**3GPP TSG-RAN WG4 Meeting # 100-e R4-2115749**

**Electronic Meeting, 16th – 27th August, 2021**

**Agenda item:** 9.13.2

**Source:** Samsung

**Title:** WF on [313]NTN\_Solutions\_Part2

**Document for:** Approval

# Introduction

This document provides way forward based on the outcomes of “Email discussion summary for [99e][313] NTN\_Solutions\_Part2”. Agreements and open issues with possible options after 1st round discussion have been captured in [2] and [3].

Results and assumptions for NTN co-existence calibration are also captured in Annex 2 & 3.

# Way Forward on [313]NTN\_Solutions\_Part2

## Coexistence scenarios

### Agreements

Following agreements have been made and reflected in [2].

1. Keep GEO scenarios of NTN.
2. Remove NTN coexistence cases with n41 (2496-2690 MHz) which are identified as Item 7 & 8 in the scenario table of R4-2108645.

### Open issues

**1) Issue 1-1: Dense Urban scenario of NR/NB-IoT**

* Option 1: Remove Dense Urban scenario
* Option 2: Keep Dense Urban scenario

**2) Issue 1-2: Rural scenario of NR/NB-IoT**

* Option 1: Focus only on “Rural” scenario of NR/NB-IoT.
* Option 2: Keep both “Rural” and “Urban” scenarios of NR/NB-IoT.

**3) Issue 1-5: NTN-NTN co-existence scenarios**

* Option 1:
* (Thales): Remove LEO-LEO, LEO-GEO and GEO-GEO scenarios in S-band of [1980-2010 MHz (UL) and 2170-2200 MHz (DL)]
* (Hughes/Inmarsat/Thales/Sateliot): RAN4 shall consider this as the input from operators that NTN-NTN (satellite) adjacent band co-existence for MSS S-band [1980-2010 MHz (UL) and 2170-2200 MHz (DL)] is not applicable and out of scope.
* Option 2(Ericsson): NTN-NTN scenarios should not be de-scoped. One satellite with FRF=3 can be considered as candidate NTN-NTN co-existence scenario.
* Option 3(Moderator): “One satellite with FRF=3” case can be first studied as NTN-NTN co-existence scenario. Other cases can be further discussed. This does not apply to HAPS.

Details have been captured in [2].

## Network layout model & methodology

### Agreements

See Annex 1. Options with Bold fonts and marked in green are those agreed in 1st round.

### Open issues

See Annex 1. Options marked in yellow with square brackets are those for discussion in 2nd round.

## Other Assumptions

### Agreements

Following agreements have been made and reflected in [2].

* Issue 3-1: Satellite max TX power for 20MHz BW
* Issue 3-2: Adjacent Beam Spacing
* Issue 3-3: Handover margin for NTN
* Issue 3-5: Satellite antenna pattern
* Issue 3-8: Changes to Table 2.3-5 in [1]
* Issue 3-9: Changes to Table 2.3-6 in [1]
* Issue 3-10: Change to Table 2.3-7 in [1]
* Issue 3-11: AAS Antenna Pattern
* Issue 3-12: Non-AAS BS conducted power
* Issue 3-13: General consideration of propagation model
* Issue 3-16: TN-NTN SINR

### Open issues

**1) Issue 3-4: Central beam elevation angle**

* Option1: Add 45° for GEO only which is consistent with TR 38.821

**2) Issue 3-6: NTN UE deployment**

* Option 1: 3 UEs (with 2 RBs per UE )
* Option 2: 10/12/15 or other numbers

**3) Issue 3-7: NTN UL TPC**

* Option 1(remaining in [1]): Adopt the same TPC model of TN for NTN UL scenarios but needs to revise CLx-ile to align with UE UL power control parameters used in TR38.821. The CLx-ile value should be adapted for rural, dense urban and indoor scenarios.
* Option 2(remaining in [1]): The CLx-ile value should be adapted for rural, dense urban and indoor scenarios.
* Option 3(Observation of calibration): Do not use UL TPC as indicated by the calibration that UE is always working at maximum power level (23dBm) to ensure the throughput

**4) 3-14: Propagation model between NTN and UE**

* Option 1(Ericsson): From TR 38.811 NTN shadow fading values:
* Use table 6.6.2-3 for urban scenario (and not table 6.6.2-2).
* For BS LOS values in S-band, reuse LOS values from Ka-band in table 6.6.2-3.
* Option 2: Follow TR 38.811 values at current stage and send a LS to RAN 1 seeking for clarifications.
* Option 3: other solutions.

**5) Issue 3-15: Propagation model between TN BS and UE**

* Option 1(Qualcomm): limit Rural ISD as 5km.

