**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-2106148**

**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. Simulation assumptions will be captured in one or two separate document(s) as appropriate. 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** |
| Qualcomm | Issue 1-1: Per preliminary simulation results, we are OK Option 3&4 at the starting point for co-ex scenarios in NTN. It might be further updated if other scenarios are identified as worse interference scenarios. |
| Huawei | Issue 1-1: We can choose one parameter set as least. Option 3 is OK for me. |
| Ericsson | Issue 1-1: option 1 is the basis which might be further down-scoped.  Option 2: it’s difficult to exclude indoor UEs without a more detailed analysis: as mentioned in R4-2107194, it’s possible for indoor UE to connect to HAPS and most likely, UE will transmit then at max power, which would create interferences. Or should we forbid somehow an indoor UE to connect to a HAPS BS?  Option 3 would be ok, but not based on the initial study results which have been given, those results are too early without consilidating all companies’ results.  Option 4: only when TN is victim. |
| ZTE | Issue 1-1: option 3is also fine for us. |
| Hughes/EchoStar | Issue 1-1: Option 1 is OK but try to down-scope some of the NTN-NTN. Option 3 is OK |
| Intelsat | Issue: Option 1 agreeable. NTN-NTN should be deprioritized. |
| THALES | Issue 1-1:  Set-1 already decided in RAN4#98e.  We are fine with Option 3 and Option 4.  We are also fine with the proposed WF. However, further down-scoping is required. |
| Samsung | Issue 1-1: We support Option 3, set-1 has higher tx eirp and antenna gain compared to set-2.  We suggest to not study all scenarios listed in option 1. Considering there’re up to 8 combinations in Issue 1-2, we suggest to discuss and consider down scope the scenarios here if possible. |
| Xiaomi | We are fine with option 3 and option 4 based on the preliminary results |
| CATT | Option 1 is the basis for further discussion. We are fine to use Option 3 as the starting point. |
| SoftBank | For Ericsson's comment of Issue 1-1 Option 2:  As you mentioned, indoor UEs have a possibility to be connected to HAPS. It might be needed to consider indoor UEs with the results of preliminary simulation, using outdoor UEs. |
|  |  |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 1-2:  For NTN-TN scenarios, we are OK with moderator’s recommended WF listed in row 1-8.  For NTN-NTN scenarios, it is not clear what’s the rationale to deprioritize NTN UL-NTN UL and NTN DL-NTN DL co-ex simulation. We prefer not to deprioritize NTN with NTN co-existence scenarios which are very important. |
| Huawei | Issue 1-2:  Option 3. |
| Ericsson | Issue 1-2: don’t agree with the recommended WF, none of the scenarios can be deprioritized nor removed from the scope for the time being.  Option 1 is the basis, adding LEO-GEO for NTN-NTN.  Option2: No: no rationale was given the NTN-NTN cases…  Option 3: the table is unclear, option 1 is better.  Option 4 is the same than option 1, but what is the goal with the text in column “5G bands…” ? We don’t really look at coexistence with adjacent bands in the system coexistence simulations’ context…  Option 5: No. We can’t reuse the outcomes of past RAN4 coex studies, the situation is different here as all NTN UEs would transmit at max power, wherever they are located, which is not the case with usual RAN4 coex studies.  Option 6: No, same as option 5.  Option 7: If possible, yes, but why talking about adjacet bands here? This is out of scope.  Option 8: Further detailed descriptions of the co-existence mechanisms mentioned in R4-2107270 would be needed to understand not considering NTN-NTN scenarios. |
| ZTE | Issue 1-2:  Fine with moderator’s recommendation. |
| Hughes/EchoStar | Option 4 |
| Intelsat | Option 2 or 3 |
| THALES | Issue 1-2:  Start with Option 4, and then deprioritize with Option 5, 6, 8.  Fine with WF. However, it seems that scenarios 7 and 8 were already de-prioritized in RAN4#98e (see also latest simulation assumptions document from RAN4#98e, **R4-2103998**). The reason is related to the TDD TN UL (n34) which is far away from FDD NTN DL (S-band), as seen below:    For the WF, we further recommend to start with Option 4, and downscope accordingly. |
| Samsung | Issue 1-2:  We support row 1-4 of recommended WF, which down-scoped the combinations.  We do not have much preference on the row 5-8 of recommended WF, however we suggest to down-scope or prioritize part of the combinations listed in row 1~8 considering the resources in Rel-17. |
| Xiaomi | Moderator’s recommendation is acceptable for us |
| CATT | We agree with Ericsson that Option 1 is the basis and we can add LEO-GEO for NTN-NTN to Option 1 if found necessary. Downscoping should be based on further evaluations. |

