**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210XXXX**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 8.8.2

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [98-bis-e][308] NTN\_Solutions\_Part2

**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.*

This lead summary document captures issues related to NR NTN coexistence aspects. It contains a summary of the contributions under sections 8.8.2 at TSG-RAN WG4 #98-bis-e, together with identified key open issues and recommends topics/questions to be handled via email discussions. The goal of this document is also to provide recommendation on prioritization of discussion and whether any issues should be postponed.

A total of 14 TDOCs have been received for this agenda (See Appendix 1) and 5 topics are listed as below to cover proposals and contents in these documents as appropriate.

* Topic #1: Coexistence simulation scenarios
* Topic #2: Network layout model & methodology
* Topic #3: Other simulation assumptions
* Topic #4: HAPS
* Topic #5: Calibration alignment

To progress the discussion, it is proposed that the meeting could:

* 1st round: Focus on Topic #1 and 2, targeting on narrowing down co-existence scenarios and agreeing on network layout aspects.
* 2nd round: Focus on Topic #3, 4, 5. Separate documents capturing assumptions for discussion are suggested. Target to agree on WFs for simulation assumptions to provide results in RAN4 #99e.

# Topic #1: Coexistence Scenarios

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2105045 | Samsung | Proposal 1: Deprioritize the inference scenario of NTN UL (aggressor) to TN UL (victim) for coexistence study in Rel-17. |
| R4-2106476 | CATT | The proposed scenarios for coexistence study are duplicated in the following table.  Table 2.1-1 Scenarios for NTN-NTN/TN co-existence   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **FR1: 2GHz** | | | **Set 1** | | | **Set 2** | | | **HAPS** | | **GEO** | **LEO 600km** | **LEO 1200km** | **GEO** | **LEO 600km** | **LEO 1200km** | | **NR / NB-IoT** | **Rural** | | X | X | X | X | X | X | FFS | | **Urban macro** | | X | X | X | X | X | X | FFS | | **Dense Urban** | | X | X | X | X | X | X | FFS | | **Indoor** | | X | X | X | X | X | X |  | | **NTN** | **GEO** | **Set 1** | X | X | X | N/A | N/A | N/A | FFS | | **LEO 1200km** | X | X | X | N/A | N/A | N/A | FFS | | **LEO 600km** | X | X | X | N/A | N/A | N/A | FFS | | **GEO** | **Set 2** | N/A | N/A | N/A | X | X | X | FFS | | **LEO 1200km** | N/A | N/A | N/A | X | X | X | FFS | | **LEO 600km** | N/A | N/A | N/A | X | X | X | FFS | | Note 1: Start with Earth Fixed beam first, Earth Moving Beams could be further discussed  Note 2: Set 1 and Set 2 could be found in Table 6.1.1.1-6 of TR 38.821. FFS if one set would be more stringent and so, if all simulations would be needed for both sets.  Note 3: GEO and LEO only operate at adjacent channel. | | | | | | | | | |   The aggressor and victim combination is list in Table 2.1-2.  Table 2.1-2 Aggressor and victim   |  |  |  |  |  | | --- | --- | --- | --- | --- | | No. | Combination | **Aggressor** | **Victim** | Notes | | 1 | TN with NTN | TN DL | NTN DL |  | | 2 | TN with NTN | TN UL | NTN UL |  | | 3 | TN with NTN | NTN DL | TN DL |  | | 4 | TN with NTN | NTN UL | TN UL |  | | 5 | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | | 6 | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | | 7 | NTN with NTN | NTN DL | NTN DL | LEO-LEO or GEO-GEO | | NTN UL | NTN UL | LEO-LEO or GEO-GEO |   The proposed frequency and bandwidth are listed as table 2.1-3.  Table 2.1-3. Proposed frequency and bandwidth for co-existence study   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **Frequency** | **Bandwidth** | **Duplex mode** | **Frequency reuse factor** | | Rural | 2 GHz | TBD | FDD, TDD | [1] | | Urban macro | 2 GHz | TBD | FDD, TDD | [1] | | Dense Urban | 2 GHz | TBD | FDD, TDD | [1] | | GEO | 2 GHz | 30 MHz for FR1 | FDD | [2] or [3] | | LEO | 2 GHz | 30 MHz for FR1 | FDD | [2] or [3] | | HAPS | 2 GHz | TBD | FDD | [1] | |
| R4-2106544 | Xiaomi | Observation 1: For the same cases, the ACIR for SET1 is more than that for SET2.  Observation 2: In term of ACIR, LEO 600Km is the worst case. |
| R4-2106609 | ZTE | Proposal 1: to adopt Table 1 for NTN coexistence study  **Table 1. scenarios for NTN coexistence study**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | No. | Combination | **Aggressor** | **Victim** | Notes | | 1 | TN with NTN | TN DL | NTN DL |  | | 2 | TN with NTN | TN UL | NTN UL |  | | 3 | TN with NTN | NTN DL | TN DL |  | | 4 | TN with NTN | NTN UL | TN UL |  | | 5 | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S band, e.g. coexistence with Band n34 and n41 | | 6 | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S band, e.g. coexistence with Band n34 and n41. |   Proposal 2: to focus the co-channel deployment for HAPS; |
| R4-2106684 | Huawei，HiSilicon | Proposal 1: It is proposed to assume 30MHz channel bandwidth for 2GHz, considering the worst case and the maximum output power. |
| R4-2106685 | Huawei，HiSilicon | There are eight types of interference which are summarized as below.   |  |  |  |  | | --- | --- | --- | --- | | No. | Combination | **Aggressor** | **Victim** | | 1 | TN - NTN | TN DL (TN BS) | NTN DL (NTN UE) | | 2 | TN - NTN | TN DL (TN BS) | NTN UL (NTN satellite) | | 3 | TN - NTN | TN UL (TN UE) | NTN UL (NTN satellite) | | 4 | TN - NTN | TN UL (TN UE) | NTN DL (NTN UE) | | 5 | TN - NTN | NTN DL (NTN satellite) | TN DL (TN UE) | | 6 | TN - NTN | NTN DL (NTN satellite) | TN UL (TN BS) | | 7 | TN - NTN | NTN UL (NTN UE) | TN DL (TN UE) | | 8 | TN - NTN | NTN UL (NTN UE) | TN UL (TN BS) | |
| R4-2107194 | Nokia, Nokia Shanghai Bell | Proposal 1: Assume HAPS altitude 20 Km in the coexistence study.  Proposal 2: Evaluate HAPS-HAPS coexistence in rural environment.  Proposal 5: Assume all UEs served by HAPS are outdoor UEs. |
| R4-2107270 | Thales | Figure 2: 3GPP bands that could be considered for adjacent channel coexistence with MSS NTN    Figure 3: S-band NTN-TN adjacent band coexistence scenarios with TN in FDD mode    Figure 4: S-band NTN-TN adjacent band coexistence scenarios with TN in FDD mode  The previous table (with the aggressor and victim combination list) should be further revised into:  **Table 1. Aggressor and victim scenarios for NTN-NTN/TN co-existence**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **No.** | **Combination** | **Aggressor** | **Victim** | **Comment** | **5G bands potentially considered for coexistence in adjacent channels with MSS S-Band**  **(1980-2010 MHz for UL; 2170-2200 MHz for DL)** | | 1.  **(i1)** | TN with NTN | TN DL | NTN DL | Coexistence with FDD band. | n1, n65; b23; b4, b10, n66 | | 2.  **(i2)** | TN with NTN | TN UL | NTN UL | Coexistence with FDD band. | n1, n65; b23; (n2, n25); n70 | | 3.  **(i3)** | TN with NTN | NTN DL | TN DL | Coexistence with FDD band. | n1, n65; b23; b4, b10, n66, see note | | 4.  **(i4)** | TN with NTN | NTN UL | TN UL | Coexistence with FDD band. | n1, n65; b23; (n2, n25); n70, see note  **Remark:** This scenario should be deprioritized since NTN-TN UL coexistence in adjacent bands is similar to already existent TN-TN UL coexistence in adjacent bands | | 5.  **(i5)** | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | n34, (n39) | | 6.  **(i6)** | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | n34, (n39) | | 7. | NTN with NTN | NTN DL | NTN DL | LEO-LEO or  GEO-GEO or  GEO-LEO600 or  HAPS-HAPS | NTN MSS S-Band 5MHz with adjacent NTN MSS S-Band 5 MHz | | 8. | NTN with NTN | NTN UL | NTN UL | LEO-LEO or  GEO-GEO or  GEO-LEO600 or  HAPS-HAPS | NTN MSS S-Band 5MHz with adjacent NTN MSS S-Band 5 MHz |   **Note:** n1 and S-Band is a family of n65.  Proposal 1: RAN4 shall remove from S-band coexistence scenarios the combination TN-NTN with FDD NTN UL to FDD TN UL.  Observation 1: For S-band there are currently around 58 scenarios to be considered for simulations required for coexistence studies in adjacent bands, and 50 if we do not consider NTN UL (aggressor) to TN UL (victim) with 8 potential combinations.  Proposal 2: RAN4 should further considering down-scoping coexistence studies from existent proposed NTN-TN and/or NTN-NTN coexistence in adjacent bands.  Proposal 4: RAN4 should prioritize NTN-TN adjacent channel coexistence for S-band.  Proposal 5: RAN4 should prioritize FDD TN adjacent channel coexistence for S-band.  Proposal 6: RAN4 should prioritize LEO@600km and GEO scenarios.  Observation 2: These decisions may further help to further reduce the number of adjacent channel coexistence scenarios for S-band to a lower number, as represented below:   |  |  |  |  | | --- | --- | --- | --- | | **Combination** | **Aggressor** | **Victim** | **Number of scenarios** | | TN with NTN | TN DL | NTN DL | At least 6 | | TN with NTN | TN UL | NTN UL | At least 6 | | TN with NTN | NTN DL | TN DL | At least 6 | | **Total number of scenarios FR1 S-band** |  | | **Around 18** |   Observation 3: Finally, if HAPS is excluded from Satellite coexistence scenarios analysis (since not a satellite), than for satellite coexistence cases only 12 scenarios will be relevant, which is a reasonable assumption from the simulations point of view.   |  |  |  |  | | --- | --- | --- | --- | | **Combination** | **Aggressor** | **Victim** | **Number of scenarios** | | TN with NTN | TN DL | NTN DL | At least 4 | | TN with NTN | TN UL | NTN UL | At least 4 | | TN with NTN | NTN DL | TN DL | At least 4 | | **Total number of scenarios FR1 S-band** |  | | **Around 12** | |

