set as following: - γ = 1; - CLx-ile = 88 + Delta\_maxpower+10\*log10 (200/X) + 11 – Y, where X is UL transmission BW (MHz), Y is the BS noise figure, Delta\_maxpower is the gap between PC1/1.5/2 and PC3. For example, For PC1, Delta\_maxpower = 8dB. Observation 1: The geographical separation of 1.5km was only considered in Scenario 1 in Rel-17 NR NTN and TN coexistence. Observation 2: It is reasonable to apply for geographical separation for all the coexistence scenarios such as S4 and S5 for NTN HPUE coexistence study in Rel-19.  Proposal 4: RAN4 to consider geographical separation for both Scenario 4 and Scenario 5 in NR NTN HPUE coexistence study. Proposal 5: For Scenario 4 and 5 in IoT NTN, the symmetric bandwidth ACLR model according to TR 36.942 section 5.1.1.4.2 with Flat ACLR model and FACLR = 0 dB is used, assuming flat ACS. The number of active UL NTN UEs is 9 UEs for 15kHz and 36UEs for 3.75kHz Proposal 6: Geographical separation should be considered for both Scenario 4 and Scenario 5 in the IoT NTN HPUE coexistence study. Proposal 7: RAN4 to consider a uniform UE distribution dropping in a circle around the TN cluster for Scenario 4 and 5 in IoT NTN HPUE coexistence study. |
| R4-2412963 | Huawei, HiSilicon | Proposal 1: the scenarios where NTN UL is the aggressor can be used to derive ACLR requirement for NTN HPUE.  Observation 1: if CLx-ile is assumed as 123.7dB, the power control for PC2 can work for LEO scenario with UL 5MHz bandwidth. However, for GEO scenario, PC2 UE may always transmit the maximum output power without any power control with UL 5MHz bandwidth. Proposal 2: For LEO scenarios, UL 5MHz bandwidth can be assumed. And correspondingly CLx-ile is assumed as 123.7dB for PC2. For GEO scenarios, in order to guarantee the enough UL SINR, FFS UL channel bandwidth/RB allocation for PC2.  Proposal 3: it’s assumed 5MHz channel bandwidth for aggressor NTN UE and victim TN system. |
| R4-2413352 | THALES, Magister Solutions Ltd | Proposal 1: RAN4 to de-scope HPUE related coexistence scenarios only to Scenario 4 and Scenario 5.  Observation 1: For Scenario 4, throughput loss increases from 0.035% to 0.20% with 12 dB ACIR from 23 dBm to 31 dBm UE. Observation 2: For Scenario 4, throughput loss is 0 at 30 dB ACIR for 31 dBm UE. Observation 3: Increased UE Transmission Power (TxP) has no co-existence impact in Scenario 4 with studied system parameters as per WID description. Observation 4: For Scenario 5, throughput loss increases from 0.07% to 0.14% with 12 dB ACIR from 23 dBm to 31 dBm UE. Observation 5: For Scenario 5, throughput loss is 0.02% at 30 dB ACIR for 31 dBm UE. Observation 6: Increased UE Transmission Power (TxP) has no co-existence impact in Scenario 5 with studied system parameters as per WID description.  Proposal 2: From adjacent channel interference impact point of view for HPUE, under WID assumption, there are no problems identified even with 31dBm NTN HPUE (31dBm NTN UL Transmission Power). Proposal 3: Rel-19 NTN HPUE to reuse Rel-17 NTN UE ACLR for all power classes up to 31dBm (PC1). Proposal 4: Since no impact on Rx side with respect to Rel-17 according to coexistence analysis, Rel-19 NTN HPUE to reuse Rel-17 NTN UE ACS. |
| R4-2411659 | Nokia | Observation 1: The WID specifies evaluation for both ACLR and ACS, thus additional scenarios with NR-NTN and IoT-NTN as the victim must be considered. Proposal 1: Regarding TN-NTN co-existence analysis for PC2 and PC1.5, agree to limit the simulation scenarios to one with TN UL being the victim. Proposal 2: Co-existence scenarios for PC1 should consider both TN UL and NTN UL being the victim. Proposal 3: Agree to reuse simulation assumptions and methodology from TR 38.863. Observation 2: Co-existence scenarios are very different for n255 and n256 as compared to other TN NR bands. Proposal 4: Derive the requirements via new co-existence simulation results only. |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1 General starting point

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 2-1: General starting point for co-ex assumptions and scenarios**

* Proposals
  + Option 1: Use TR 38.863 as starting point for scenarios and assumptions for NR-NTN HPUE coex (Xiaomi, CMCC, vivo, Samsung, ZTE, China Telecom, Nokia)
  + Option 2: Use WF R4-2217473 (based on TR 38.863) as starting point for scenarios and assumptions for IoT-NTN HPUE coex (Xiaomi, CMCC, vivo, Samsung, ZTE, China Telecom, Nokia)
* Recommended WF
  + It seems all companies support the Option 1 and Option 2 which is also requested by the WID.
  + 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.

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.

### Sub-topic 2-2 Scenarios

*Sub-topic description*

*Open issues and candidate options before meeting:*

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

* Proposals
  + Option 1: Scenario consider scenarios in TR 38.863 as a baseline, which includes GEO, LEO600, LEO1200 (CATT, Xiaomi)
  + Option 2: Focus on GEO as worst case (vivo, MTK, Samsung)
* Recommended WF
  + Option 1 and 2 are not mutually exclusive
  + GEO seems agreeable to all and can be starting point
  + Further discuss whether LEO600 and LEO1200 are needed.

Huawei: We can consider three scenarios. For NR NTN, the smaller power class 2 cannot be used for GEO scenario. We can consider LEO for PC2 and PC1.5.

Qualcomm: In Rel-18, we have identified GEO is the worse case. We suggest keeping GEO as high priority.

Xiaomi: We can use GEO as the starting point to do the simulation and further discuss the need of LEO.

LGE: Rel-17 and Rel-18 NTN, we specify PC2 for both GEO and LEO?

Samsung: for PC3, we can support GEO. Why can PC2 and PC1.5 not support GEO? We should consider all the power classes. We agree with Qualcomm to prioritize GEO. We can prioritize LEO1200.

China Telecom: Tend to agree with moderator. At least GEO should be taken as baseline.

T-Mobile USA: there is assumption of separation between TN and NTN. That may not be always the case. We should look at the space in-between in the co-existence.

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**

* Proposals
  + Option 1: Scenario consider scenarios in TR 38.863 as a baseline, which includes Rural Macro and Urban Macro (CATT, Xiaomi)
  + Option 2: Urban Macro as worst case (vivo, MTK, Samsung)
  + Option 3: To discuss whether Dense Urban scenarios are needed (Ericsson)
* Recommended WF
  + Option 1 and 2 are not mutually exclusive
  + Urban macro can be starting point and Rural macro can be listed as optional.
  + Collect views and discuss option 3.