### 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** |
| **Issue 1-1: Scenarios for NTN-NTN/TN co-existence** | Different views have been expressed upon options and the recommended WF.  *Tentative agreements:*   * Use Option 1 as basis * Use Set 1 satellite antenna as the starting point for co-existence study.   *Candidate options:*   * Option 2: 1 support, 1 oppose; * Option 4: 5 support (2 with conditions)   *Recommendations for 2nd round:*  Further discuss on down-scoping NTN-NTN scenarios in Table 1.4-1 in the GTW session and 2nd round. |
| **Issue 1-2: Interference table** | Difference views have been expressed upon options and the recommended WF.  *Tentative agreements: N/A*  *Candidate options:*   * Whether to deprioritize NTN-NTN cases: 6 Yes, 4 No   *Recommendations for 2nd round:*  It is true that all scenarios need to be considered at current stage. However, given the limits of time and resource, the moderator would like to recommend a phase-by-phase based approach to ensure that the co-existence study can be proceeded in time.  The study can be conducted in phase 1 and phase 2 with different cases so that resources can be focused in a certain time period. As different views have been given upon these cases, the moderator would suggest to study cases with consensus in phase 1 and then move to the remaining cases in phase 2. Therefore, the proposed approach can be found in Table 1.4-2.  It is recommended to further discuss Table 1.4-2 in the GTW session and 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)

### Open issues summary

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

* Recommendations for 2nd round: Further discuss on down-scoping NTN-NTN scenarios in Table 1.4-1 in the GTW session and 2nd round.

Table 1.4-1 scenarios for NTN-NTN/TN co-existence

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **FR1: 2GHz** | | | **Set 1** | | | **Set 22** | | | **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 |  |
| **NTN1** | **GEO3** | **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 22** | 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: Use Set 1 satellite antenna as the starting point for co-existence study. Set 2 might be used if any worst case in associate with Set 2 is found.  Note 3: GEO and LEO only operate at adjacent channel.  Note 4: Use GEO and LEO@600km when TN is victim. | | | | | | | | | |

**Issue 1-2: Interference table**

* Recommendations for 2nd round:

The moderator would like to recommend a phase-by-phase based approach to ensure that the co-existence study can be proceeded in time.

The study can be conducted in phase 1 and phase 2 with different cases so that resources can be focused in a certain time period. As different views have been given upon these cases, the moderator would suggest to study cases with consensus in phase 1 and then move to the remaining cases in phase 2. Therefore, the proposed approach can be found in Table 1.4-2.

It is recommended to further discuss Table 1.4-2 in the GTW session and 2nd round.

Table 1.4-2 Interference Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Combination | **Aggressor** | **Victim** | Notes | Study Phase |
| 1 | TN - NTN | TN DL | NTN DL |  | Phase 1 |
| 2 | TN with NTN | TN UL | NTN UL |  | Phase 1 |
| 3 | TN with NTN | NTN DL | TN DL |  | Phase 1 |
| 4 | TN with NTN | NTN UL | TN UL |  | Phase 1 |
| 5 | TN with NTN | NTN UL | TN DL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | Phase 1 |
| 6 | TN with NTN | TN DL | NTN UL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | Phase 1 |
| 7 | TN with NTN | TN UL | NTN DL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | Phase 2 |
| 8 | TN with NTN | NTN DL | TN UL | Applicable for satellite operating in S band, e.g. coexistence with Band 34 TDD. | Phase 1 |
| 9 | NTN with NTN | NTN DL | NTN DL | LEO-LEO | Phase 1 |
| GEO-GEO | Phase 1 |
| GEO-LEO@600 or  HAPS-HAPS | Phase 2 |
| NTN UL | NTN UL | LEO-LEO | Phase 1 |
| GEO-GEO | Phase 1 |
| GEO-LEO@600 or  HAPS-HAPS | Phase 2 |