Note: as described in 38.901, the distance is less then 5km.



* Option 2(Moderator): Use ISD derived from Cell range. Values of Cell range were agreed in last meeting.

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|  | Urban Macro | Rural Macro |
| Cell range in meters | 500 | 5000 |
| ISD in meters | 750 | 7500 |

**6) Issue 3-17: ACIR model for uplink cases**

For uplink ACIR model, how many UE numbers should be considered?

* Option 1: 3
* Option 2: Other numbers

**7) Issue 3-18: Non AAS BS mechanical downtilt angles**

* Option 1: Consider Rural 3 degree and Urban 10 degree for non-AAS as mechanical downtilt angles, same as Issue 5-11 agreements.

Details have been captured in [2].

## HAPS

### Agreements

Following agreements have been made and reflected in [3].

1. Do not use wrap-around network for HAPS.
2. Accept proposed parameters except “Tx power per antenna panel” and “Conducted power per antenna element”.

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| Element gain | 7.8 dBi |
| Element spacing horizontal/vertical | 0.7 wavelength for both H/V |
| EIPR/cell | 56.8 dBm (1st layer cell), 59.8 dBm (2nd layer cell) |
| EIRP spectral density/cell | 43.8 dBm/MHz (1st layer cell),46.8 dBm/MHz (2nd layer cell) |

1. Align the terrestrial network assumption with NTN simulation assumptions for HAPS coexistence scenarios, but specific parameters may be changed to meet the unique requirements for HAPS co-existence study
2. 3UEs for TN UL
3. Urban macro channel model can refer to TR 38.901.

### Open issues

**1) Issue 4-2: HAPS network parameters**

**Tx power per antenna panel:**

* Option 1: Remove this item
* Option 2: Keep this item

**Conducted power per antenna element:**

* Option 1: 21 dBm for 4 x 2 (x 2 polarizations)
* Option 2: 31dBm for 4 x 2 (x 2 polarizations)

**2) Issue 4-4: Specific TN network parameters**

**Indoor UE percentage:**

* Option 1: 0%
* Option 2: 20%
* Option 3: 80% (Uma) & 50%(Rural)

**ISD:**

* Option 1: 750m (UMa) & 7.5km (Rural)
* Option 2: 500m (Uma) & 5km (Rural)

**3) Issue 4-5: HAPS UL Scheduled BW**

* Option 1: 3UEs with [2][or more] RBs
* Option 2: 10UEs with 2RBs
* Option 3: Traffic mode needs to be considered when discussing Option 1&2

**4) Issue 4-7: UE uplink power control**

Determine TN & HAPS transmission BW based on agreements of Issue 4-5 & Issue 4-6

Details have been captured in [3].

## Calibration and alignment

### Agreements

The updated summary of calibration results and assumptions are shown in Annex 2 and Annex 3 respectively and will be captured in the new TR 38.863.

The calibration results indicate the consistency of most companies’ simulations. Therefore, calibration work has mostly been done for NTN coexistence. Companies can continue to contribute on calibration aspect over emails till Sep 30th.

For HAPS calibration, companies will continue the effort for calibration. It’s encouraged interested companies can provide results for HAPS, RAN4 will check the status till Nov 2021 RAN4 meeting.

RAN4 start to discuss the simulation assumption and co-existence results for phase 1 as agreed in previous work plan, RAN4 will check the status in Nov 2021 RAN4 meeting with the target to conclude phase 1 co-existence study by Nov 2021.

### Open issues

**1) Issue 5-7: TN polarization gain consideration**

* Option 1(Samsung, Xiaomi, CATT): polarization gain not considered;
* Option 2(Qualcomm, Nokia, Huawei): 3dB polarization gain considered

**2) Issue 5-10: Cell radius / Inter-site distance**

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|  | Option 1(Samsung) | Option 2(Nokia) | Option 3(CATT) |
| Inter-site distance(m) | Rural | 7500 | 2000 | 2500 |
| Urban | 750 | 1000 | 500 |

# Reference

[1] R4-2115785, “Email discussion summary for [100e][313]NTN\_Solutions\_Part2”, Samsung

[2] R4-2115750, “Simulation assumptions for NTN co-existence”, Samsung, CATT

[3] R4-2115751, “Simulation assumptions for HAPS co-existence”, Nokia

# Annex 1. Deployment of NTN&TN networks, UEs

**Options with Bold fonts and marked in green are those Agreed in 1st round.**

Options marked in yellow with square brackets are those for discussion in 2nd round.