## Open issues summary

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

### Sub-topic 1-1

*Open issues and candidate options before e-meeting:*

**Issue 1-1: Scenarios for NTN-NTN/TN co-existence**

* Proposals
  + Option 1: Adopt following scenarios for NTN-NTN/TN co-existence

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **FR1: 2GHz** | | | **Set 1** | | | **Set 2** | | | **HAPS** |
| **GEO** | **LEO 600km** | **LEO 1200km** | **GEO** | **LEO 600km** | **LEO 1200km** |  |
| **NR / NB-IoT** | **Rural** | | X | X | X | X | X | X | FFS |
| **Urban macro** | | X | X | X | X | X | X | FFS |
| **Dense Urban** | | X | X | X | X | X | X | FFS |
| **Indoor** | | X | X | X | X | X | X |  |
| **NTN** | **GEO** | **Set 1** | X | X | X | N/A | N/A | N/A | FFS |
| **LEO 1200km** | X | X | X | N/A | N/A | N/A | FFS |
| **LEO 600km** | X | X | X | N/A | N/A | N/A | FFS |
| **GEO** | **Set 2** | N/A | N/A | N/A | X | X | X | FFS |
| **LEO 1200km** | N/A | N/A | N/A | X | X | X | FFS |
| **LEO 600km** | N/A | N/A | N/A | X | X | X | FFS |
| Note 1: Start with Earth Fixed beam first, Earth Moving Beams could be further discussed  Note 2: Set 1 and Set 2 could be found in Table 6.1.1.1-6 of TR 38.821. FFS if one set would be more stringent and so, if all simulations would be needed for both sets.  Note 3: GEO and LEO only operate at adjacent channel. | | | | | | | | | |

* + Option 2: Evaluate HAPS-HAPS coexistence in rural environment. Assume all UEs served by HAPS are outdoor UEs.
  + Option 3: Use Set 1 Satellite Antenna (based on initial study results).
  + Option 4: Prioritize LEO@600km and GEO.
* Recommended WF
  + Further down scope the scenarios based on discussions on Options above. Please provide your views on Option 1~4.

### Sub-topic 1-2

*Open issues and candidate options before e-meeting:*

**Issue 1-2: Interference table**

* Proposals
  + Option 1:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Combination | **Aggressor** | **Victim** | Notes |
| 1 | TN with NTN | TN DL | NTN DL |  |
| 2 | TN with NTN | TN UL | NTN UL |  |
| 3 | TN with NTN | NTN DL | TN DL |  |
| 4 | TN with NTN | NTN UL | TN UL |  |
| 5 | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. |
| 6 | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. |
| 7 | NTN with NTN | NTN DL | NTN DL | LEO-LEO or GEO-GEO |
| NTN UL | NTN UL | LEO-LEO or GEO-GEO |

* + Option 2:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Combination | **Aggressor** | **Victim** | Notes |
| 1 | TN with NTN | TN DL | NTN DL |  |
| 2 | TN with NTN | TN UL | NTN UL |  |
| 3 | TN with NTN | NTN DL | TN DL |  |
| 4 | TN with NTN | NTN UL | TN UL |  |
| 5 | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. |
| 6 | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. |

* + Option 3:

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Combination | **Aggressor** | **Victim** |
| 1 | TN - NTN | TN DL (TN BS) | NTN DL (NTN UE) |
| 2 | TN - NTN | TN DL (TN BS) | NTN UL (NTN satellite) |
| 3 | TN - NTN | TN UL (TN UE) | NTN UL (NTN satellite) |
| 4 | TN - NTN | TN UL (TN UE) | NTN DL (NTN UE) |
| 5 | TN - NTN | NTN DL (NTN satellite) | TN DL (TN UE) |
| 6 | TN - NTN | NTN DL (NTN satellite) | TN UL (TN BS) |
| 7 | TN - NTN | NTN UL (NTN UE) | TN DL (TN UE) |
| 8 | TN - NTN | NTN UL (NTN UE) | TN UL (TN BS) |