### Companies views’ collection for 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | **Scenario 4 can be further de-scoped since:**   * **NTN UEs are with (much) lower density as TN UEs** * **NTN UEs and TN UEs are sharing same parameterization for S-band (e.g. same transmission power, same ACLR, etc.)** * **The scenario looks very similar to TN UEs interfering in UL with other TN UEs from neighbor cells** * **3GPP already handles this situation, so we propose to descope.**   **Scenarios 7 and 8 can be de-scoped** since it corresponds to the coexistence of NTN FDD with TN TDD and   * UL TN is located far away from NTN DL S-band * NTN DL S-band is located far away from UL TN     Please also find the following GTW agreement from RAN#98-bis-e **WF on [307] NTN\_Solutions\_Part1**:   * For NTN S-band, RAN4 shall at least consider 1 DL spectrum + 1 UL spectrum in the range (1980 - 2010 MHz) and (2170 - 2200 MHz).   **Scenarios 9 can be further de-scoped,** please find the following GTW agreement from RAN#98-bis-e **WF on [307] NTN\_Solutions\_Part1**:   * RAN4 shall consider inputs from NTN operators for the NTN-NTN coexistence scenarios for MSS S-band. |
| Samsung | Issue 1-1:  We fully support the down scoped scenarios agreed in GTW session. And we’d like to deprioritize the NR/NB IoT Indoor scenario in current Table 1.4-1. Because the O2I propagation model for the paths between ground indoor stations (NR/NB-IOT) and NTN space/HAPS stations, suggested by 3GPP TR 38.811 Section 6.6.3 is referring to ITU-R P.2109.  And this P.2109 needs multiple inputs, including probability of location(P), building type(r,s,t,u,v,w,x,y,z), elevation angle of building façade(θ) and frequency (f). And except frequency (f), all other variables to generate this path loss needs to be aligned before we conduct co-ex calibration or study.  Thus, even though we agree that the indoor case is very important and should not be excluded, but considering the meeting is tentatively to kick off the calibration and there were no inputs to trigger discussion on the O2I variables in P.2109 model, we suggest to ‘de-prioritize’ or ‘postpone’ the calibration and study for NR/NB IoT indoor case until next meeting after members have chance to input their preferred values and rationales behind.  Issue 1-2:  We support the 2-phase approach agreed in GTW session. We are OK to the current phases status in the table, however we’d like to point out the current discussion of co-ex assumption is lack of inputs for NTN-NTN scenario.  The current assumption discussion and inputs only covers NTN ground cells (beams), we are lack of information of how the two NTN space stations (satellites or HAPS) could co-exist in terms of constellation, altitude differences, minimum separation distances or angles, etc. Thus, we need more discussion to build agreed assumptions for co-ex between two NTN systems.  Technically, we are open to whatever that could be agreed for the NTN-NTN assumptions, but if it’s phase-1, we need more inputs and start discussing the details to develop co-ex study. |

## Summary on 2nd round (if applicable)

GTW session on April 16 has made following agreements.

Agreement 1: Table 1.4- 1 agreed for simulation.

Note: Further check the possibility of remove **LEO 1200km in simulation in future RAN4 meetings.**

Agreement 2: Table 1.4-2 Interference Table agreeable with the changes highlight in yellow

# 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. |
| R4-2106000 | 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** |
| Qualcomm | Issue 2-1: we’re OK with option 1 with the clarifications that 6 co-frequency beams are simulated with the assumption that NTN FRF is larger than 1.  Issue 2-2: We are OK with option 1. Need further discuss the number of TN networks for the case that TN network number will have impact on the co-existence results. |
| Huawei | Issue 2-1: We’d like to clarify whether generating 7 co-frequency beams is the real deployment case.  Issue 2-2: I’m OK with both option 1 and option 2. The figure 2.2.1 can be used to derive the number of BS sites. |
| Ericsson | Issue 2-1: Recommended WF is ok  Issue 2-2: When TN is victim, only focusing on the TN at Nadir point should be enough. |
| ZTE | Issue 2-1: fine with Recommended WF  Issue 2-2: both option 1 and option 2 is fine for us. |
| Hughes/EchoStar | Issue 2-1: Option 1 and with Recommended WF  Issue 2-2: both option 1 and option 2 OK |
| Intelsat | Issue 2-1: Option 1 and with Recommended WF  Issue 2-2: both option 1 or option 2 |
| THALES | Issue 2-1:  We are fine with both option 1 & option 2. Frequency reuse higher than 1 should be considered, (see also latest simulation assumptions document from RAN4#98e, **R4-2103998**), preferably 3.  Fine with the WF.  Issue 2-2:  Fine with option 1, but maybe coexistence with TDD (n34) can be deprioritized. It depends on available TN TDD deployments in n34. |
| Samsung | Issue 2-1: We support Option 1 and 2, and support the recommended WF. We’d like clarify that the 7 co-frequency beams in option 1 was proposed to study the aggregated interference in NTN DL to TN DL specific scenario. For other scenarios, we are open to whatever number of co-frequency beams is applicable and reasonable for co-ex study.  Issue 2-2: We support Option 1. We may need more discussions on the number of TN sites for co-ex study of TN to NTN scenario. |
| Xiaomi | Issue 2-1: Fine with option 1  Issue 2-2:option 1 |
| CATT | Issue 2-1: fine with Recommended WF  Issue 2-2: both option 1 and option 2 is fine for us. |

