**3GPP TSG-RAN WG4 Meeting # 100-e [draft]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 the 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.

Summary of status in this intermediate version are made based on 2nd round discussion by 9:00 UTC, Aug. 25, with the purpose to facilitate the discussion in GTW session on Aug. 25.

# 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

Conclusion of 2nd round discussion:

Agree on Option 1 to remove Dense Urban scenario with some clarification to explain the rationale included in TR 38.863. The wording will be further discussed.

**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.

Conclusion of 2nd round discussion: Agree on Option 2.

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

* Option 1a (Thales): Remove LEO-LEO, LEO-GEO and GEO-GEO scenarios in S-band of [1980-2010 MHz (UL) and 2170-2200 MHz (DL)]
* Option 1b(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.

Conclusion of 2nd round discussion:

Keep NTN-NTN for the time being. Satellite operators and vendors are strongly encouraged to introduce clarifications on following matters:

* How two adjacent NTN networks would co-exist?
* In-addition, whether and how GEO and LEO can co-exist under ITU framework?

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

Agreement of GTW session on Aug.25:

Adding 45° for GEO and LEO as baseline assumption for simulation. Interested companies can bring analysis and results for other values

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

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

Agreement of GTW session on Aug.25:

9 UEs and 2RBs per UE for GEO and LEO

- UEs are equally splitted inside the channel bandwidth into ACIR 3 regions.

**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

Agreement of GTW session on Aug.25: Option 1.

**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.

Agreement of GTW session on Aug.25:

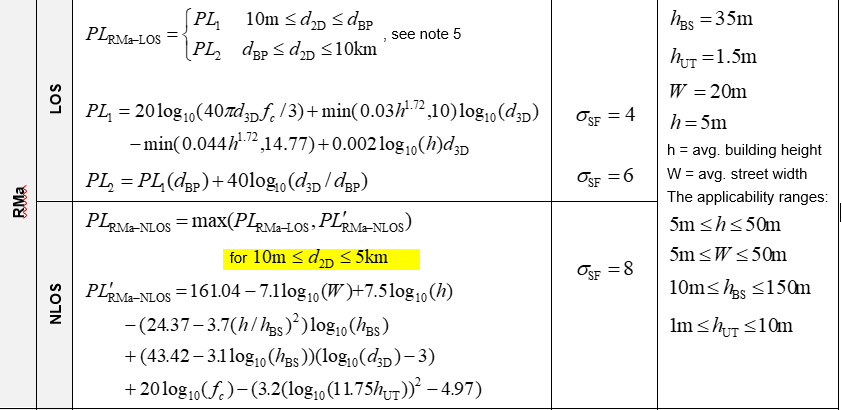
Accept Option 2

- Further discuss and include background information into RAN4 TR 38.863

**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 |

Conclusion of 2nd round discussion: Accept Option 2.

**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

Conclusion of 2nd round discussion: the number would be 9 in alignment of Issue 3-16

**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.

Conclusion of 2nd round discussion: Accept Option 1.

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”.

|  |  |
| --- | --- |
| 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

Conclusion of 2nd round discussion: Accept Option 2 to 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)

Conclusion of 2nd round discussion: Accept Option 2.

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

**Indoor UE percentage:**

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

Conclusion of 2nd round discussion: Accept Option 1 as baseline. Interested companies can input additional results based on Option 3.

**ISD:**

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

Conclusion of 2nd round discussion: Accept Option 1 to align with NTN cases.

**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

Remaining issue: Further discuss RB numbers and UE numbers.

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

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

[Status: TN BW of 5.94MHz seems OK, but HAPS BW needs further discussion pending on Issue 4-5.]

Conclusion of 2nd round discussion: Accept 5.94MHz as TN UE BW.

Remaining issue: Further discuss HAPS UE BW.

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

Conclusion of 2nd round discussion: Adopt Option 2. 3dB polarization gain.]

**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 |

Conclusion of 2ndround discussion: Adopt Option 1.