Qualcomm: in Rel-17 co-existence, for some scenario, Rural is the worst case. We should focus on the worst case for different scenario. If we use Urban as starting point, we may lose the worst case for some scenario.

Mediatek: in other issues, we also need discuss the scenario. We have no consensus on whether scenario 5 is needed.

Moderator: Mediatek has good suggestion to first narrow down the scenarios.

**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 |

Moderator note: The scenario # from TR 38.863 is provided here to help discussion.

* Proposals
  + Option 1: Scenario 4 NTN UL to TN UL only (MTK[R4-2412463], Xiaomi, CMCC, vivo, Samsung, China Telecom)
  + Option 2: Scenario 4 and 5 (ZTE, Qualcomm, Huawei, Thales)
    - Option 2-1: Clarify whether scenario 5 is needed (MTK[R4-2411505])
  + Option 3: Collect views on Scenario 1/2/6
    - Option 3-1: Clarify whether Scenario 1 for NTN UE ACS needed (MTK)
    - Option 3-2: Clarify whether Scenario 2/6 for NTN SAN ACS needed (MTK)
    - Option 3-3: For PC1, consider Scenario 2/6 (Nokia)
* Recommended WF

|  |
| --- |
| **High power UE (HPUE) for NTN**   * Conduct the coexistence analysis based on TR 38.863 for the above example bands and corresponding power classes   + **Evaluate the impact on the uplink performance of TN (Terrestrial network)**     - Example bands include bands n256 and 256, n255 and 255     - PC2, PC1.5 (for NR-NTN only) and PC1 will be evaluated for ACLR and ACS     - For NR-NTN and IoT-NTN: coexistence studies shall be carried out under the same conditions, including geographical separation between NTN UE and Terrestrial Networks (TN), as the co-existence studies in Rel-17 and Rel-18 |

Moderator Note: The study scope in WID is limited to ‘Evaluate the impact on the uplink performance of TN (Terrestrial network)’, hence the scenario was already narrowed down to Scenario 4.

* + Scenario 4 seems to be agreeable to all, and can be starting point.
  + Recommend companies to consider scenario 4 as first priority and further discuss rest scenarios.
    - Please consider the objectives description in WID as quoted above, and collect views on scenario 1/2/5/6.

Echostar: Support Option 2.

CMCC: We should focus on impact on uplink. Scenario 5 is also needed. If we want to study the co-existence, scenario 5 is also needed.

Samsung: According to Rel-17/18 study, the worst case is scenario 4. We prefer to prioritize 4 over 5.

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

### Sub-topic 2-3 Deployment and layout

*Sub-topic description*

*Open issues and candidate options before meeting:*

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

* Proposals
  + Option 1: Consider isolation distance in scenario 4 and/or 5 for both NR-NTN HPUE coex and IoT-NTN HPUE coex. (Qualcomm)
  + Option 2: Isolation distance only applied to scenario 1 for both NR-NTN HPUE coex and IoT-NTN HPUE coex. (Reuse TR 38.863, WF R4-2217473)

Moderator note: Those companies who proposed to use TR 38.863/WF R4-2217473 may support ‘no-change’ implicitly, hence option 2 is listed here.

* Recommended WF
  + Discuss the above two options and agree on one as baseline assumption.

Thales: Support Qualcomm proposal. In WID, we have the same condition.

Qualcomm: in Rel-17, we agreed to introduce the separation. Due to time limit of Rel-17, some companies only applies 1.5km for scenario 1. For other scenarios, 1.5km is not introduced. Come back to the proposal. This isolation should be applied to all the scenarios.

Huawei: the basic idea is that UE can support both TN and NTN functionality. Support Qualcomm proposal.

T-Mobile USA: Understand the idea given UE supports both. I do not know there is guarantee when one operator use TN and other operator use NTN. Do not think 1.5km is the guarantee.

Echostar: We can have 1.5km for all the cases. Not sure if we need any FFS here. I do not know why we should change the assumption.

Inmarsat: similar view. The baseline is to reuse the number in the TR. Otherwise, we change all the assumption for the previous requirement.

Thales: The reason to consider 1.5km is due to scenario 1.

T-Mobile USA: We also concern on UE to UE interference. The assumption is for Rel-17 in the TR.

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**

* Proposals
  + Option 1: To disable wrap-around function for Scenario 4 and/or 5 for TN. (Qualcomm)
* Recommended WF
  + Discuss whether option 1 is agreeable.
  + If not, the wrap-around will be implemented for TN clusters/network in simulation as before.

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

* Proposals
  + Option 1: Uniformly dropped on the circle for IoT-NTN HPUE coex. (Qualcomm)
  + Option 2: Randomly dropped on the circle for both NR-NTN HPUE coex and IoT-NTN HPUE coex.. (Reuse TR 38.863, WF R4-2217473)

Moderator note 1: To decouple this issue with 2-3-1: whether the circle is around the TN cluster or around the isolation distance depends on the agreement from Issue 2-3-1.

Moderator note 2: Those companies who proposed to use TR 38.863/WF R4-2217473 may support ‘no-change’ implicitly, hence option 2 is listed here.

* Recommended WF
  + For NR-NTN HPUE coex: Randomly dropped on the circle
  + For IoT-NTN HPUE coex: Discuss the above two options.
    - Option 2 (Random dropping) can be the starting point, and option 1 (Uniformly dropping) can be listed optional.

**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.

* Proposals
  + Option 1: All active TN clusters which has the NTN UE(s) at its edge. (Samsung)
  + Option 2: Only the TN sectors which have NTN UE(s) at their edges.

Moderator note: To decouple this issue with 2-3-1: whether the circle is around the TN cluster or around the isolation distance depends on the agreement from Issue 2-3-1.

* Recommended WF
  + TR 38.863 was to use Option 1 is the baseline and it is not precluded companies can follow Option 2 to bring results
  + One company proposed down scope to Option 1 as it was only considered in previous NR/IoT-NTN studies at the end.
  + Discuss whether we can down scope to Option 1 only.
    - If not agreed, we can always use option 1 as baseline and option2 as optional, same as TR 38.863.

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

* Proposals
  + Option 1: Discuss the ratio of NTN HPUE in all NTN UE (vivo)

Moderator note: any proposed value for this ratio?

* + Option 2: Other option
    - TBA
    - Option 2-X: Assume all UE(s) transmit with studied power class (Moderator)
* Recommended WF
  + Collect views on this ratio of HPUE.

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

* Proposals
  + Option 1: Consider 5MHz for NR-TN and NR-NTN (Huawei)
  + Option 2: Consider 5/10/15/20 MHz channel bandwidth for NR-NTN and 20MHz for NR-TN (TR38.863)
* Recommended WF
  + Option 1 is to use 5MHz, and Option 2 is to use 20MHz if we consider same worst case as rel-17.
  + Further discuss two options, and agree on one.