Sub topic 2-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 2-3: Option 2.  Technically, either option 1 or option 2 is fine. But we think option 2 can reduce the complexity of simulation, i.e., putting the NTN UEs in the boundaries or centers of TN network. So there is no need to run so many snapshots to cover all the possible NTN UE locations.  Issue 2-4 : OK with option 1. |
| Huawei | Issue 2-3: A question on clarification on “NTN UEs at TN centers” for option 2. Does it mean the distance between BS site and NTN UEs is zero?  Issue 2-4 : following the general method RAN4 used. |
| Ericsson | Issue 2-3: Option 2 is ok but we need also to agree on the number of NTN UEs per cells and which cells to observe.  Issue 2-4: Just follow RAN4 methodology, UEs are spread randomly in TN cells, no need to discuss this further. |
| ZTE | Issue 2-3: maybe option 1 is more aligned with practical case.  Issue 2-4: fine with option 1. |
| THALES | Issue 2-3: Down-scope from Option 2, or create a new option.  In general, we should consider worst cases. However, in most of the cases NTN UEs can be considered at the boundary of the TN cell, since otherwise NTN UEs will connect to TN cells.  Also not clear why is important to consider NTN UE distribution at TN center when NTN UL (satellite) is impacted.  Proposed WF: We should first decide/down-scope the coexistence scenarios (victim and aggressor) and then decide the NTN UE and TN UE distribution, with respect to previous remarks.  Issue 2-4:  Ok with Option 1.  Fine with recommended WF. |
| Samsung | Issue 2-3: Option 1.  For option 2, which is similar to option 1, it seems when NTN UE dropped at TN center, the path distances between surrounding TN BS sites and NTN UE are fixed. Though the coupling losses will still be randomly distributed, we have concerns if such method could generally represent enough co-ex cases. And in our view, option 1 is actually not more complex than option 2.  Issue 2-4: Support recommended WF, it is general method in RAN4. |
| Xiaomi | Issue 2-3: Option 1  Issue 2-4: Ok with Option 1. Fine with recommended WF. |
| CATT | Issue 2-3: Our understanding is that NTN UE should be randomly generated within the NTN area. How does it co-locate with TN network depends on how we place the 2 networks.  Issue 2-4: Follow RAN4 methodology for TN network, Ues are spread randomly in TN cells. |

Sub topic 2-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 2-5: Option 1. We think it is necessary to consider curvature formula because this is important to accurately calculate the distance between UE and satellite as the UEs are randomly distributed withing very large cell range, e.g. 250 km.  Issue 2-6: OK with option 1 |
| Huawei | Issue 2-5: Option 2. Only 0.003~0.05dB path loss difference can be observed between the Nadir point and satellite cell edge point. Based on the analysis above, there is no need to consider the curvature of earth assuming one satellite beam for the simulation.  Issue 2-6: OK with option 1 |
| Ericsson | Issue 2-5 Option 1 is just about another coordinate approach, no need to discuss this.  Option 2 is assuming looking at the NTN central beam (at Nadir point) which would be ok for TN victim, but might not ok for NTN victim.  Issue 2-6 That’s usual RAN4 coex simu methodology. Step 3 should detail which cells/TNs should be observed. |
| ZTE | Issue 2-5: no strong opinions, if curvature of earth is not considered, then simulation might be further simplified.  Issue 2-6: follow legacy RAN4 approach. |
| THALES | Issue 2-5: Option 1  Issue 2-6: Option 1 |
| Samsung | Issue 2-5: Option 1.  Technically, we are open to both option 1 and option 2. From submitted analysis, it seems minor differences between two options. If there’s only minor differences, then it’s not a big issue as it will not impact calibration and co-ex results.  Issue 2-6: Support recommended WF. |
| Xiaomi | Issue 2-6: Support recommended WF. |
| CATT | Issue 2-5:  If earth curve is just increasing simulation complexity without obvious impact on simulation results, we would prefer not to consider it.  Issue 2-6:  Recommended WF is fine. |