# 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

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

**[Options with Bold fonts and marked in green are those Agreed in 1st round and GTW session on Aug.25.**

Options marked in yellow with square brackets are those concluded based on 2nd round discussion.]

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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:**  **NTN UEs dropped 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? | **All active TN cells which host NTN UEs** |  |
|  | Samsung: Option 2.  In this case, the NTN UE is suffering interference from TN BS, Consider the TN stations that far from the interfered NTN UE is resource consuming and meaningless. |  |
|  | Ericsson:  Option 2 would be ok as we have 1 NTN beam only and 1 TN only.  To Qualcomm: the active rate consideration would be relevant when considering all NTN beams/cells.  If we have only 1 TN (as agreed in 1st round), then the active rate would not be relevant anymore. |  |
|  | Qualcomm: Thanks Ericsson for the clarifications. We support Option 2 |  |
|  | ***Tentative agreement: Option 2*** |  |

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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**] | Samsung: NTN UE drop can be skipped in this case. | **Consider an active rate of 20% for Rural and Urban of TN.** |  | ~~[Option 1:~~ **All active TN cells in central NTN beam**  ~~Option 2: All active TN cells in all 7 NTN beams]~~ | Samsung: Option 1 or 2. |
| Ericsson: to be aligned with #1 (in this table) |  | Ericsson: Option 1.  As we agreed to only have 1 NTN beam, option 2 is not relevant anymore |
| Qualcomm: Drop UE at the edge of TN cluster |  | Qualcomm: Option 1 |
| ZTE: NTN UE should dropped in the7 beams, and TN UE should be dropped in 7 beams.  For NTN victim UE, only center beam is considered, however when calculating the SINR without interference from TN, other 6 beams interference should be still considered. |  | ZTE: prefer option 2. it’s difficult to understand that why for center beam, interference from other beams should not been considered. |
| ***Suggestion: To align with #1***  **NTN UEs dropped at the edge of TN clusters** |  | ***Suggestion: To align with #1.***  **All active TN cells which host NTN UEs** |

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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** |  | **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 (45° for GEO and LEO，Interested companies can bring analysis and results for other values)**  **NTN UE:**  **NTN UEs dropped outside or at the edge of TN clusters** | [Elevation angle TBD] | **TN clusters randomly placed in this NTN beam** |  |  |
| Samsung: elevation angle should refer to discussion result of Issue 3-4. |  |  |
| Ericsson: Ok to align with issue 3-4. |  |  |
| ***Tentative agreement:***  ***45° for GEO and LEO，Interested companies can bring analysis and results for other values*** |  |  |

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| 4 | TN with NTN | NTN UL | TN UL | **NTN cell:**  **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**~~]~~ | Samsung: Option 2 or 3.  We are OK to take either option which can be agreed by the meeting. For Option 3, we cannot agree to drop NTN UE outside the TN cluster without limitation.  Whatever is to be agreed should be clear and workable. | **TN 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)]~~ | Samsung: Option 2 or 1.  We prefer Option 2 but can go with Option 1. |
| Ericsson: Option 2 or option 3 with NTN UEs dropped around cell edge, but not outside. To be aligned with #5. |  | Ericsson: option 1 |
| Qualcomm: Option 3. UE drop at the edge of TN clusters |  | Qualcomm: prefer option 2 but fine with option 1 |
| ***Suggestion: To align with #1***  **NTN UEs dropped at the edge of TN clusters** |  | ***Tentative agreement: Option 1*** |