### Sub-topic 2-4 Detailed parameters modifications proposals

*Sub-topic description:*

*Open issues and candidate options before meeting:*

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

* Proposals
  + Option 1: Consider Set-1 for NR-NTN (Samsung, Xiaomi)
  + Option 2: Consider both set-1 and set-2 for NR-NTN (TR 38.863, CATT)
* Recommended WF
  + Discuss whether agree to down scope to set-1

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

|  |
| --- |
| 2. Way forward on discussion points The following way forward is proposed:   * Number of active UL NTN UEs: 9 UEs for 15kHz, 18 and 36UEs for 3.75kHz |

Moderator note: WF R4-2217473 provided above for reference.

* Proposals
  + Option 1: 9 UEs for 15kHz, 18 and 36UEs for 3.75kHz (R4-2217473)
  + Option 2: 36 UEs for 3.75kHz as worst case (Samsung)
  + Option 3: 9 UE for 15kHz and 36 UE for 3.75kHz (Qualcomm)
* Recommended WF
  + Collect views on option 2 and 3, check whether we can down scope.
  + Option 1 can be the WF if down scope cannot be agreed.

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

* Proposals
  + Option 1: 5GAA proposal for automotive NR NTN UE for PC2 and LEO600 (Ericsson)
    - **NF: 7dB**
    - Max Gain: 0 dBi
    - Tx power: 26 dBm
  + Option 2: Below parameters for PC2 as an example (CATT)
    - **NF: 9dB**
    - Max Gain 0dBi
    - Tx power: 26 dBm
* Recommended WF
  + Discuss and agree on the starting point of UE parameters for PC2 considering both options.
  + Discuss and agree on the starting point of UE parameters for PC1 and 1.5 scenarios.
  + If no agreement, the referenced values from TR 38.863/WF R4-2217473 would be the starting point for co-ex study.

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

* Proposals
  + Option 1: 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.
* Recommended WF
  + Agree on Option 1.

### Sub-topic 2-5 Other considerations for co-ex studies

*Sub-topic description:*

*Open issues and candidate options before meeting:*

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

* Proposals
  + Option 1: PC 1/1.5/2 for NR-NTN and PC1/2 for IoT-NTN as WID requested (Xiaomi, vivo, Samsung, China Telecom, Thales, Qualcomm)
  + Option 2-1: Prioritize PC 2 for NR-NTN and IoT-NTN (Ericsson)
  + Option 2-2: Remove PC 1.5 from scope (Ericsson)
  + Option 2-3: PC 1 based on feasibility study (Ericsson)
* Recommended WF
  + Please discuss whether to prioritize PC2 (Option 2-1) in co-ex study among other power classes as WID requested in Option 1.
    - Further discuss Option 2-2 and 2-3.
  + If no agreement, all power classes listed in WID will be considered as WF.

Vivo: we prefer to Option 1. We do not see the simulation burden.

Ericsson: PC1.5 is for TDD band. Most of NTN is for FDD.

OPPO: We share the similar view as Ericsson. For non-hand held UE, we can consider PC1.5.

China telecom: Why should we preclude high power in this agenda? Why to remove PC1.5 from IoT-NTN.

Huawei: We also have the issue for the work scope. Handheld UE is pre-mature to implement PC1.5. If PC1 can be used for non-handheld UE, we do not need to introduce separate power class. The key point is whether to keep PC1.5 for handheld UE.

Qualcomm: Share the similar view as China telecom. For co-existence study, we can keep all the power classes.

Samsung: We have two issues: the feasibility to support PC1 and PC1.5 handheld UE, which can be discussed in UE RF requirement. We should de-couple the discussion of co-existence study and UE RF requirements.

Mediatek: share the similar view as Samsung. We have already done all the simulation.

Sony: one is feasibility and one is for co-existence study.

Thales: we can keep the worst case for the study.

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

* Proposals
  + Option 1: Consider UE characteristics from TR38.863 as baseline (CATT, Xiaomi, vivo, ZTE, Samsung, Qualcomm, China Telecom, Thales)
  + Option 2: Collect information on non-handheld UE characteristics (Ericsson, CATT, China Telecom)
* Recommended WF
  + To use TR 38.863 UE characteristics as starting point for NTN HPUE co-ex studies.
  + To not preclude non-handheld specific characteristics, and encourage companies to provide characteristics for non-handheld UE for co-ex simulation purpose, especially on the different items compared to the existing TR 38.863.

China Telecom: We use the same assumption for both form factors and use the same antenna gain.

Huawei: This is related to antenna gain assumption. For both handheld and non-handheld UE, 0dBi is assumed.

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

### Sub-topic 2-6 For information

*Sub-topic description:*

*Open issues and candidate options before meeting:*

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

* Proposals
  + Source 1: MTK (R4-2412463) proposed no interference impact or tighten ACIR requirement from NTN UL to TN UL for NR NTN HPUE
  + Source 2: Samsung (R4-2412556)
  + Source 3: Thales (R4-2413352) proposed following:
    - From adjacent channel interference impact point of view for HPUE, under WID assumption, there are no problems identified even with 31dBm NTN HPUE (31dBm NTN UL Transmission Power)
    - Rel-19 NTN HPUE to reuse Rel-17 NTN UE ACLR for all power classes up to 31dBm (PC1).
    - Since no impact on Rx side with respect to Rel-17 according to coexistence analysis, Rel-19 NTN HPUE to reuse Rel-17 NTN UE ACS.
* Recommended WF
  + Please take above results and analysis for information in this meeting, and further discuss them when more results received in the next or future meetings.

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

* Proposals
  + R4-2412557 is proposed by Samsung as a running document to capture the existing and agreed assumptions for each meeting.
* Recommended WF
  + Agree to revise the R4-2412557 in this meeting to capture agreements for information.