Sub topic 2-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 2-7: OK with option 1. |
| Ericsson | Issue 2-7 This is a good starting point. We should probably consider 1 GEO + 1 or 2 LEOs at diverse elevations. |
| ZTE | Okay with option 1. |
| THALES | Issue 2-7: Option 1, if NTN-NTN coexistence in adjacent bands are considered useful by satellite operators in S-band. |
| Samsung | Issue 2-7: Support recommended WF.  The current option 1 seems only covers NTN DL to NTN DL scenario, but we also need satellite/HAPS space stations layout to study NTN UL to NTN UL case. Anyhow, it needs further inputs and discussions. |
| Xiaomi | Issue 2-7:option 1 |
| CATT | OK with Option 1. |

### 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** |
| **Issue 2-1: NTN Network** | *Tentative agreements:*  NTN central beam is at satellite nadir, surrounded with 6 co-frequency beams. NTN FRFs higher than 1 need to be considered. Assume one NTN aggressor as default.  *Candidate options:* N/A  *Recommendations for 2nd round:*  Agree on the tentative agreement in 2nd round. |
| **Issue 2-2**  **TN Network** | Most agree on Option 1 or 2, except one view is that when TN is victim, only focusing on the TN at Nadir point should be enough.  *Tentative agreements:*  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. The number of TN networks needs further discussion. As an option, Figure 2.4-1 could be used to derive the number.  |  |  |  |  | | --- | --- | --- | --- | | 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.   general NTN topology  Figure 2.4-1 The heterogeneous network layout  *Candidate options:*N/A  *Recommendations for 2nd round:*  Try to agree on the Tentative agreement in 2nd round. |
| **Issue 2-3**  **Deployment of NTN UE** | Option 1 got 3 supports and Option 2 got 2. However, there were questions raised and a down-scope of Option 2 was proposed. There’s another view that NTN UE should be randomly generated within the NTN area.  *Tentative agreements:N/A*  *Candidate options:*  Option 1  Option 2  New Option 3: First decide/down-scope the coexistence scenarios (victim and aggressor) and then decide the NTN UE and TN UE distribution  New Option 4: NTN UE should be randomly generated within the NTN area. How does it co-locate with TN network depends on how we place the 2 networks.  *Recommendations for 2nd round:*  Further discuss 4 options above in 2nd round. |
| **Issue 2-4: Deployment of TN UE** | All agree on Option 1 as RAN the general method in RAN4  *Tentative agreements:*  TN UE are generated randomly inside the TN network, make sure enough TN UEs are associated to each TN sectors based on coupling loss.  *Candidate options:*N/A  *Recommendations for 2nd round:* N/A |
| **Issue 2-5: Coordinate System** | 3 companies support Option 1 and 5 companies are OK for Option 2.  *Tentative agreements: N/A*  *Candidate options:*   * Option 1 * Option 2   *Recommendations for 2nd round:* N/A  Further discuss these two Options in 2nd round. |
| **Issue 2-6: Methodology for TN-NTN coexistence.** | All agree with Option 1. Further details about which cells/TNs should be observed may be needed in Step 3.  *Tentative agreements:*  Option 1 approach, and more details about which cells/TNs should be observed in Step 3 may be added.  *Candidate options:* N/A  *Recommendations for 2nd round:* N/A |
| **Issue 2-7: Layouts for NTN-NTN** | All agree with Option 1.  *Tentative agreements:* Carry forward Option 1 for further discussion.  *Candidate options:* N/A  *Recommendations for 2nd round:* N/A |

### 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”.*

### Open issues summary

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 2-1: NTN Network** | *Tentative agreements:*  NTN central beam is at satellite nadir, surrounded with 6 co-frequency beams. NTN FRFs higher than 1 need to be considered. Assume one NTN aggressor as default.  *Recommendations for 2nd round:*  Agree on the tentative agreement in 2nd round. |
| **Issue 2-2**  **TN Network** | *Tentative agreements:*  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. The number of TN networks needs further discussion. As an option, Figure 2.4-1 could be used to derive the number.  |  |  |  |  | | --- | --- | --- | --- | | 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.   general NTN topology  Figure 2.4-1 The heterogeneous network layout  *Recommendations for 2nd round:*  Try to agree on the Tentative agreement in 2nd round. |
| **Issue 2-3**  **Deployment of NTN UE** | *Candidate options:*   * 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 |  * New Option 3: First decide/down-scope the coexistence scenarios (victim and aggressor) and then decide the NTN UE and TN UE distribution * New Option 4: NTN UE should be randomly generated within the NTN area. How does it co-locate with TN network depends on how we place the 2 networks.   *Recommendations for 2nd round:*  Further discuss 4 options above in 2nd round. |
| **Issue 2-5: Coordinate System** | *Candidate options:*   * 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.   *Recommendations for 2nd round:* N/A  Further discuss these two Options in 2nd round. |