* + Option 4:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Combination** | **Aggressor** | **Victim** | **Comment** | **5G bands potentially considered for coexistence in adjacent channels with MSS S-Band**  **(1980-2010 MHz for UL; 2170-2200 MHz for DL)** |
| 1.  **(i1)** | TN with NTN | TN DL | NTN DL | Coexistence with FDD band. | n1, n65; b23; b4, b10, n66 |
| 2.  **(i2)** | TN with NTN | TN UL | NTN UL | Coexistence with FDD band. | n1, n65; b23; (n2, n25); n70 |
| 3.  **(i3)** | TN with NTN | NTN DL | TN DL | Coexistence with FDD band. | n1, n65; b23; b4, b10, n66, see note |
| 4.  **(i4)** | TN with NTN | NTN UL | TN UL | Coexistence with FDD band. | n1, n65; b23; (n2, n25); n70, see note  **Remark:** This scenario should be deprioritized since NTN-TN UL coexistence in adjacent bands is similar to already existent TN-TN UL coexistence in adjacent bands |
| 5.  **(i5)** | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | n34, (n39) |
| 6.  **(i6)** | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | n34, (n39) |
| 7. | NTN with NTN | NTN DL | NTN DL | LEO-LEO or  GEO-GEO or  GEO-LEO600 or  HAPS-HAPS | NTN MSS S-Band 5MHz with adjacent NTN MSS S-Band 5 MHz |
| 8. | NTN with NTN | NTN UL | NTN UL | LEO-LEO or  GEO-GEO or  GEO-LEO600 or  HAPS-HAPS | NTN MSS S-Band 5MHz with adjacent NTN MSS S-Band 5 MHz |

**Note:** n1 and S-Band is a family of n65.

* + Option 5: Deprioritize the inference scenario of NTN UL (aggressor) to TN UL (victim) for coexistence study in Rel-17.
  + Option 6: Remove from S-band coexistence scenarios the combination TN-NTN with FDD NTN UL to FDD TN UL.
  + Option 7: Further considering down-scoping coexistence studies from existent proposed NTN-TN and/or NTN-NTN coexistence in adjacent bands.
  + Option 8: Prioritize NTN-TN adjacent channel coexistence for S-band. And RAN4 should prioritize FDD TN adjacent channel coexistence for S-band.
* Recommended WF
  + Discuss WFs shown as below per item.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Combination | **Aggressor** | **Victim** | Notes | WF |
| 1 | TN - NTN | TN DL | NTN DL |  | WF: Prioritize FDD TN |
| 2 | TN with NTN | TN UL | NTN UL |  | WF: Prioritize FDD TN |
| 3 | TN with NTN | NTN DL | TN DL |  | WF: Prioritize FDD TN |
| 4 | TN with NTN | NTN UL | TN UL |  | WF: Do not consider. |
| 5 | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | WF: Consider TDD TN |
| 6 | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | WF: Consider TDD TN |
| 7 | TN - NTN | TN UL | NTN DL |  | WF: Prioritize FDD TN |
| 8 | TN - NTN | NTN DL | TN UL |  | WF: Prioritize FDD TN |
| 9 | NTN with NTN | NTN DL | NTN DL | LEO-LEO or  GEO-GEO or  GEO-LEO@600 or  HAPS-HAPS | WF: Deprioritize |
| NTN UL | NTN UL | LEO-LEO or  GEO-GEO or  GEO-LEO@600 or  HAPS-HAPS | WF: Deprioritize |

Figure 1.2.1 is only for information to have a general profile of potential coexistence between TN bands and MSS S-band (1980-2010 MHz for UL; 2170-2200 MHz for DL)



Figure 1.2.1: 3GPP bands that could be considered for adjacent channel coexistence with MSS NTN

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 1-1 |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 1-2 |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #2: Network layout model & methodology