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| **No.** | **Combination** | **Aggressor** | **Victim** | **Which NTN cell/UE to observe?**  | **Which TN/UE to observe?** | **Which TN cells in a TN to observe?** |
| 1 | TN with NTN | TN DL | NTN DL | **NTN cell:****Observe NTN central beam for SINR, 6 adjacent beams for inter-beam interference.**NTN UE:[Option 3(Qualcomm): NTN UEs dropped outside or at the edge of TN clusters] |  | [Option 1 (Ericsson): Consider an active rate of TN.Option 2 (Qualcomm): One cluster with 19 TN cells (57 sectors) randomly placed in the central NTN beam] | Qualcomm: Need clarification. For DL, we already agreed to only consider one TN with 19 TN cells (57 sectors), UEs randomly distributed in the TN cells. What does the active rate of TN here? | [Option 1 (Ericsson): All active TN cells.Option 2 (Samsung): All active TN cells which host NTN UEs] |  |
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| 2 | TN with NTN | TN UL | NTN UL | **NTN cell:****Observe NTN central beam for SINR, 6 adjacent beams for inter-beam interference.**NTN UE:[Option 3(Qualcomm): NTN UEs dropped outside or at the edge of TN clusters] |  | **Consider an active rate of 20% for Rural and Urban of TN.** |  | [Option 1: All active TN cells in central NTN beamOption 2: All active TN cells in all 7 NTN beams] |  |
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| 3 | TN with NTN | NTN DL | TN DL | **NTN cell:****Nadir point.****NTN UE:****NTN UEs dropped outside or at the edge of TN clusters** |  | [Option 1(Ericsson):FRF≠1: TN randomly placed in the NTN cell.FRF=1: TN at NTN cell edgeOption 2(Samsung):TN clusters randomly placed in this NTN beam] |  | **All in central NTN beam** |  |
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| **NTN cell:****NTN cell with satellite at low elevation (additional case)****NTN UE:****NTN UEs dropped outside or at the edge of TN clusters** | [Elevation angle TBD] | [Option 1(Ericsson):FRF≠1: TN randomly placed in the NTN cell.FRF=1: TN at NTN cell edgeOption 2(Samsung):TN clusters randomly placed in this NTN beam] |  |  |
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| 4 | TN with NTN | NTN UL | TN UL | **NTN cell:****Option 1(Ericsson and Samsung): Nadir point.**NTN UE:[Option 2(Samsung): NTN UEs dropped inside the TN clusters (19-cell with wrap-around).Option 3(Qualcomm): NTN UEs dropped outside or at the edge of TN clusters] |  | **N randomly placed in this NTN beam** |  | [Option 1 (Ericsson):Only the TN cells (sectors) hosting NTN UE(s)Option 2 (Qualcomm): All 19 TN cells (57 sectors)] |  |
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| 5 | TN with NTN | NTN UL | TN DL | **NTN cell:** **Option 1 (Ericsson): nadir point**NTN UE:[Option 2(Qualcomm): NTN UEs dropped outside or at the edge of TN clusters] |  | [Option 1(Ericsson):FRF≠1: TN randomly placed in the NTN cell.FRF=1: TN at NTN cell edgeOption 2(Samsung):TN clusters randomly placed in this NTN beam] | Clarification on Option 2 is needed with regard to Qualcomm’s addition “One cluster with 19 TN cells (57 sectors) randomly placed in the NTN beam”*.* | [Option 1 (Ericsson):AllOption 2 (Samsung): All TN cells which host NTN UEs.] |  |
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| ***Summary:***  | ***Summary:***  | ***Summary:***Note that this is a UE-UE case,  |
| NTN cell:Option 1(Ericsson):NTN cell with satellite at low elevation (additional case)NTN UE:[Option 2(Qualcomm): NTN UEs dropped outside or at the edge of TN clusters] |  | [Option 1(Ericsson)FRF≠1: TN randomly placed in the NTN cell.FRF=1: TN at NTN cell edgeOption 2(Samsung):TN clusters randomly placed in this NTN beam] | Clarification on Option 2 is needed with regard to Qualcomm’s addition “One cluster with 19 TN cells (57 sectors) randomly placed in the NTN beam”. | [Option 1 (Samsung): All TN cells which host NTN UEsOption 2 (Qualcomm): All the 19 TN cells (57 sectors)] | ***[Try to agree on Option 1]*** |
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| ***Summary:***Note that this is a UE-UE case. | ***Summary:***  | ***Summary:*** |

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| 6 | TN with NTN | TN DL | NTN UL | **NTN cell:****Observe NTN central beam for SINR, 6 adjacent beams for inter-beam interference.****NTN UE:****NTN UEs dropped outside or at the edge of TN clusters** |  | **Consider the active rate of 20% for Rural and Urban of TN.** |  | [Option 1: All active TN cells in central NTN beamOption 2: All active TN cells in all 7 NTN beams] |  |
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| 7 | TN with NTN | TN UL | NTN DL | TBD | Qualcomm: No need to consider this scenario for S-band at this stage. | TBD |  |  |  |
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| ***Summary:*** ***Given the tentative agreement of Issue 1-4, do not consider this scenario at this stage*** |