### Companies views’ collection for 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | **Issue 2-2 TN Network**  Since the number of TN networks needs further discussion for two cases, other options should not be precluded.  **Issue 2-3 Deployment of NTN UE**  Option 2 that can reduce the simulation complexity.  **Issue 2-5: Coordinate System**  Option 1. The curvature of earth for layout is necessary for NTN co-ex study. |
| Samsung | Issue 2-1: Agree on the tentative agreement in 2nd round.  Issue 2-2: Agree on the tentative agreement in 2nd round.  Issue 2-3: We support below options for each scenario, with rationale   |  |  |  |  |  | | --- | --- | --- | --- | --- | | No. | Combination | **Aggressor** | **Victim** | NTN UE deployment/distribution | | 1 | TN - NTN | TN DL | NTN DL | Option 4.  Reason: Interference from TN BS to NTN UE: we think the interested aggressor in this case are those TN BSs (19-site) surrounding the NTN UE. | | 2 | TN with NTN | TN UL | NTN UL | Option 4  Reason: Interference from TN UE to NTN space station: in this case, we think the NTN UE should be randomly deployed throughout the beam coverage. Also, the number or density of TN UE should be discussed and aligned for co-ex study. | | 3 | TN with NTN | NTN DL | TN DL | No impact  Reason: Interference from NTN space station to TN UE: NTN UE location/distribution does not impact the NTN space beam pointing angles or eirp under current assumption | | 4 | TN with NTN | NTN UL | TN UL | Option 1.  Reason: Interference from NTN UE to TN BS: in this scenario, it has no meaning to study the case where NTN UE are generated far away from TN. | | 5 | TN with NTN | NTN UL | TN DL | Option 1  Reason: Interference from NTN UE to TN UE: similar reason as scenario No. 4 above. | | 6 | TN with NTN | TN DL | NTN UL | Option 4  Reason: Interference from TN BS to NTN space station: NTN UE needs to be generated spread the beam to study all cases. | | 7 | TN - NTN | TN UL | NTN DL | Option 1  Reason: Interference from TN UE to NTN UE: though in different link direction, but the reason is similar to scenario No. 4 above. | | 8 | TN - NTN | NTN DL | TN UL | No impact  Reason: Interference from NTN space station to TN UE: NTN UE location/distribution does not impact the NTN space beam pointing angles or eirp under current assumption | | 9 | NTN with NTN | NTN DL | NTN DL | Option 4  Reason: No TN existed in these scenarios. | | NTN UL | NTN UL |   Issue 2-5: We prefer option 1 than option 2, but open to both options. |
| ZTE | **Issue 2-2 TN Network**  Fine with that.  **Issue 2-3 Deployment of NTN UE**  We support the option 4 or maybe option 1 if we could have NTN UE density from operators.  **Issue 2-5: Coordinate System**  Option 1. |

## Summary on 2nd round (if applicable)

# 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. |
| R4-2106000 | 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 9dB UE noise figure as the assumption for NTN co-existence simulation calibration and RF requirements definition. |
| 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: |
| 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
* 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** |
| Qualcomm | Issue 3-1: Option 2.  Issue 3-2: OK with option 1  Issue 3-3: Option 2, Alt2: 3 |
| Huawei | Issue 3-1: Option 1.  Issue 3-2: Option 1.  Issue 3-3: Option 1 for simplifying the assumption. |
| Ericsson | Issue 3-1  Option 1 is ok.  Issue 3-2  If we go for 30MHz CBW, this is ok but not needed as we already have EIRP value/MHz…  Issue 3-3  Option 2 Alt 2 is ok BUT then it shall then be captured that FFR=1 is forbidden deployment for NTN as this would be more stringent. |
| ZTE | Issue 3-1  Option 1 is ok.  Issue 3-2: Option 1.  Issue 3-3: option 2 |
| THALES | Issue 3-1: Option 2. In R4-2103998 (Simulation assumption for NTN co-existence study) it has been discussed TN NR with 20 MHz and NTN NR with 5 MHz. We believe these configurations are also corresponding to worst cases.  Issue 3-2: None, because proposed NTN channel bandwidth is 30 MHz, and we should consider 5 MHz for NTN (see also R4-2103998). Ok for simulation coexistence with Set-1, as decided in RAN4#98e.  Issue 3-3: Option 2, Alt2 (FRF=3). |
| Panasonic | Issue 3-3: We prefer to Option 1 (FRF=1) as it shows the worst case of co-channel interference. |
| Samsung | Issue 3-1 Option 1.  We are also open to option 2, but this depends on the agreed number in Issue 3-3. I see no conflict between option 1 and 2 under this issue.  Issue 3-2 We are OK with option 1. But whether set-2 needs study or not depends on discussion in other issue.  Issue 3-3 We prefer option 1. We are open to option 2 alt2: 3. |
| Xiaomi | Issue 3-1: agree with Samsung’s view  Issue 3-2:Option 1  Issue 3-3: no strong view |
| CATT | Issue 3-1  Option 1 is ok.  Issue 3-2  OK with Option 1.  Issue 3-3  Option 2 is ok. |