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2105045 | Samsung | Proposal 3: Simulation methodology in section 2.3 is proposed to be applied for coexistence simulation of NTN DL to TN DL interference scenario.  **2.3.1 NTN DL to TN DL Co-existence Layout**  It is proposed that the TN, as victim system, is generated inside the central beam of the NTN, as aggressor system.  Due to the assumption of using omni-directional antenna for both NTN and TN UE in 2 GHz, mathematically, it is sufficient to study the impact of TN inside the NTN central beam, and to skip the cases of TN in other NTN beams.    **2.3.2 Coordinate System**  Referring to TR 38.811 Section 6.3 and Annex A, a 3D global coordinate system is considered (Earth-Centred Earth Fixed) for simulating NTN beams direction and location on the earth surface. It means the NTN beam location, TN randomly dropping location are generated with a set of three parameters (x,y,z). **2.3.3 Methodology of System Level Simulation** It is proposed to adopt following simulation steps by considering both implementation complexity and statistical nature.  Step 1: Aggressor (NTN) and victim (TN) network locations are generated.  - NTN central beam is at satellite nadir, surrounded with 6 co-frequency beams.  - TN (19-cell with wrap around) center is randomly generated within the NTN central beam on earth surface.  Step 2: UE generation and association.  - NTN UE is randomly generated within the TN area depending on the NTN UE density.  - TN UE are generated randomly inside the TN network, make sure enough TN UEs are associated to each TN sectors based on coupling loss.  Step 3: Once association is done, round robin scheduling is used. BF weights are adjusted to point to the LOS direction between BS-UE. This is done for both victim and aggressor networks.  Step 4: Throughput is computed in the victim systems without considering ACI as below:  - , where is the inter-cell interference.  Step 5: Throughput is computed considering ACI as below:  - , where is the adjacent channel interference.  Step 6: RF parameters are determined based on the degradation cause by ACI as below:  *- .* |
| R4-2106476 | CATT | **Co-existence between NTN and TN**  For co-existence between NTN and TN, it is proposed to consider [TBD] satellite(s) and the layout is FFS. The number of TN IMT BS should be large enough to emulate the interference seen by the satellite from the IMT systems. It is FFS on exact range of TN BS deployment based on simulations.  **Co-existence between NTN and NTN**  For co-existence between NTN and NTN, the following 2 cases are considered as [candidate options].   * One satellite carries two neighbour carriers, where the footprints of the 2 carriers are the same and coordinated see figure 2.2-1. * Two satellites (GEO and LEO) operate on two neighbour carriers but at different height, see figure 2.2-2. The number of LEO satellite and footprints are FFS.   **Co-existence between HAPS and TN**  For co-existence between HAPS and TN, the exact layout is FFS.  **Methodology of TN and NTN coexistence simulation**  Adopt the following simulation steps:   1. Aggressor and victim network are generated.   - NTN central beam is at satellite nadir, surrounded with 6 co-frequency beams.  - TN center is randomly generated within the NTN central beam.  - NTN to TN: 19-cell with wrap around  - TN to NTN: It is expected that a large number of cells are needed. The exact number of cell should be decided by system level simulation.  2. UE associations  - NTN UE is randomly generated within the TN area depending on the NTN UE density.  - TN UE is randomly generated inside the TN network. TN UEs are associated to each TN sectors based on coupling loss.  3. Once association is done, round robin scheduling is used. BF weights are adjusted to point to the LOS direction between BS-UE. This is done for both victim and aggressor networks.  4. Throughput is computed in the victim systems without considering ACI as below:  - , where is the inter-cell interference.  5. Throughput is computed considering ACI as below:  - , where is the adjacent channel interference.  6. RF parameters are determined based on the degradation cause by ACI as below:  - . |
| R4-2106609 | ZTE Corporation | For NTN coexisting with TN, network layout of TN are summarized in the following Table 2. For Case 2 and Case 6, this need more discussions in RAN4.  **Table 2.TN network layout**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | No. | Combination | **Aggressor** | **Victim** | TN Network layout | | 1 | TN with NTN | TN DL | NTN DL | 19 sites with 57 sectors | | 2 | TN with NTN | TN UL | NTN UL | more sites might be needed due to large coverage per beam of NTN node. | | 3 | TN with NTN | NTN DL | TN DL | 19 sites with 57 sectors | | 4 | TN with NTN | NTN UL | TN UL | 19 sites with 57 sectors | | 5 | TN with NTN | NTN UL | TN DL | 19 sites with 57 sectors | | 6 | TN with NTN | TN DL | NTN UL | more sites might be needed due to large coverage per beam of NTN node. | |
| R4-2106684 | Huawei, HiSilicon | Observation 1: The heterogeneous scenario between TN and NTN systems has to be considered when we look into NTN UE/Satellite performance with NR legacy networks as aggressor.  Observation 2: Even if the minimum beam diameter was chosen in table 6.1.1.1-1 from TR 38.821, thousands of sites will be used. Thus, RAN4 need to further check whether there is a method to further decrease the complexity of simulations.  Proposal 3: The figure 1 can be used as heterogeneous network layout between NR legacy network and NTN network for one beam cell.  general NTN topology  Figure 1 The heterogeneous network layout |
| R4-2106685 | Huawei, HiSilicon | |  |  |  |  | | --- | --- | --- | --- | | No. | Combination | **Aggressor** | **Victim** | | 1 | TN – NTN | TN DL (TN BS) | NTN DL (NTN UE) | | 2 | TN – NTN | TN DL (TN BS) | NTN UL (NTN satellite) | | 3 | TN – NTN | TN UL (TN UE) | NTN UL (NTN satellite) | | 4 | TN – NTN | TN UL (TN UE) | NTN DL (NTN UE) | | 5 | TN – NTN | NTN DL (NTN satellite) | TN DL (TN UE) | | 6 | TN – NTN | NTN DL (NTN satellite) | TN UL (TN BS) | | 7 | TN – NTN | NTN UL (NTN UE) | TN DL (TN UE) | | 8 | TN – NTN | NTN UL (NTN UE) | TN UL (TN BS) |   Proposal 1: For case 2 (Aggressor TN BS to victim NTN satellite) and case 3 (Aggressor TN UE to victim NTN satellite), heterogeneous network mapping between TN and NTN need to be considered. (We have to calculate all the interference from the terrestrial base station or user equipment for one satellite beam at least.)  Proposal 2: For case 1 and case 4~8, RAN4 can simulate these cases under the hexagonal grid (19 sites with wrap around). NTN UE can be spread randomly and satellite interference can be generated randomly for all the BS or UE in hexagonal grid.  Proposal 3: There is no need to consider the curvature of earth for layout, assuming one satellite beam for the simulation. The distances for LEO-600, LEO-1200 and GEO can be assumed as 600km, 1200km and 35786km separately for any point under the 3dB satellite beam. |
| R4-2106898 | Ericsson | **TN as a victim**  Proposal1: When TN is a victim, coexistence simulations should only consider one NTN aggressor at a time.  Proposal 2: When considering TN as a victim it might be enough to analyze 2 TNs (one as close as possible to satellite Nadir point and one as far as possible to this point) and not all TNs in the satellite coverage area (assuming a fractional frequency reuse factor not equal to 1).  Proposal 3: When TN is victim, for UL evaluation, one of the following alternative should be considered:  - Alternative 1: Analyze simulation results only for the BSs/cells which hosts a NTN UE.  - Alternative 2: The density of NTN UEs in a TN cell shall be the same as the density of TN UE.  Proposal 4: When TN is victim, for DL evaluation, all TN BSs (but only one of the 3 sectors per BS) and all UEs should be considered.  **NTN as a victim**  Proposal 5: When NTN is victim, all TNs and HAPS in the satellite coverage shall be considered.  Proposal 6: All BSs in all TNs will not be active at the same instant, only a certain ratio of them per TNs should be considered when NTN is victim. |
| R4-2107120 | Qualcomm Incorporated | Proposal 1: RAN4 to adopt the layout for co-existence between NTN and TN as shown in Figure 2 and apply the following procedure to distribute the NTN UEs.   * Deploy the TN network in every satellite beam center * Distribute the NTN UEs within the TN network boundaries or centers randomly corresponding to Table 1.   Table 1: NTN UE distribution mapping   |  |  |  | | --- | --- | --- | | **Aggressor** | **Victim** | **NTN UE distribution** | | TN DL | NTN DL | NTN UEs at TN centers | | TN UL | NTN UL | NTN UEs at TN boundaries | | NTN DL | TN DL | NTN UEs at TN boundaries | | NTN UL | TN UL | NTN UEs at TN centers | | NTN UL | TN DL | NTN UEs at TN boundaries | | TN DL | NTN UL | NTN UEs at TN centers |     Figure 2: Layout for co-existence between NTN and TN |

## Open issues summary

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

### Sub-topic 2-1

*This sub-topic focus on the generation of TN & NTN network layouts for TN-NTN coexistence.*

*Open issues and candidate options before e-meeting:*

**Issue 2-1: NTN Network**

* Proposals
  + Option 1: NTN central beam is at satellite nadir, surrounded with 6 co-frequency beams.
  + Option 2: When TN is a victim, coexistence simulations should only consider one NTN aggressor at a time.
* Recommended WF
  + Agree on Option 1 assume one NTN aggressor as default.

**Issue 2-2: TN Network**

* Proposals
  + Option 1: TN center is randomly generated within the NTN central beam on earth surface.
* For following two cases, more TN sites might be needed due to large coverage per beam of NTN node.

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Combination | **Aggressor** | **Victim** |
| 1 | TN - NTN | TN DL (TN BS) | NTN UL (NTN satellite) |
| 2 | TN - NTN | TN UL (TN UE) | NTN UL (NTN satellite) |

* For other cases, 19-cell with wrap around will be used.
  + Option 2: TN center is randomly generated within the NTN central beam on earth surface.
* For following two cases, Heterogeneous network mapping between TN and NTN need to be considered. See Figure 2.2.1.

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Combination | **Aggressor** | **Victim** |
| 1 | TN - NTN | TN DL (TN BS) | NTN UL (NTN satellite) |
| 2 | TN - NTN | TN UL (TN UE) | NTN UL (NTN satellite) |



Figure 2.2.1 The heterogeneous network layout

* For other cases, 19-cell with wrap around will be used.
  + Option 3:
* When NTN is victim, all TNs and HAPS in the satellite coverage shall be considered and all BSs in all TNs will not be active at the same instant, only a certain ratio of them per TNs should be considered
* When TN is victim

- It might be enough to analyze 2 TNs (one as close as possible to satellite Nadir point and one as far as possible to this point) and not all TNs in the satellite coverage area (assuming a fractional frequency reuse factor not equal to 1)

- For UL evaluation, one of the following alternative should be considered:

- Alternative 1: Analyze simulation results only for the BSs/cells which hosts a NTN UE.

- Alternative 2: The density of NTN UEs in a TN cell shall be the same as the density of TN UE.

- For DL evaluation, all TN BSs (but only one of the 3 sectors per BS) and all UEs should be considered.

* + Option 4: Deploy the TN network in every satellite beam center
* Recommended WF
  + TBA

### Sub-topic 2-2

*This sub-topic focus on UE associations for TN-NTN coexistence.*

*Open issues and candidate options before e-meeting:*

**Issue 2-3: Deployment of NTN UE**

* Proposals
  + Option 1: NTN UE is randomly generated within the TN area depending on the NTN UE density.
  + Option 2: Distribute the NTN UEs within the TN network boundaries or centers randomly corresponding to Table 1.