# Topic #2: HPUE Tx requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411067 | CATT | Observation 1: RAN4 may need to discuss the NTN HPUE architecture for each of the supported power classes.  Proposal 1: For NTN HPUE, both 1Tx and 2Tx architecture could be considered for band n265, n255 and n254. Observation 2: Different MPR and A-MPR requirements may need to be specified to support NTN HPUE 1Tx and 2Tx architectures. |
| R4-2411144 | Apple | Proposal: To reduce number of A-MPR simulations for the FR1 satellite bands, we suggest not considering scenarios/combinations that are not expected for the satellite bands: large RB allocations, CP-OFDM, higher-order modulations. |
| R4-2411145 | Apple | Share initial results of A-MPR for n254. |
| R4-2411499 | Mediatek India Technology Pvt. | Observation 1: Based on UE implementation, the PC2 ACLR of -31dB from NR TN UE may be used as a reference for specifying PC2 ACLR for NR NTN UE. Proposal 1: Discuss whether to use PC2 ACLR of [-31dB] as a starting point. Decide the final ACLR value pending on the NTN PC2 coexistence analysis results.   Observation 2: The PC3 and PC1 ACLR values of -30dB and -37dB in TS 36.101 [3] are the same as PC3 and PC1 ACLR values in TS 38.101-1 [2]. The PC2 ACLR of -31dB for CBW of 5MHz to 20MHz is used in TS 38.101-1 and TS 36.101. There is no PC2 ACLR specified in TS 36.101 for CBW of 1.4MHz and 3MHz.  Proposal 2: Discuss whether to use TS 38.101-1 [2] PC2 ACLR of -31dB as a starting reference for specifying PC2 ACLR values for CBW of 1.4MHz and 3MHz in TS 36.101 [3] and TS 36.102[4]. Decide the final ACLR values pending on the NTN PC2 coexistence analysis results.    Observation 3: There is no PC2 ACLR specified in TS 36.101 [3] for IoT TN Cat-NB1/NB2 UE.  Observation 4: There is no PC2 ACLR specified in TS 36.102 [4] for IoT NTN Cat-NB1/NB2 UE.  Proposal 3: Regarding IoT NTN Cat-NB1/NB2 UE, discuss whether to use TS 36.102 [4] PC3 ACLR values with [1dB] improvement as a starting reference for specifying PC2 ACLR values in TS 36.102. Decide the final ACLR values pending on the NTN PC2 coexistence analysis results.   Observation 5: Based on TS 38.101-1 [2] and TS 38.101-5 [5], it is observed that the PC3 MPR specification for NR TN UE is reused for NR NTN UE.  Observation 6: Based on TS 38.101-1 [2], it is observed that there is PC2 MPR specification for NR TN UE. The MPR is relevant to ACLR and modulation EVM requirements. Proposal 4: Consider reusing TS.38.101-1 [2] PC2 MPR specification from NR TN UE for NR NTN UE as starting point. For NR NTN UE, the final PC2 MPR values in TS 38.101-5 [5] would be decided after NR NTN PC2 ACLR is completed. |
| R4-2411540 | Sony | Observation 1: Due to the lack of TN requirement as a reference, the MPR and AMPR values of the HPUE need to be re-evaluated based on reasonable implementations of IoT devices.  Proposal 1: RAN4 shall carefully study the corresponding emission limit from regulators and specify the method to ensure the 3GPP HPUE IoT NTN does not violate them.  Proposal 2: RAN4 may wait for ETSI to specify the new harmonized standard for HPUE IoT NTN before capturing any emission limit from ETSI in HPUE. |
| R4-2411603 | Xiaomi | Proposal 1: Using +2/-3 tolerance for PC1, PC1.5 and PC2 for NTN HPUE including NR-NTN and IoT-NTN. Proposal 2: MPR, A-MPR and ACLR for NTN HPUE need further evaluate based on the simulation results of co-existence study. Proposal 3: For the SAR issue, using P-MPR as the starting point. |
| R4-2411659 | Nokia | Observation 1: The WID specifies evaluation for both ACLR and ACS, thus additional scenarios with NR-NTN and IoT-NTN as the victim must be considered. Proposal 1: Regarding TN-NTN co-existence analysis for PC2 and PC1.5, agree to limit the simulation scenarios to one with TN UL being the victim. Proposal 2: Co-existence scenarios for PC1 should consider both TN UL and NTN UL being the victim. Proposal 3: Agree to reuse simulation assumptions and methodology from TR 38.863. Observation 2: Co-existence scenarios are very different for n255 and n256 as compared to other TN NR bands. Proposal 4: Derive the requirements via new co-existence simulation results only. |
| R4-2412099 | vivo | Feasibility Observation 1: Feasibility study cases can be classified by combination of NR/Iot, Power classes and handheld or not.  Observation 2: The feasibility of NR NTN is similar to FDD NR TN case. Observation 3. The feasibility of NR FDD for PC1.5 is comparable to NR FDD PC2 1Tx implementation. Proposal 1: For NR-NTN, including handheld and non-handheld: - Power Class 2 is feasible; - Power Class 1.5 is feasible [with possible restrictions on components]  - Power Class 1 is FFS  Observation 4: It is easier for NB-Iot to implement higher power with its half-duplex and very narrow bandwidth.  Proposal 2: For NB-Iot based Iot-NTN, including handheld and non-handheld: - Power Class 2 is feasible; - Power Class 1 is likely to be feasible.  Observation 5: eMTC based Iot-NTN feasibility is largely comparable to NR-NTN. Proposal 3: For eMTC based Iot-NTN: - Power Class 2 is likely to be feasible for handheld and non-handheld; - Power Class 1 feasibility is FFS;  HPUE Impact guidelines Observation 6: The study of NTN HPUE Tx requirements generally would have to consider co-existence need, UE implementation feasibility, and existing HPUE requirements.  Tx Impact Proposal 4: Reuse nominal MOP and study the related parameters such as tolerances.  Proposal 5: SAR solution: - Discuss if P-MPR is needed for NB-Iot based Iot-NTN. - For NR NTN HPUE, currently do not consider duty cycle based SAR solution. - For NR NTN HPUE, currently do not consider duty cycle based SAR solution.  Proposal 6: Considering the reuse of components and feasibility, the MPR requirements for NR NTN are as following, provided that the corresponding ACLR be reused from TN and not violate co-existence : - Power class 2: Reuse the current TN PC2 MPR requirements. - Power class 1.5: Use the current TN PC1.5 MPR requirements as starting point - Power class 1: FFS Observation 7: Higher power class not defined for NB-Iot and eMTC yet, and there is no similar baseline MPR requirements for Iot-NTN HPUE. Proposal 7: MPR for Iot-NTN HPUE is FFS.  Proposal 8: Considering the reuse of components and feasibility, the ACLR requirements for NR NTN are as following, provided that the condition that co-existence can be satisfied - Power class 2/1.5: Reuse the current TN PC2/1.5 ACLR requirements. - Power class 1: FFS Proposal 9: For Iot NTN, the ACLR for HPUE is FFS.  Observation 8: A-MPR may also be impacted by higher power class. |
| R4-2412357 | LG Electronics France | Proposal 1: The technical discussion on ACL, MPR and A-MPR need to consider following aspects n ACLR – Up to the co-existence study n MPR – If the NTN HPUE ACLR value is different from TN HPUE, MPR simulation is needed to specify the MPR requirement for NTN HPUE n A-MPR – Regardless of ACLR difference based on co-existence study, A-MPR is needed for NTN HPUE  Proposal 2: It needs to be checked whether the co-existence study objective include PC2, PC1.5, and PC1, while the requirement objective only includes PC2. |