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| 5 | TN with NTN | NTN UL | TN DL | **NTN cell:**  **Nadir point**  NTN UE:  ~~[Option 2(Qualcomm):~~ **NTN UEs dropped** ~~outside or~~ **at the edge of TN clusters**~~]~~ | Samsung: Part of Option 2.  For NTN UE, we can agree on UEs to be dropped at the edge of TN clusters or randomly inside the TN clusters. But we cannot agree on ‘out of TN clusters’ without limitation.  It should be clear and workable. | **TN clusters randomly placed in this NTN beam** |  | ~~[Option 1 (Ericsson):~~  ~~All~~  ~~Option 2 (Samsung):~~ **All TN cells which host NTN UEs.**~~]~~ | Samsung: Option 2.  It’s not meaningful to consider all TN cells which are far away from those interfering NTN UEs. |
| Ericsson: Option 2 with NTN UEs dropped around cell edge, but not outside.  To be aligned with #4. |  | Ericsson: ok with option 2 |
| Qualcomm: Option 2 with at the edge of TN clusters. |  | Qualcomm: Option 2 |
| ZTE: option 2 is not correct, if NTN UE is outside of TN cluster, the NTN ue to TN ue distance might be very large, then NTN UL to TN DL interference might be limited. |  | ZTE: fine with option 2. |
| ***Suggestion: To align with #1***  **NTN UEs dropped at the edge of TN clusters** |  | ***Tentative agreement: Option 2*** |
| **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:**  ~~[Option 2(Qualcomm):~~ **NTN UEs dropped** ~~outside or~~ **at the edge of TN clusters**~~]~~ | Samsung: Part of Option 2.  Same as above. | [Option 1(Ericsson)  ~~FRF≠1: TN randomly placed in the NTN cell.~~  ~~FRF=1: TN at NTN cell edge~~  ~~Option 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 UEs**  ~~Option 2 (Qualcomm): All the 19 TN cells (57 sectors)]~~ | ***1st round suggestion: Try to agree on Option 1*** |
| Ericsson: Option 2 with NTN UEs dropped around cell edge, but not outside.  To be aligned with #4. | Samsung: Option 2  Same as above. | Samsung: Option 1 and 2 (Combine)  Clarifications on Option1, we mean one TN cluster (19-cell, 57 sectors) that either host NTN UEs, or has the NTN UE at its edge, depending on the discussion on NTN UE location. |
| Qualcomm: Option 2 with at the edge of TN clusters. | Ericsson: Option 1: The scenario for FRF=1 is a worst case scenario, still realistic considering only 1 TN in 1 NTN beam. | Ericsson: should be aligned with the above: all TN cells which host a NTN UEs. |
| ZTE: option 2 is not correct, if NTN UE is outside of TN cluster, the NTN ue to TN ue distance might be very large, then NTN UL to TN DL interference might be limited. | Qualcomm: Option 2 | Qualcomm: OK with option 1 with Samsung’s clarifications. |
| ***Tentative agreement:***  ***NTN cell***  ***45° for GEO and LEO，Interested companies can bring analysis and results for other values***  ***Suggestion: To align with #1***  ***NTN UE***  ***NTN UEs dropped at the edge of TN clusters*** | ***Suggestion: To align with above.***  **TN clusters randomly placed in this NTN beam** | ***Tentative agreement: Option 1*** |

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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 beam**  ~~Option 2: All active TN cells in all 7 NTN beams]~~ | Samsung: Option 1 or 2. |
|  |  | Ericsson: option 1  As we agreed to have 1 NTN beam only, option 2 is not relevant anymore. |
|  |  | Qualcomm: Option 1 |
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|  |  | ***Tentative agreement: Option 1*** |

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| 7 | TN with NTN | TN UL | NTN DL | 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 |  | Option 1(Ericsson):  TN randomly placed in this NTN beam |  | Option 1(Ericsson):  Only the TN cells hosting NTN UE(s)  Option 2(Samsung)All active TN cells in this beam |  |
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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 | 3dB |
| No. of UE | 1 DL/ 3 UL |
| Outdoor | 100% Outdoor |
| ISD | Rural: 7500m; Urban: 750m |
| 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 | 3dB |
| No. of UE | 1 DL/ 3 UL |
| Outdoor | 100% Outdoor |
| ISD | Rural: 7500m; Urban: 750m |
| **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. |