Table 1: NTN UE distribution mapping

|  |  |  |
| --- | --- | --- |
| **Aggressor** | **Victim** | **NTN UE distribution** |
| TN DL | NTN DL | NTN UEs at TN centers |
| TN UL | NTN UL | NTN UEs at TN boundaries |
| NTN DL | TN DL | NTN UEs at TN boundaries |
| NTN UL | TN UL | NTN UEs at TN centers |
| NTN UL | TN DL | NTN UEs at TN boundaries |
| TN DL | NTN UL | NTN UEs at TN centers |

* + Option 3: When TN is victim, For UL evaluation, one of the following alternative should be considered:

- Alternative 1: Analyze simulation results only for the BSs/cells which hosts a NTN UE.

- Alternative 2: The density of NTN UEs in a TN cell shall be the same as the density of TN UE.

* Recommended WF
  + TBA

**Issue 2-4: Deployment of TN UE**

* Proposals
  + Option 1: TN UE are generated randomly inside the TN network, make sure enough TN UEs are associated to each TN sectors based on coupling loss.
* Recommended WF
  + Agree on Option 1.

### Sub-topic 2-3

*Open issues and candidate options before e-meeting:*

**Issue 2-5: Coordinate System**

* Proposals
  + Option 1: Referring to TR 38.811 Section 6.3 and Annex A, a 3D global coordinate system is considered (Earth-Centred Earth Fixed) for simulating NTN beams direction and location on the earth surface. It means the NTN beam location, TN randomly dropping location are generated with a set of three parameters (x,y,z).
  + Option 2: There is no need to consider the curvature of earth for layout, assuming one satellite beam for the simulation. The distances for LEO-600, LEO-1200 and GEO can be assumed as 600km, 1200km and 35786km separately for any point under the 3dB satellite beam.
* Recommended WF
  + TBA

**Issue 2-6: Methodology for TN-NTN coexistence.**

* Proposals
  + Option 1: Adopt following simulation steps for TN-NTN co-existence study.

1. Aggressor and victim network are generated. [Sub-topic 2-1]
2. UE associations [Sub-topic 2-2]
3. Once association is done, round robin scheduling is used. BF weights are adjusted to point to the LOS direction between BS-UE. This is done for both victim and aggressor networks.
4. Throughput is computed in the victim systems without considering ACI as below:

- , where is the inter-cell interference.

1. Throughput is computed considering ACI as below:

- , where is the adjacent channel interference.

1. RF parameters are determined based on the degradation cause by ACI as below:

- .

* Recommended WF
  + Agree on Option 1.

### Sub-topic 2-4

*Open issues and candidate options before e-meeting:*

**Issue 2-7: Layouts for NTN-NTN**

* Proposals
  + Option 1:

For co-existence between NTN and NTN, the following 2 cases are considered as [candidate options].

* One satellite carries two neighbour carriers, where the footprints of the 2 carriers are the same and coordinated see figure 2.6.1.
* Two satellites (GEO and LEO) operate on two neighbour carriers but at different height, see figure 2.6.2. The number of LEO satellite and footprints are FFS.

Fig 2.6.1

Fig 2.6.2

* Recommended WF
  + Carry forward Option 1 for further discussion.

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-1  Issue 2-2 |

Sub topic 2-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-3  Issue 2-4 |

Sub topic 2-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-5  Issue 2-6 |

Sub topic 2-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-7 |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: Other simulation assumptions

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-20105045 | Samsung | Refer to section 2.2 |
| R4-2106476 | CATT | Refer to Section 2.3 to 2.10 |
| R4-2106609 | ZTE Corporation | Refer to Section 2.2.2 to 2.2.7 |
| R4-2106684 | Huawei, HiSilicon | Proposal 1: It is proposed to assume 20MHz channel bandwidth for 2GHz, considering the worst case and the maximum output power.  Proposal 2: It is proposed to assume Satellite max TX power in dBm for 2GHz as below.  Table 2-3 Set-1 satellite parameters for co-existence study   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Satellite orbit | | GEO | LEO-1200 | LEO-600 | | Satellite altitude | | 35786 km | 1200 km | 600 km | | Payload characteristics for DL transmissions | | | | | | Satellite EIRP density | 2GHz | 59 dBW/MHz | 40 dBW/MHz | 34 dBW/MHz | | Satellite Tx max Gain | 51 dBi | 30 dBi | 30 dBi | | Satellite max TX power in dBm | 52.6dBm | 54.6dBm | 48.6dBm | | Channel bandwidth | 30MHz | 30MHz | 30MHz | | 3dB beamwidth | 0.4011 deg | 4.4127 deg | 4.4127 deg | | Satellite beam diameter | 250 km | 90 km | 50 km |   Table 2-4 Set-2 satellite parameters for co-existence study   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Satellite orbit | | GEO | LEO-1200 | LEO-600 | | Satellite altitude | | 35786 km | 1200 km | 600 km | | Payload characteristics for DL transmissions | | | | | | Satellite EIRP density | 2GHz | 53.5 dBW/MHz | 34 dBW/MHz | 28 dBW/MHz | | Satellite Tx max Gain | 45.5 dBi | 24 dBi | 24 dBi | | Satellite max TX power in dBm | 52.6dBm | 54.6dBm | 48.6dBm | | Channel bandwidth | 30MHz | 30MHz | 30MHz | | 3dB beamwidth | 0.7353 deg | 8.8320 deg | 8.8320 deg | | Satellite beam diameter | 450 km | 190 km | 90 km |   Proposal 4: The passive antenna is assumed for 2GHz BS. The parameter in table 4-1 can be used for 2GHz BS antenna pattern in the NTN system simulation. For UE antenna, an omni-directional radiation pattern with antenna gain 0dBi is assumed  Table 4-1 FR1 BS antenna pattern for 2GHz   |  |  | | --- | --- | | Parameter for BS | Values | | Antenna vertical radiation pattern (dB) |  | | Antenna horizontal radiation pattern (dB) |  | | Combining method for 3D antenna pattern (dB) |  | | Maximum directional gain of an antenna *GE,max* | 12 dBi |   Proposal 5: It’s proposed to use the following TPC model for UL NTN power control.  *TPC model specified in Section 9.1 TR 36.942 [7] could be applied for UL NTN power control with following parameters.*  *Where, Pmax = 23dBm, Rmin = TBD dB, CL (dB) is the path coupling loss defined as max{path loss-G\_Tx-G\_Rx, MCL}*  *CLx-ile is the x-percentile CL value. With this power control equation, the x percent of UEs that have the highest coupling loss will transmit at Pmax.*  *CLx-ile (dB) and γ are set as following:*  *- CLx-ile = Pmax – (SNRtarget +10\*log10(kT) +10\*log10(B) + F),*  *Where:*  *Pmax is the maximum output power for NTN UE (23dBm)*  *SNRtarget is the target SNR for NTN system (dB)*  *10\*log10(kT) = -174dBm/Hz*  *B is the channel bandwidth (Hz)*  *F is the noise figure for NTN system (dB)*  *- 0<γ<=1 is the balancing factor for UEs with bad channel and UEs with good channel*  Observation 3: the noise figure F for NTN system (dB) should be further evaluated based on the couple loss assumption between satellite and gateway.  Observation 4: Generally, 15 dB targeted SNR is not suitable for NTN system. This value may affect how many UEs need to transmit the maximum output power for simulation.  Proposal 6: the following parameters α, SNIRMIN, and SNIRMAX need to be further studied and decided for NR NTN system. |
| R4-2106898 | Ericsson | Proposal 3: When TN is victim, for UL evaluation, one of the following alternative should be considered:  - Alternative 1: Analyze simulation results only for the BSs/cells which hosts a NTN UE.  - Alternative 2: The density of NTN UEs in a TN cell shall be the same as the density of TN UE.  Observation 1: A fractional frequency reuse factor (FFR) value of 1 would be the most stringent scenario but it might not be representative of NTN deployment.  Proposal 7: A FFR value of 1 shall be forbidden for NTN deployment if this value is not taken as simulation assumptions for the coexistence study.  Proposal 8: A FFR value greater than 1 would reduce the available BW per satellite beam, dividing the considered frequency band accordingly.  Proposal 9: For the coexistence study, consider two satellite elevation angles: one for which the central beam centre corresponds to the satellite Nadir point, and another one for which this central beam centre would be as far as possible from this point, still considering a realistic value.  Proposal 10: At 2 GHz, UE NF for TN and NTN shall be equal to 9 dB.  Proposal 11: Adopt NR TN UL power control for NTN. |
| R4-2107120 | Qualcomm Incorporated | Proposal 2: RAN4 to 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.  Proposal 3: RAN4 to adopt 10 UEs per beam/cell for both UL and DL as the assumption for NTN co-existence simulation.  Proposal 4: RAN4 to adopt 7dB UE noise figure as the assumption for NTN co-existence simulation. |
| R4-2107270 | Thales | Proposal 3: coexistence simulations in adjacent bands should consider a dedicated TR (similar to e.g. TR 38.803).  Proposal 7: RAN4 should use CDF to determine SNR values experienced by most of the users. |