| R4-2412558 | Samsung | Observation 1: For NR-NTN, the power class 2, 1.5 and 1 are considered at initial stage. For IoT-NTN, the power class 2 and 1 are considered in initial stage. Observation 2: The consideration of the power classes depend on the outcome of co-existence studies. Proposal 1: The power classes 2, 1.5 and 1 for NR-NTN, power classes 2 and 1 for IoT-NTN are all considered for RF requirement discussion at starting point, and it will depend on the outcomes of co-existence studies.  Proposal 2: The RF requirements could be different for handheld UE and non-handheld UE. The discussion can start with one set of requirement, and whether two sets of requirements will be needed can depend on the co-existence and feasibility studies later.   Observation 3: SAR solution is to be specified only for handheld UE. However, this depends on whether the handheld UE and non-handheld UE eventually need two sets of RF requirements. Proposal 3: It is proposed to adopt P-MPR for SAR solution for handheld NTN HPUE as the starting point.  Observation 4: Given the difference in structure and technology, the NR-NTN and IoT-NTN HPUE RF requirements are suggested to be seaprately discussed.  Observation 5: For NR-NTN HPUE, if we take the current structure of TS 38.101-5, the following Tx requirements can be impacted depending on further discussions and agreements: Section Expected changes/update 6.2 Transmitted power  6.2.1 UE maximum output power 6.2.2 UE maximum output power reduction  6.2.3 UE additional maximum output power  6.2.4 Configured transmitted power For 6.2.1: The MOP requirements should be introduced for the new power classes, which would be concluded by the co-existence and/or feasibility studies, considering existing TN requirements as a reference.  For 6.2.2: The MPR requirement should be introduced based on the agreed ACLR for the agreed power classes and study results, considering existing TN requirements as a reference.  For 6.2.3  The A-MPR requirement should be introduced for the agreed power classes, considering existing TN requirements as a reference.  For 6.2.4: The SAR solution (e.g. P-MPR) should be introduced for the HPUE, depending on discussion. 6.5 Output RF spectrum emission 6.5.2 Out of band emission For 6.5.2: The new ACLR requirements should be introduced for the new power classes, which would be concluded by the co-existence and/or feasibility studies. Observation 6: For IoT-NTN HPUE, if we take the current structure of TS 36.102, the following Tx requirements can be impacted depending on further discussions and agreements: - 6.2A.1 UE maximum output power for category M1; - 6.2A.2 UE maximum output power reduction for category M1; - 6.2A.3 UE additional maximum output power reduction for category M1; - 6.2A.4 Configured transmitted power for category M1; - 6.2B.1 UE maximum output power for category NB1 and NB2; - 6.2B.2 UE maximum output power reduction for category NB1 and NB2; - 6.2B.3 UE additional maximum output power reduction for category NB1 and NB2; - 6.2B.4 Configured transmitted power for category NB1 and NB2; - 6.5A.3 Out of band emission for category M1; - 6.5B.3 Out of band emission for category NB1 and NB2.  Observation 7: The HPUE requirements from TS 38.101-1 and TS 36.101 can still be the reference to avoid duplicate effort for the NR-/IoT-NTN HPUE in TS 38.101-5 and TS 36.102 respectively. |
| R4-2412719 | ZTE Corporation, Sanechips | Proposal 1: To use the proposals in Table 2.1 for Tx requirements of Rel-19 NTN HPUE   |  |  | | --- | --- | | **NR-NTN UE Tx requirement** | **Proposals for Rel-19 NTN HPUE requirements** | | 6.2.1 UE maximum output power | No specification impact. | | 6.2.2 MPR | MPR for NTN HPUE should be further evaluated according to the agreed ACLR value, PA model and other limiting factor for MPR evaluation.  In addition, regarding the SAR requirement for FDD NTN HPUE, we could follow the legacy approach to leave it up to p-MPR design instead of defining any uplink duty cycle to guarantee the SAR limits. | | 6.2.3 A-MPR | Regarding the A-MPR requirements, once HPUE e.g. PC2/PC1.5or PC1 are supported in any specific bands, then the A-MPR requirement should be revisited again to identify the appropriate the A-MPR requirements. | | 6.2.4 Configured transmitted power | No specification impact. | | 6.3.1 Minimum output power | No specification impact. | | 6.3.2 Transmit OFF power | No specification impact. | | 6.3.3 Transmit ON/OFF time mask | No specification impact. | | 6.3.4 Power control | No specification impact. | | 6.4.1 Frequency error | No specification impact. | | 6.4.2 Transmit modulation quality | No specification impact. | | 6.5.1 Occupied bandwidth | No specification impact. | | 6.5.2.2 Spectrum emission mask | This depends on the outcome of coexistence study, however it’s most likely that the existing SEM requirement for PC3 could be reused for other PCs. | | 6.5.2.3 Additional Spectrum emission mask | No specification impact. | | 6.5.2.4.1 NR ACLR | This depends on the outcome of coexistence study. | | 6.5.3.1 General spurious emissions | No specification impact | | 6.5.3.2 Spurious emissions for UE co-existence | No specification impact. | | 6.5.3.3 Additional spurious emissions | Specification impact. | | 6.5.4 Transmit intermodulation | No specification impact | |
| R4-2412726 | OPPO | Proposal 1: For the PC2 NTN, transmitter power including output power and MPR/A-MPR as well as the ACLR requirement need to be updated compared to PC3 NTN UE RF requirement. Proposal 2: Further investigate the duty cycle method for regulation of NTN hand-held UE. |
| R4-2412839 | China Telecom | Observation 1: Regarding NTN HPUE TX requirement discussion, it’s proposed to study based on state-of-art RF front-end implmentation with dedicated improvement on antenna performance with respect to GSO and NGSO system separately with prioritization on example bands, i.e. band n256/256 and band n255/255. |
| R4-2412964 | Huawei, HiSilicon | Observation 1: If more power classes and operating bands are included in this WI, the workloads will be increased dramatically, especially for simulation works.  Proposal 1: based on the WID, exemplary bands n256 and n255 can be considered in this WI for NR NTN HPUE feature.  Proposal 2: considering the workloads, UE implementation and demands, we can specify PC2 for handheld/non-handheld UE and PC1 for non-handheld UE in Rel-18.  Proposal 3: one Tx RF architecture and Dual Tx RF architecture can be reused for NR NTN PC2 UE.  Proposal 4: The mechanism to support flexible scheduling in a longer duration in FDD can be considered as a SAR solution. |
| R4-2413144 | Qualcomm Incorporated | Observation 1: Based on WID discussions on SAR, MPR and A-MPR and RSD are expected. Proposal 1: RAN4 should study applicable regulatory requirements in ECC/CEPT region and take those requirements into account in MPR and A-MPR evaluations. Proposal 2: Based on the study outcome, necessary corrections should be made also for PC3 in 36.102 and 38.101-5 Proposal 3: In case ETSI TC SES identifies later that some requirements are not required for market access in Europe, those requirements should be removed from 3GPP. Proposal 4: For NB-NTN, discussion on at least Pcmax tolerance, IQ-image and DC-leakage and spectrum emission mask are needed Proposal 5: At least for NB-NTN HPUE, single Tx operation should not be ruled out from higher power classes. |
| R4-2413365 | Ericsson India Private Limited | Proposal 1: Until the feasibility of other power classes is confirmed based on the co-existence and feasibility study, we propose that RAN4 should focus on specifying power class 2.  Proposal 2: Since PC1.5 is specified for TN TDD bands only, unless there is a specific need to introduce PC1.5 for FR1-NTN bands n256, n255 and n254 (which are all FDD bands), we propose to remove PC1.5 from the scope of this WI.  Proposal 3: Similar to FR1 TN, for both FR1-NTN and IoT-NTN PC1 should be targeted for non-handheld UEs only.  Proposal 4: As the starting point, for FR1-NTN PC2 handheld UEs (at least smartphones) consider reusing the same SAR requirements as for TN PC2 handheld UEs. |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1 General considerations