Sub topic 3-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 3-4: 0dBi should be assumed for UE antenna. |
| Huawei | Issue 3-4: A clarification on BS type. Does BS assume as AAS or passive antenna? |
| Ericsson | Issue 3-4  Most of BSs deployed today in 2GHz are non-AAS BSs, so such BSs shall also be considered.  For AAS BS, align with latest LS Reply to ITU-R (R4-2008924).  For UE, omni antenna + 0dBi shall be assumed (usual assumptions). |
| ZTE | Issue 3-4  To align with ITU-R reply LS R4-2008924  For UE, 0dBi could be assumed. |
| THALES | Issue 3-4: We can follow TR 38.803 parameters for TN BS, with omni-directional radiation pattern 0dBi for UE TN. |
| Samsung | Issue 3-4: We support Option-3, which proposed AAS pattern for BS and 0 dBi omni-directional pattern for UE. Also the BS element number, the BS and UE antenna heights are aligned with the agreed 3GPP output LS to ITU-R WP5D for 2GHz band.  For option 1, the BS sector antenna cannot be used to correctly calculate gain towards satellite or HAPS in the sky. And it only contains BS height for Urban scenario, which still lacks of rural and suburban cases.  For option 2, the difference is whether we assume AAS or passive antenna for BS at 2GHz exemplary band. We slightly prefer to use AAS but we are open to Option 2. |
| CATT | Issue 3-4  Align with latest LS Reply to ITU-R (R4-2008924).  For UE, omni antenna + 0dBi shall be assumed. |

Sub topic 3-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 3-5: Option 2. Per our simulation, reusing TN TPC will lead to all the NTN UE transmitting with full power.  Issue 3-6: Option 2.  Issue 3-7:  Issue 3-8: prefer option 1 for NTN-NTN coexistence simulation. Can accept with option 3 which is the typical active UE number assumption in co-ex simulation. |
| Huawei | Issue 3-5: It depends how much targeted SINR can be achieved. If we still reuse 15dB targeted SINR, maybe the NTN UE has to transmit with full power. The analysis about option 3 can be considered.  Issue 3-6: Both option 1 and option 2 are OK for us.  Issue 3-7: Option 1  Issue 3-8: We don’t have a strong view on this. But it better refer to the real deployment. |
| Ericsson | Issue 3-5 Almost all NTN UEs should transmit at max power so TPC might not be that important here. Option 2 would be ok then.  Issue 3-6 Option 2, that’s the usual assumption for UEs at this frequency.  Issue 3-7: ok with option 1  Issue 3-8 Option 2, alternative 1 or 2 are ok. |
| ZTE | Issue 3-5  Option 2 is fine for us,  Issue 3-6 Option 2,  Issue 3-7: option 1  Issue 3-8: it’s better to check the practical deployment . |
| THALES | Issue 3-5: Option 2 with power control parameters from TR 38.821. Most of the UEs will probably use maximum transmission power.  Issue 3-6: Both Option 1 and Option 2 are fine. Some vendors could provide 7dBs, and this is the reason for having NTN UEs with 7dBs NF.  Issue 3-7: We should probably decide after the NTN exact architecture is decided (see [98-bis-e][307] NTN\_Solutions\_Part1).  Issue 3-8: Depends on the scenario, if LEO or GEO, cell beam size, etc. We should refer to TR 38.821. |
| Samsung | Issue 3-5: We are open to Option 2 and Option 3.  Technically, these two options are not conflict. We suggest to further study and settle down with an agreed targeted SNR or x-ile number for NTN UL power control.  Issue 3-6: Option 2.  Issue 3-7: OK with option 1.  Issue 3-8: Prefer option 3 for simplification. |
| Xiaomi | Issue 3-5 Option 2  Issue 3-6 Option 2,  Issue 3-7: option 1  Issue 3-8: option 2 or option 3 |
| CATT | Issue 3-5: Option 2 would be ok.  Issue 3-6: Option 2.  Issue 3-7: Option 1  Issue 3-8: regarding Option2, what does it mean by “hosts” in Alternative 1? Why the density of NTN UEs in a TN cell has to be the same as the density of TN UE? |