## Open issues summary

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

### Sub-topic 3-1

*Open issues and candidate options before e-meeting:*

**Issue 3-1: Satellite and NR Bandwidth**

* Proposals
  + Option 1:
* Satellite 30MHz,
* TN NR: 20MHz
  + Option 2: A FFR value greater than 1 would reduce the available BW per satellite beam, dividing the considered frequency band accordingly.
* Recommended WF
  + TBA

**Issue 3-2: Satellite max TX power**

* Proposals
  + Option 1: Assume Satellite max TX power in dBm for 2GHz as below.

**Table 2-3 Set-1 satellite parameters for co-existence study**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Satellite orbit | | GEO | LEO-1200 | LEO-600 |
| Satellite altitude | | 35786 km | 1200 km | 600 km |
| Payload characteristics for DL transmissions | | | | |
| Satellite EIRP density | 2GHz | 59 dBW/MHz | 40 dBW/MHz | 34 dBW/MHz |
| Satellite Tx max Gain | 51 dBi | 30 dBi | 30 dBi |
| Satellite max TX power in dBm | 52.6dBm | 54.6dBm | 48.6dBm |
| Channel bandwidth | 30MHz | 30MHz | 30MHz |

**Table 2-4 Set-2 satellite parameters for co-existence study**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Satellite orbit | | GEO | LEO-1200 | LEO-600 |
| Satellite altitude | | 35786 km | 1200 km | 600 km |
| Payload characteristics for DL transmissions | | | | |
| Satellite EIRP density | 2GHz | 53.5 dBW/MHz | 34 dBW/MHz | 28 dBW/MHz |
| Satellite Tx max Gain | 45.5 dBi | 24 dBi | 24 dBi |
| Satellite max TX power in dBm | 52.6dBm | 54.6dBm | 48.6dBm |
| Channel bandwidth | 30MHz | 30MHz | 30MHz |

The satellite max Tx power can be calculated by the equation as below:

* Recommended WF
  + TBA

**Issue 3-3: NTN FRF**

* Proposals
  + Option 1: 1
  + Option 2: >1

- Alt1: 2

- Alt2: 3

* Recommended WF
  + TBA

### Sub-topic 3-2

**Issue 3-4: FR1 TN BS and UE antenna pattern**

* Proposals
  + Option 1: Antenna and beam forming pattern modelling of TN BS and UE could be referred to TR 38.803 [6].

**BS antennas**

,

 is the 3dB beam width which corresponds to 65 degrees, and  is the maximum attenuation

Antenna heights and gains for macro cells are given in table 2.4.2-1.

Table 2.4.2-1: Antenna height and gain for Macro Cells

|  |  |  |  |
| --- | --- | --- | --- |
|  | Rural Area | Urban Area | |
| 900 MHz | 2000 MHz | 900 MHz |
| BS antenna gain (dBi) (including feeder loss) | 15 | 15 | 12 |
| BS antenna height (m) | 45 | 30 | 30 |

**UE antenna**

For UE antennas, an omni-directional radiation pattern with antenna gain 0dBi is assumed.

* + Option 2: The passive antenna is assumed for 2GHz BS. The parameter in table 4-1 can be used for 2GHz BS antenna pattern in the NTN system simulation. For UE antenna, an omni-directional radiation pattern with antenna gain 0dBi is assumed

Table 4-1 FR1 BS antenna pattern for 2GHz

|  |  |
| --- | --- |
| Parameter for BS | Values |
| Antenna vertical radiation pattern (dB) |  |
| Antenna horizontal radiation pattern (dB) |  |
| Combining method for 3D antenna pattern (dB) |  |
| Maximum directional gain of an antenna *GE,max* | 12 dBi |

* + Option 3: It is proposed adopt the element pattern and composite antenna pattern from TR 37.842 section 5.3.3, with the parameters assumed in Table 2.2.4-2. For UE antenna, an omni-directional radiation pattern with antenna gain 0dBi is assumed

Table2.2.4.1.1-1: Array element pattern for antenna array model

|  |  |
| --- | --- |
| Horizontal Radiation Pattern |  |
| Horizontal half-power bandwidth of single array element | To be found in Table 2.2.4-2. |
| *Front-to-back ratio* | Am, SLAv to be found in Table 2.2.4-2. |
| Vertical Radiation Pattern |  |
| Vertical half-power bandwidth of single array element | To be found in Table 2.2.4-2. |
| Array element radiation pattern |  |
| Element Gain without antenna losses | To be found in Table 2.2.4-2. |

Table2.2.4.1.2-1: Composite antenna pattern for UE specific beamforming

|  |  |
| --- | --- |
| Configuration | Multiple columns (*NV*x*NH* elements) |
| Composite Array radiation pattern in dB | For beam i:    the super position vector is given by:    the weighting is given by: |
| *Antenna array* configuration (Row×Column) | To be found in Table 2.2.4-2. |
| Horizontal radiating element spacing d/ λ | To be found in Table 2.2.4-2. |
| Vertical radiating element spacing d/ λ | To be found in Table 2.2.4-2. |
| Down-tilt angle | To be found in Table 2.2.4-2. |