*Sub-topic description:*

*Open issues and candidate options before meeting:*

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

* Proposals
  + Option 1: The RF requirements could be different for handheld UE and non-handheld UE. The discussion can start with one set of requirement, and whether two sets of requirements will be needed can depend on the co-existence and feasibility studies later. (Samsung)
  + Option 2: The study of NTN HPUE Tx requirements generally would have to consider co-existence need, UE implementation feasibility, and existing HPUE requirements. (vivo)
  + Option 3: Derive the requirements via new co-existence simulation results only (Nokia)
  + Option 4: Regarding NTN HPUE TX requirement discussion, it’s proposed to study based on state-of-art RF front-end implmentation with dedicated improvement on antenna performance with respect to GSO and NGSO system separately (China Telecom)
* Recommended WF
  + Above options are not mutually exclusive.
  + Further discuss and check if we can agree on Option 2, which seems to cover all above options.
    - 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)**

* Proposals
  + Option 1: n256, n255, 256, 255 (China Telecom, Huawei)
  + Option 2: n256, n255, n254 (CATT, Ericsson)
  + Option 3: n254 (Apple)
* Recommended WF
  + Further discuss the above options.

**Samsung: in WID, option 1 is listed as example bands. Option 1 can be considered.**

**Thales: in Rel-17, we first finish the 2GHz n256. We do not need to do the evaluation for other bands. 2GHz is the worst case.**

**Qualcomm: it is good to clarify whether it is for requirement or for co-existence.**

**China Telecom: Those example bands are clearly described in the WID. If we complete one of example bands, the WI can be announced completed.**

**Samsung: We list those four bands for co-existence study.**

**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**

* Proposals
  + Option 1: Power class 1/1.5/2 for NR-NTN and Power class 1/2 for IoT-NTN (MTK, Xiaomi, vivo, Samsung, ZTE, China Telecom)
    - Option 1-1: The power classes 2, 1.5 and 1 for NR-NTN, power classes 2 and 1 for IoT-NTN are all considered for RF requirement discussion at starting point, and it will depend on the outcomes of co-existence studies. (Samsung)
  + Option 2: Remove PC 1.5 (Ericsson)
  + Option 3: Prioritize PC 2, and other PC to be confirmed by co-ex and feasibility study. (Ericsson)
  + Option 4: PC 1 considered for non-handheld only for both IoT-NTN and NR-NTN. (Ericsson, Huawei)
  + Option 5: PC2 for both handheld and non-handheld (Huawei)
* Recommended WF
  + Further discuss the above options.
  + If no agreement, all power classes in WID, Power class 1/1.5/2 for NR-NTN and Power class 1/2 for IoT-NTN, will be considered at starting point, and further discuss whether down scope can be agreeable considering study outcomes.

Vivo: we are not starting the study at this moment. I do not think that there is very clear approach to down-select. To Ericsson, removing PC1.5 is due to that we have no PC1.5 TDD for TN? We propose to go with option 1.

OPPO: we slightly concern. How can we differentiate handheld and non-handheld? We want to preclude handheld PC1 and PC1.5.

Qualcomm: It is too early to do down-selection. What kind of MPR and A-MPR should be and what kind of SAR solution is needed? Better to start the study with open-mind.

Ericsson: PC1.5 is not specified for TN FDD unless UE vendor confirms it is feasible.

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

* Proposals
  + Option 1: RAN4 shall carefully study the corresponding emission limit from regulators and specify the method to ensure the 3GPP HPUE IoT NTN does not violate them. (Sony)
  + Option 2: RAN4 may wait for ETSI to specify the new harmonized standard for HPUE IoT NTN before capturing any emission limit from ETSI in HPUE. (Sony)
  + Option 3: RAN4 should study applicable regulatory requirements in ECC/CEPT region and take those requirements into account in MPR and A-MPR evaluations. (Qualcomm)
    - Option 3-1: Based on the study outcome, necessary corrections should be made also for PC3 in 36.102 and 38.101-5 (Qualcomm)
  + Option 4: In case ETSI TC SES identifies later that some requirements are not required for market access in Europe, those requirements should be removed from 3GPP. (Qualcomm)
* Recommended WF
  + Further discuss the above options.

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

* Proposals
  + Option 1: Different MPR and AMPR requirements may need to be specified for 1Tx and 2Tx architectures. (CATT)
  + Option 2: the MPR and AMPR values of the HPUE need to be re-evaluated based on reasonable implementations of IoT devices. (Sony)
  + Option 3: one Tx RF architecture and Dual Tx RF architecture can be reused for NR NTN PC2 UE (Huawei)
  + Option 4: At least for NB-NTN HPUE, single Tx operation should not be ruled out from higher power classes (Qualcomm)
* Recommended WF
  + Further discuss the above options.

OPPO: does 2Tx mean UL-MIMO.

Huawei: the TN UL-MIMO framework can be reused.

Vivo: There are many power classes. It is difficult to use one sentence to cover everything.

Nokia: PC1 is specified for many LTE and NR bands. NTN can only do 1Tx.

Thales: the point is to reuse the requirements of FR1 as much as possible.

### Sub-topic 3-2 Feasibility

*Sub-topic description:*

*Open issues and candidate options before meeting:*

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

* Proposals
  + Option 1: For NR-NTN, including handheld and non-handheld (vivo)
    - Power Class 2 is feasible;
    - Power Class 1.5 is feasible [with possible restrictions on components]
    - Power Class 1 is FFS
  + Option 2: TBA
* Recommended WF
  + Further discuss above Option 1.

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

* Proposals
  + Option 1: For NB-Iot based Iot-NTN, including handheld and non-handheld (vivo)
    - Power Class 2 is feasible;
    - Power Class 1 is likely to be feasible
  + Option 2: TBA
* Recommended WF
  + Further discuss above Option 1.

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

* Proposals
  + Option 1: For eMTC based IoT-NTN, including handheld and non-handheld (vivo)
    - Power Class 2 is likely to be feasible for handheld and non-handheld;
    - Power Class 1 feasibility is FFS
  + Option 2: TBA
* Recommended WF
  + Further discuss above Option 1.