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| 8 | TN with NTN | NTN DL  | TN UL | NTN cell: Option 1 (Ericsson): nadir point | Samsung: Support Option 1. | Option 1(Ericsson):TN randomly placed in this NTN beam | Samsung: Support Option 1. | Option 1(Ericsson):Only the TN cells hosting NTN UE(s)Option 2(Samsung)All active TN cells in this beam | Samsung: Both options seem not very fit in this row. We propose to modify Option 2 to ‘All active TN cells in this beam’ |
| Ericsson: option 1 | Ericsson: option 1 | Ericsson: option 1. Due to NTN UE density, which would be very low in a TN, impact might be too minimized while it might be huge in the vicinity of a NTN UE… |
| ZTE:option 1 | ZTE: option 1 | ZTE: all active TN cells should be defined.s |
| Qualcomm: No need to consider this scenario per S-band frequency allocation at this stage. Low elevation needs to be considered if it applies for other NTN bands.  |  |  |
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| Summary: 3 support Option 1 | Summary: 3 support Option 1 | Summary: Further discuss Option 1 & new Option 2 |
| ***Summary:*** ***Given the tentative agreement of Issue 1-4, do not consider this scenario at this stage*** |

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| 9 | NTN with NTN | NTN DL | NTN DL | TBD |  | TBD |  | NA |  |
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| NTN UL | NTN UL | TBD |  | TBD |  | NA |  |
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# Annex 2. NTN co-existence calibration data

See Attachment 1.

# Annex 3. NTN co-existence calibration assumptions

Open issues are still under discussion in 2nd round and marked in yellow with square brackets.

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| **Calibration Assumptions** | **Values** |
| **Propagation model 38.811 for NTN** | Basic path loss  | Yes |
| Atmospheric loss | 0 |
| Ionospheric or scintillation loss | 0 |
| O2I / building-entry loss | N/A |
| **NTN SINR** | SINR statistics target | Central beam (UL/DL) |
|  Interference | Co-channel interference from 6 adjacent beams  |
|  BW / #UE  | 20MHz / 1 DL, 3UL  |
| Polarization gain with 3dB | Not considered |
| Elevation angle | 90 degrees for GEO and LEO |
| **TN AAS** | Rural | Element gain | 7.1 dBi |
| 3dB | H 90 / V 54 |
| Front-back | 30 H/V |
| Array | 8x8 |
| Element spacing | H 0.5/V 0.9 |
| Conducted Tx | 25 dBm |
| Ohmic loss | 2 dB |
| Mechanical downtilt | 3 deg  |
| Polarization gain | [Option 1: Not considerOption 2: 3dB] |
| No. of UE | 1 DL/ 3 UL  |
| Outdoor | 100% Outdoor |
| ISD | [TBD in Issue 5-10] |
| Urban | Element gain | 6.4 dBi |
| 3dB | H 90 / V 65 |
| Front-back | 30 H/V |
| Array | 8x8 |
| Element spacing | H 0.5/V 0.7 |
| Conducted Tx | 25 dBm |
| Ohmic loss | 2 dB |
| Mechanical downtilt | 10 deg  |
| Polarization gain | [Option 1: Not considerOption 2: 3dB] |
| No. of UE | 1 DL/ 3 UL  |
| Outdoor | 100% Outdoor |
| ISD | [TBD in Issue 5-10] |
| **TN non-AAS** | Antenna gain  | 17 dBi |
| Conducted Tx  | 46 dBm  |
| 3dB | Referring to R4-2108645 Table 2.4.3-1 |
| Front-back | Referring to R4-2108645 Table 2.4.3-1 |
| Mechanical downtilt | Rural 3 / Urban 10 |
| **HAPS SINR** | SINR statistics target | 7 cells for DL and UL, HAPS UE is uniformly distributed in 7 cells |
|  Interference | Co- channel interference from other 6 cells  |
|  BW / #UE  | 20MHz/1DL, 3UL and each UE BW is 0.36MHz |
| Polarization gain with 3dB | Considered  |
| **Propagation model 38.811 for HAPS** | Basic path loss  | Yes |
| Atmospheric loss | 0 |
| Ionospheric or scintillation loss | 0 |
| O2I / building-entry loss | 0 |
| **HAPS** | power control parmater  | gamma =1, CL-ile = 121.45 |
| Rural vs. Urban difference  | Only reflect on the propagation model. Other assumptions are the same.  |