Table 2.2.4-2: Deployment-related parameters of TN (2 GHz)

|  | Urban Macro | Suburban Macro | Rural Macro | Remarks |
| --- | --- | --- | --- | --- |
| Cell radius in meters | 500 | 1000 | 5000 | ITU-R Report M.2292 |
| BS Antenna height in meters | 25 | 30 | 30 |
| **Base Station Antenna Characteristics** | | | | |
| Antenna Pattern | TR 37.842 Section 5.3.3 | | | TR 37.842 |
| Element Gain in dBi | 6.4 | 7.1 | 7.1 | 3GPP LS to ITU-R WP5D RP-200559  and  ITU-R WP5D  [IMT\_Parameters] |
| H and V 3dB beamwidth of single element in degree | 90º for H  65º for V | 90º for H  54º for V | 90º for H  54º for V |
| H and V front-to-back ratio in dB | 30 for both H/V | 30 for both H/V | 30 for both H/V |
| Antenna polarization | Linear ±45º | Linear ±45º | Linear ±45º |
| Antenna array configuration (Row × Column) | 8 x 8 elements | 8 x 8 elements | 8 x 8 elements |
| Horizontal/Vertical radiating element spacing | 0.5 of wavelength for H, 0.7 of wavelength for V | 0.5 of wavelength for H, 0.9 of wavelength for V | 0.5 of wavelength for H, 0.9 of wavelength for V |
| Conducted power per antenna element in dBm | 25 | 25 | 25 |
| Mechanical downtilt in degree | 10 | 6 | 3 |
| **UE Parameters** | | | | |
| UE Outdoor/indoor | 100% Outdoor | | | Because NTN Satellite to TN UE O2I is hard to calibrate, we propose to only consider outdoor TN UE cases in this study. |
| UE height in meter | 1.5 | 1.5 | 1.5 | 3GPP LS to ITU-R WP5D RP-200559  and  ITU-R WP5D  [IMT\_Parameters] |

* Recommended WF
  + TBA

### Sub-topic 3-3

**Issue 3-5: TPC model for UL NTN power control**

* Proposals
  + Option 1: Adopt NR TN UL power control for NTN.
  + Option 2: 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.
  + Option 3: Use the following TPC model for UL NTN power control.

|  |
| --- |
| TPC model specified in Section 9.1 TR 36.942 [7] could be applied for UL NTN power control with following parameters.  Where, Pmax = 23dBm, Rmin = TBD dB, CL (dB) is the path coupling loss defined as max{path loss-G\_Tx-G\_Rx, MCL}  CLx-ile is the x-percentile CL value. With this power control equation, the x percent of UEs that have the highest coupling loss will transmit at Pmax.  CLx-ile (dB) and γ are set as following:  - CLx-ile = Pmax – (SNRtarget +10\*log10(kT) +10\*log10(B) + F),  Where:  Pmax is the maximum output power for NTN UE (23dBm)  SNRtarget is the target SNR for NTN system (dB)  10\*log10(kT) = -174dBm/Hz  B is the channel bandwidth (Hz)  F is the noise figure for NTN system (dB)  - 0<γ<=1 is the balancing factor for UEs with bad channel and UEs with good channel |

* Recommended WF
  + TBA

**Issue 3-6: Noise Figure of NTN UE**

* Proposals
  + Option 1: 7dB
  + Option 2: 9dB
  + Option 3: the noise figure F for NTN system (dB) should be further evaluated based on the couple loss assumption between satellite and gateway.
* Recommended WF
  + TBA

**Issue 3-7: Noise Figure of NTN System**

* Proposals
  + Option 1: the noise figure F for NTN system (dB) should be further evaluated based on the couple loss assumption between satellite and gateway.
* Recommended WF
  + Agree on Option 1

**Issue 3-8: Active NTN UE number per beam/cell**

* Proposals
  + Option 1: 10 for both DL and UL
  + Option 2: When TN is victim, for UL evaluation, one of the following alternative should be considered:

- Alternative 1: Analyze simulation results only for the BSs/cells which hosts a NTN UE.

- Alternative 2: The density of NTN UEs in a TN cell shall be the same as the density of TN UE.

* + Option 3: 1 or 3 for UL (to be further down scoped) and 1 for DL.
* Recommended WF
  + TBA

### Sub-topic 3-4

**Issue 3-9: Throughput ~ SNR mapping**

* Proposals
  + Option 1: Adopt Section 5.2.7 of TR 38.803 as the SINR-Throughput performance metrics.
  + Option 2: Adopt Section 5.2.7 of TR 38.803 as the SINR-Throughput performance metrics, but α, SNIRMIN, and SNIRMAXneed to be further studied and decided for NR NTN.
* Recommended WF
  + TBA

**Issue 3-10: Performance metric for NTN**

* Proposals
  + Option 1: RAN4 should use CDF to determine SNR values experienced by most of the users.
  + Option 2: Apply same criteria with TN.
* Recommended WF
  + TBA

### Sub-topic 3-5

*Open issues and candidate options before e-meeting:*

**Issue 3-11: Potential TR for coexistence simulation**

* Proposals
  + Option 1: coexistence simulations in adjacent bands should consider a dedicated TR (similar to e.g. TR 38.803).
* Recommended WF
  + Agree on Option 1.

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-1  Issue 3-2  Issue 3-3 |

Sub topic 3-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-4 |

Sub topic 3-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-5  Issue 3-6  Issue 3-7  Issue 3-8 |

Sub topic 3-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-9  Issue 3-10 |

Sub topic 3-5

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-11 |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #4: HAPS

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2107194 | Nokia, Nokia Shanghai Bell | Proposal 1: Assume HAPS altitude 20 Km in the coexistence study.  Proposal 3: Evaluate HAPS coexistence at various center-to-center inter-system distances between the victim network and the HAPS aggressor network.   |  |  | | --- | --- | | (a) | (b) |   Figure 1. Coexistence scenarios of (a) HAPS and TN, (b) HAPS and HAPS.  Table 1. HAPS coexistence scenarios   |  |  | | --- | --- | | HAPS altitude | 20 Km | | Carrier frequency | 2 GHz | | Duplex scheme | FDD | | Coexistence scenarios | HAPS + TN (UMa) | | HAPS + TN (RMa) | | HAPS + HAPS (RMa) | | Center-to-center inter-system distance (Km) | 0, 10, 20, 30, 40, 50 |   Proposal 4: Adopt a reference HAPS antenna model for HAPS coexistence study.   |  |  | | --- | --- | |  | A picture containing dome, tiled, net  Description automatically generated | | (a) | (b) |   Figure 2. Proposed HAPS antenna array and cell layout  Table 2. Proposed HAPS parameters   |  |  | | --- | --- | | Number of cells | 7 | | Antenna array configuration (row x column) | 2 x 2 for 1st layer cell  4 x 2 for 2nd layer cell | | Antenna polarization | Linear | | Element gain | 8 dBi | | Element HPBW horizontal/vertical | for both H/V | | Element front-to-back ratio horizontal/vertical | 30 dB for both H/V | | Element spacing horizontal/vertical | 0.5 wavelength for both H/V | | Antenna panel tilt (from the horizon) | for 1st layer cell  for 2nd layer cell | | Tx power per antenna panel | 46 dBm | | Noise figure | 5 dB | | Indoor UE percentage | 0% |   Observation 1: Practical HAPS antenna arrays can achieve 100 Km coverage radius at 2 GHz frequency.  Proposal 6: Assume a HAPS coverage radius of 100 Km at 2 GHz for HAPS coexistence study.  Observation 2: UL bandwidth allocation for HAPS network may need to consider the scheduled UE’s channel condition, e.g., LOS/NLOS status, due to the power limited nature of HAPS UL.  Table 7. Proposed DL and UL transmission bandwidth   |  |  |  | | --- | --- | --- | | Parameters | Downlink | Uplink | | Subcarrier spacing (SCS) | 15 KHz | 15 KHz | | Channel bandwidth | 20 MHz | 20 MHz | | Scheduled bandwidth per TN UE | 20 MHz | TBD | | Number of scheduled UEs per TN cell | 1 | TBD | | Scheduled bandwidth per HAPS UE | 20 MHz | TBD | | Number of scheduled UEs per HAPS cell | 1 | TBD |   Proposal 7: Consider different UL power control setting for UE served by TN and for UE served by HAPS.  One potential model with UE transmit power determined according to    where, Pmax = 23dBm, Rmin = TBD dB, CLx-ile and γ are set as following:  - CLx-ile = 88 + 10\*log10 (200/X) + 11 – Y,  where X is UL transmission BW (MHz) and Y is the BS noise figure  - γ = 1  UEs connected to TN and HAPS networks may have different X (transmission BW) in this model. |

## Open issues summary

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

### Sub-topic 4-1

*Open issues and candidate options before e-meeting:*

**Issue 1-1: Co-existence scenarios for HAPS**

* Proposals
  + Option 1: Evaluate HAPS-HAPS coexistence using scenarios summarized in Table 4.2.1.