### Sub-topic 3-3 Tx requirements impact in detail

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Moderator note: The following items are either proposed as impacted requirements or proposed with detailed methodologies and/or values.**

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

* Proposals
  + Option 1: Using +2/-3 tolerance for PC1, PC1.5 and PC2 for NTN HPUE including NR-NTN and IoT-NTN (Xiaomi)
  + Option 2: Reuse nominal MOP and study the related parameters such as tolerances (vivo)
* Recommended WF
  + Further discuss above options.
  + Check if +2/-3 tolerance and nominal MOP can be reused for NTN HPUE as starting point.

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

* Proposals
  + Option 1: MPR, A-MPR and ACLR for NTN HPUE need further evaluate based on the simulation results of co-existence study (Xiaomi)
  + Option 2: Consider reusing TS.38.101-1 [2] PC2 MPR specification from NR TN UE for NR NTN UE as starting point. For NR NTN UE, the final PC2 MPR values in TS 38.101-5 [5] would be decided after NR NTN PC2 ACLR is completed. (MTK)
  + Option 3: Considering the reuse of components and feasibility, the MPR requirements for NR NTN are as following, provided that the corresponding ACLR be reused from TN and not violate co-existence (vivo)
    - Power class 2: Reuse the current TN PC2 MPR requirements.
    - Power class 1.5: Use the current TN PC1.5 MPR requirements as starting point
    - Power class 1: FFS
  + Option 4: MPR for Iot-NTN HPUE is FFS (vivo)
  + Option 5: If the NTN HPUE ACLR value is different from TN HPUE, MPR simulation is needed to specify the MPR requirement for NTN HPUE (LGE)
  + Option 6: MPR for NTN HPUE should be further evaluated according to the agreed ACLR value, PA model and other limiting factor for MPR evaluation. In addition, regarding the SAR requirement for FDD NTN HPUE, we could follow the legacy approach to leave it up to p-MPR design instead of defining any uplink duty cycle to guarantee the SAR limits. (ZTE)
  + Option 7: Assumptions for DC-leakage and IQ-image for NTN HPUE need to be discussed
* Recommended WF
  + Further discuss above options.

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

* Proposals
  + Option 1: MPR, A-MPR and ACLR for NTN HPUE need further evaluate based on the simulation results of co-existence study (Xiaomi)
  + Option 2: To reduce number of A-MPR simulations for the FR1 satellite bands, we suggest not considering scenarios/combinations that are not expected for the satellite bands: large RB allocations, CP-OFDM, higher-order modulations (Apple)
  + Option 3: Regardless of ACLR difference based on co-existence study, A-MPR is needed for NTN HPUE (LGE)
  + Option 4: Regarding the A-MPR requirements, once HPUE e.g. PC2/PC1.5or PC1 are supported in any specific bands, then the A-MPR requirement should be revisited again to identify the appropriate the A-MPR requirements. (ZTE)
* Recommended WF
  + Further discuss above options.

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

* Proposals
  + Option 1: For the SAR issue, using P-MPR as the starting point (Xiaomi, Samsung, vivo, Ericsson)
  + Option 2: Discuss if P-MPR is needed for NB-IoT based IoT-NTN (vivo)
  + Option 3: Do not consider duty cycle based SAR solution for NR-NTN and IoT-NTN HPUE. (vivo)
  + Option 4: Further investigate the duty cycle method for regulation of NTN hand-held UE (OPPO)
  + Option 5: The mechanism to support flexible scheduling in a longer duration in FDD can be considered as a SAR solution (Huawei)
* Recommended WF
  + Further discuss if P-MPR can be agreed as starting point.

Moderator: most companies propose to use P-MPR. The difference is that companies proposed different addition solutions.

Huawei: For NTN, uplink coverage is the bottleneck. If we only consider P-MPR for SAR, UE may reduce the output power to meet the SAR. This is the big disadvantage. We can figure out the other solution to keep the uplink and to meet the SAR at the same time.

OPPO: The duty cycle here is not directly the scheme used for PC1.5 TN UE. Both duty cycle and P-MPR should be considered.

LGE: support duty cycle method.

Apple: P-MPR is not optimized solution to address SAR. Duty cycle approach may be a good direction.

Qualcomm: P-MPR should be part of solution. SAR impact depends on the position of human. We need discuss more details on whether we do P-MPR only or P-MPR+duty cycle.

Vivo: We also support keeping P-MPR. Duty cycle may have some benefit. We cannot directly reuse the TN duty cycle.

Samsung: We support P-MPR at least.

Tentative 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**

* Proposals
  + Option 1: This depends on the outcome of coexistence study, however it’s most likely that the existing SEM requirement for PC3 could be reused for other PCs. (ZTE)
  + Option 2: Discussion on NB.IoT SEM for higher power classes is needed.
* Recommended WF
  + Further discuss whether SEM will be impacted.

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

* Proposals
  + Option 1: Discuss whether to use PC2 ACLR of [-31dB] as a starting point. Decide the final ACLR value pending on the NTN PC2 coexistence analysis results. (MTK)
  + Option 2: Discuss whether to use TS 38.101-1 [2] PC2 ACLR of -31dB as a starting reference for specifying PC2 ACLR values for CBW of 1.4MHz and 3MHz in TS 36.101 [3] and TS 36.102[4]. Decide the final ACLR values pending on the NTN PC2 coexistence analysis results. (MTK)
  + Option 3: Regarding IoT NTN Cat-NB1/NB2 UE, discuss whether to use TS 36.102 [4] PC3 ACLR values with [1dB] improvement as a starting reference for specifying PC2 ACLR values in TS 36.102. Decide the final ACLR values pending on the NTN PC2 coexistence analysis results. (MTK)
  + Option 4: Considering the reuse of components and feasibility, the ACLR requirements for NR NTN are as following, provided that the condition that co-existence can be satisfied (vivo)
    - Power class 2/1.5: Reuse the current TN PC2/1.5 ACLR requirements.
    - Power class 1: FFS
  + Option 5: For Iot NTN, the ACLR for HPUE is FFS. (vivo)
  + Option 6: Up to co-existence study (LGE, Samsung, ZTE)
* Recommended WF
  + All companies support to define ACLR based on co-existence study outcomes.
  + Discuss if anything else can be agreed.