**Table 4.2.1. HAPS coexistence scenarios**

|  |  |
| --- | --- |
| HAPS altitude | 20 Km |
| Carrier frequency | 2 GHz |
| Duplex scheme | FDD |
| Coexistence scenarios | HAPS + TN (UMa) |
| HAPS + TN (RMa) |
| HAPS + HAPS (RMa) |
| Center-to-center inter-system distance (Km) | 0, 10, 20, 30, 40, 50 |

|  |  |
| --- | --- |
| (a) | (b) |

Figure4.2.1 Coexistence scenarios of (a) HAPS and TN, (b) HAPS and HAPS.

* Recommended WF
  + Agree on Option 1.

### Sub-topic 4-2

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 4-2: HAPS antenna and cell layout**

* Proposals
  + Option 1:
* Adopt a reference HAPS antenna model for HAPS coexistence study.

|  |  |
| --- | --- |
|  | A picture containing dome, tiled, net  Description automatically generated |
| (a) | (b) |

Figure 2. Proposed HAPS antenna array and cell layout

Table 2. Proposed HAPS parameters

|  |  |
| --- | --- |
| Number of cells | 7 |
| Antenna array configuration (row x column) | 2 x 2 for 1st layer cell  4 x 2 for 2nd layer cell |
| Antenna polarization | Linear |
| Element gain | 8 dBi |
| Element HPBW horizontal/vertical | for both H/V |
| Element front-to-back ratio horizontal/vertical | 30 dB for both H/V |
| Element spacing horizontal/vertical | 0.5 wavelength for both H/V |
| Antenna panel tilt (from the horizon) | for 1st layer cell  for 2nd layer cell |
| Tx power per antenna panel | 46 dBm |
| Noise figure | 5 dB |
| Indoor UE percentage | 0% |

* Assume all UEs served by HAPS are outdoor UEs.
* Assume a HAPS coverage radius of 100 Km at 2 GHz for HAPS coexistence study.
* Recommended WF
  + Agree on Option 1.

**Issue 4-3: UL TPC for HAPS UE**

* Proposals
  + Option 1: Consider different UL power control setting for UE served by TN and for UE served by HAPS.One potential model with UE transmit power determined according to



where, Pmax = 23dBm, Rmin = TBD dB, CLx-ile and γ are set as following:

- CLx-ile = 88 + 10\*log10 (200/X) + 11 – Y,

where X is UL transmission BW (MHz) and Y is the BS noise figure

- γ = 1

UEs connected to TN and HAPS networks may have different X (transmission BW) in this model.

* Recommended WF
  + Agree on Option 1.

## Companies views’ collection for 1st round

### Open issues

Sub topic 4-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 4-1 |

Sub topic 4-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 4-2  Issue 4-3 |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #5: Calibaration alignment

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2105046 | Samsung | Provides interpolate ACIR required for NTN DL to TN DL. |
| R4-2106544 | Xiaomi | Provides simulation results on average throughput loss versus ACIR for NTN DL to TN DL.  Two observations:  1. For the same cases, the ACIR for SET1 is more than that for SET2  2. In term of ACIR, LEO 600Km is the worst case. |
| R4-2106901 | Ericsson | Provides simulations results of DL SINR cdf, UE Tx power cdf and and UL SINR cdf for TN, NTN and HAPS |
| R4-2107121 | Qualcomm Incorporated | Provides simulation results of CL and SINR in both UL and DL for a single NTN system. |
| R4-2107195 | Nokia, Nokia Shanghai Bell | Provides worst case DL ACIR for 5% loss in average throughput and cell edge throughput of the victim network  Observation 1: For FDD DL, terrestrial NR + HAPS coexistence scenarios have lower adjacent channel interference than HAPS + HAPS scenario.  Observation 2: For FDD DL, the victim network suffers a higher degradation in cell-edge throughput than in average throughput. |
| R4-2107270 | Thales | Provides SNR CDF in DL and UL per cell with Set-1 of satellite parameters for S-band with LEO@600km |

## Open issues summary

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

### Sub-topic 1-1

*This Sub-topic intends to settle KPIs for calibration alignment.*

*Open issues and candidate options before e-meeting:*

**Issue 5-1: Which KPIs/parameters will be used for alignment?**

* Proposals
  + Option 1: Use DL SINR cdf, UE Tx power cdf and UL SINR cdf of TN, NTN and HAPS for alignment.
  + Option 2: Use CL and SINR in both UL and DL of a single NTN system for alignment.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 5-1 |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Appendix 1. TDOC list for this agenda

A total of 14 TDOCs have been provided for this agenda listed as below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***TDoc Number*** | ***TDoc Type*** | ***Title*** | ***Company*** | ***Status*** | ***General Purpose*** | ***Agenda Item*** |
| R4-2105045 | discussion | Simulation assumptions for FR1 coexistence study | Samsung | available | Approval | 8.8.2 |
| R4-2105046 | discussion | Initial simulation results of some NR-NTN co-ex scenarios | Samsung | available | Discussion | 8.8.2 |
| R4-2106476 | discussion | Simulation assumptions for NTN co-existence | CATT | available | Approval | 8.8.2.1 |
| R4-2106544 | discussion | Preminary simulation result for coexistence study on NR to support non-terrestrial networks | Xiaomi | available | Discussion | 8.8.2.2 |
| R4-2106609 | other | Further discussion on simulation assumptions for NTN | ZTE Corporation | available | Approval | 8.8.2.1 |
| R4-2106684 | other | Further discussion on NTN simulation assumptions | Huawei, HiSilicon | available | Approval | 8.8.2.1 |
| R4-2106685 | other | Initial analysis and results about the NTN simulation | Huawei, HiSilicon | available | Approval | 8.8.2.2 |
| R4-2106898 | other | NTN Simulations assumptions | Ericsson | available | Approval | 8.8.2.1 |
| R4-2106901 | discussion | NTN - simulation results for alignment | Ericsson | available | Discussion | 8.8.2.2 |
| R4-2107120 | discussion | Simulation assumptions for NR NTN co-existence study | Qualcomm Incorporated | available |  | 8.8.2.1 |
| R4-2107121 | discussion | Simulation restuls for NTN co-existence calibtartion | Qualcomm Incorporated | available |  | 8.8.2.2 |
| R4-2107194 | discussion | HAPS simulation assumptions for coexistence study | Nokia, Nokia Shanghai Bell | available | Approval | 8.8.2.1 |
| R4-2107195 | discussion | HAPS adjacent channel coexistence simulation results | Nokia, Nokia Shanghai Bell | available | Approval | 8.8.2.2 |
| R4-2107270 | discussion | On the S-band NTN coexistence scenarios and simulation parameters | THALES | available | Discussion | 8.8.2 |