# Topic #4: HPUE Rx requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411500 | Mediatek India Technology Pvt. | Proposal 1: Regarding PC2 IoT NTN IoT NB1 and NB2 UEs operated in half-duplex FDD mode, no RX RSD for bands 256 and 255.  Proposal 2: Although IoT NTN category M1 (Cat-M1) supports both FDD and HD-FDD modes, RX RSD is not needed for bands 256 and 255 when PC2 IoT NTN Cat-M1 UE operates in HD-FDD mode.  Proposal 3: Regarding NR NTN UE operated in PC2, define the RX RSD values as shown in tables below for bands n256 and n255. |
| R4-2412100 | vivo | Observation 1: Scope does not include any requirements related to CA/EN-DC etc, such as MSD. Observation 2: The study can be classified by combination of NR/Iot, Power classes and handheld or not.  Observation 3: HPUE may involve larger impact to its own Rx and bring sensitivity degradation. In FDD NR TN HPUE, the concept and requirements of Reference Sensitivity Degradation (RSD) were introduced. Observation 4: A complete method exists for RSD derivation for FDD NR HPUE.  Proposal 1. Use Reference Sensitivity Degradation (RSD) for the NTN HPUE Rx requirements. Proposal 2: The study method of NR NTN Rx requirements can be similar to FDD HPUE Wis. Proposal 3: For power class 2, at least n256 and n254 can have 0dB RSD for NR-NTN. Proposal 4: For power class 1.5, more study on RSD is needed for NR-NTN.. Proposal 5: Power class 1 is FFS for NR NTN. Proposal 6: For NB-Iot based Iot-NTN, the sensitivity would not be impacted by HPUE. Proposal 7: For eMTC based Iot-NTN and half duplex, the sensitivity would not be impacted by HPUE. Proposal 8: For eMTC based Iot-NTN and full duplex, reference NR NTN method, but only consider 1TX. |
| R4-2412559 | Samsung | Observation 1: The reference senstivity degradation will be impacted by the introduction of HPUE, and it is encouraged that companies to provide the analysis for the actual RSD values for the agreed power classes based on co-existence and feasibility studies later. |
| R4-2412720 | ZTE Corporation, Sanechips | Proposal 1: To use the proposals in Table 2.1 for Rx requirements of Rel-19 NTN HPUE   |  |  | | --- | --- | | **NR-NTN UE Rx requirement** | **Proposals for Rel-19 NTN HPUE requirements** | | 7.3.2 Reference sensitivity | Regarding the RSD requirement for NTN HPUE, propose to postpone the discussions until the agreement reached for ACLR requirement for NTN HPUE. | | 7.4 Max input level | no specification impact. | | 7.5 Adjacent channel selectivity | no specification impact. | | 7.6.2 In-band blocking | no specification impact. | | 7.6.3 Out of band blocking | no specification impact. | | 7.6.4 Narrow band blocking | no specification impact. | | 7.7 Spurious response | no specification impact. | | 7.8 Intermodulation characteristics | no specification impact. | | 7.9 Spurious emissions | no specification impact. | |
| R4-2412725 | OPPO | Proposal 1: The RX requirements including max input level, ACS, blocking characteristics, spurious response, intermodulation characteristics, spurious emissions with PC3 in current TS 38.101-5 should apply to other power class. Proposal 2: Use RSD of n1 as starting point for band n256. |
| R4-2412840 | China Telecom | Observation: For the study on reception requirement of NTN HPUE, it’s proposed to consider more realistic condition of satellite payload and improvement on UE RX antenna performance with the aim to improve the DL coverage together with UL coverage. |
| R4-2412965 | Huawei, HiSilicon | Proposal 1: When RAN4 discussed RSD requirements, it’s better to confirm whether the flexible Tx-Rx frequency separation is allowed or not. |
| R4-2413366 | Ericsson India Private Limited | Proposal 1: Study the introduction of a table on reference sensitivity degradation from PC3 to PC2 in clause 7.3.2 of TS38.101-5.  Proposal 2: Study the introduction of tables/adding additional rows in the existing tables on reference sensitivity degradation from PC3 to PC2 in clauses 7.3A and 7.3B of TS36.102. |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 4-1

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 4-1: General considerations**

* Proposals
  + Option 1: Use Reference Sensitivity Degradation (RSD) for the NTN HPUE Rx requirements. (vivo)
  + Option 2: The RX requirements including max input level, ACS, blocking characteristics, spurious response, intermodulation characteristics, spurious emissions with PC3 in current TS 38.101-5 should apply to other power class. (OPPO)
  + Option 3: When RAN4 discussed RSD requirements, it’s better to confirm whether the flexible Tx-Rx frequency separation is allowed or not. (Huawei)
  + Option 4: Study the introduction of a table on reference sensitivity degradation from PC3 to PC2 in clause 7.3.2 of TS38.101-5. (Ericsson)
  + Option 5: Study the introduction of tables/adding additional rows in the existing tables on reference sensitivity degradation from PC3 to PC2 in clauses 7.3A and 7.3B of TS36.102. (Ericsson)
* Recommended WF
  + Above options are not mutually exclusive.
  + RSD is the only proposed impacted Rx requirements in this meeting.
  + Further check whether Max input level, ACS, blocking parameters, spurious response, intermodulation characteristics, spurious emissions with PC3 can apply to other power classes.

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

* Proposals
  + Option 1: Regarding NR NTN UE operated in PC2, define the RX RSD values as shown in tables below for bands n256 and n255. (MTK)

**Table 1 RSD from PC3 to PC2 for FDD bands for NR NTN UE not supporting Tx Diversity**

| Operating Band | 5  MHz (dB) | 10  MHz (dB) | 15  MHz (dB) | 20  MHz (dB) |
| --- | --- | --- | --- | --- |
| n256 | 0 | 0 | 0 | 0 |
| n255 | [0.4] | [0.4] | [0.5] | [0.5] |

**Table 2 RSD from PC3 to PC2 for FDD bands for NR NTN UE supporting Tx Diversity**

| Operating Band | 5  MHz (dB) | 10  MHz (dB) | 15  MHz (dB) | 20  MHz (dB) |
| --- | --- | --- | --- | --- |
| n256 | 0 | 0 | 0 | 0 |
| n255 | [0.8] | [0.8] | [0.9] | [0.9] |

* + Option 2: The study method of NR NTN Rx requirements can be similar to FDD HPUE WIs (vivo)
    - Option 2-1: For power class 2, at least n256 and n254 can have 0dB RSD for NR-NTN
    - Option 2-2: For power class 1.5, more study on RSD is needed for NR-NTN
    - Option 2-3: Power class 1 is FFS for NR NTN
  + Option 3: Depending on the agreement from co-existence study and ACLR (ZTE, Samsung,
  + Option 4: Use RSD of n1 as starting point for band n256
* Recommended WF
  + Further discuss the NR-NTN HPUE RSD proposals for each power classes.

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

* Proposals
  + Option 1: Regarding PC2 IoT NTN IoT NB1 and NB2 UEs operated in half-duplex FDD mode, no RX RSD for bands 256 and 255. (MTK)
  + Option 2: Although IoT NTN category M1 (Cat-M1) supports both FDD and HD-FDD modes, RX RSD is not needed for bands 256 and 255 when PC2 IoT NTN Cat-M1 UE operates in HD-FDD mode. (MTK)
  + Option 3: For NB-Iot based Iot-NTN, the sensitivity would not be impacted by HPUE (vivo)
  + Option 4: For eMTC based Iot-NTN and half duplex, the sensitivity would not be impacted by HPUE. (vivo)
  + Option 5: For eMTC based Iot-NTN and full duplex, reference NR NTN method, but only consider 1TX. (vivo)
* Recommended WF
  + Further discuss the IoT-NTN HPUE RSD proposals for each power classes.