Sub topic 3-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 3-9: Option 2.  Issue 3-10: Option 2. |
| Huawei | Issue 3-9: Option 2, we need to be careful about these parameters used for NTN UEs.  Issue 3-10: Option 2 |
| Ericsson | Issue 3-9 option 2, but we don’t have any proposal for the alpha value for the time being.  Issue 3-10 Option 2 to apply same criteria on NTN and TN. |
| ZTE | Issue 3-9: Option 2, w  Issue 3-10: Option 2 |
| THALES | Issue 3-9: We could consider Option 2. However, NTN parameters might be different from TN.  Issue 3-10: SINR or SNR are important metrics (and we could consider Option 2 if NTN performance metrics values can be considered different as for TN). However, these should be probably combined with CDF in order to determine the percentage of satisfied users.  Potentially Option3: Apply same criteria with TN if NTN performance metrics values can be considered different as for TN. |
| Samsung | Issue 3-9: Option 2.  Issue 3-10: We are open to both options. SINR and throughput are traditional metrics for TN. |
| Xiaomi | Issue 3-9: Option 2. |
| CATT | Issue 3-9: Option 2 could be considered.  Issue 3-10: Option 2 to apply same criteria on NTN and TN. |

Sub topic 3-5

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 3-11: Agree, that’s good proposal. |
| THALES | Issue 3-11: Fine with Option 1, for S-band.  Agree with WF. |
| Samsung | Issue 3-11: Support recommended WF. |
| CATT | Issue 3-11: Agree. |

### 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** |
| **Issue 3-1: Satellite and NR Bandwidth** | 5 companies are OK with Option 1 and 3 companies are OK Option 2. And it is also proposed 5MHz to follow R4-2103998. (R4-2103998 was only noted in RAN4 98e.)  *Tentative agreements:* TN NR: 20MHz  *Candidate options:*  Satellite bandwidth will be   * Option 1: 5MHz * Option 2: Depending on FRF value   *Recommendations for 2nd round:*  Further discuss Satellite bandwidth in 2nd round. Satellite companies are encouraged to provide information on this. |
| **Issue 3-2: Satellite max TX power** | Most agree with Option 1 and one proposes to consider 5MHz bandwidth.  *Tentative agreements:*   * The satellite max Tx power can be calculated by the equation as below: * Further discuss bandwidth issue in Issue 3-1   *Candidate options: N/A*  *Recommendations for 2nd round: N/A* |
| **Issue 3-3: NTN FRF** | 3 companies are OK with FRF=1. 6 are OK with FRF>1 and 4 among these 6 are OK with FRF=3. Yet, one proposal is that it shall be captured that FRF=1 is forbidden if FRF =3 is chosen.  *Tentative agreements:* N/A  *Candidate options:*  To consider FRF in 2 phases as following:   * FRF=1 in phase 1 for simplification. * FRF=3 in phase 2 or it is found FRF=1 is too stringent.   *Recommendations for 2nd round:*  Further discuss and try to agree the candidate options in 2nd round |
| **Issue 3-4: FR1 TN BS and UE antenna pattern** | *Tentative agreements:*   * For UE antenna, an omni-directional radiation pattern with antenna gain 0dBi is assumed. * For BS antenna, align AAS pattern with latest LS Reply to ITU-R (R4-2008924). Non-AAS pattern will also be considered.   *Candidate options:* N/A  *Recommendations for 2nd round:*  Try to agree on the tentative agreements in 2nd round. |
| **Issue 3-5: TPC model for UL NTN power control** | Most agree with Option 2 and one agrees with Option 3.  *Tentative agreements:*  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.  *Candidate options:*  *Recommendations for 2nd round:*  Try to agree on the tentative agreements in 2nd round. |
| **Issue 3-6: Noise Figure of NTN UE** | All are OK with 9dB.  *Tentative agreements:* 9dB  *Candidate options:* N/A  *Recommendations for 2nd round:* N/A |
| **Issue 3-7: Noise Figure of NTN System** | *Tentative agreements:*  The noise figure F for NTN system (dB) should be further evaluated based on the couple loss assumption between satellite and gateway. Note that it may be settled down when after the NTN exact architecture is decided  *Candidate options:* N/A  *Recommendations for 2nd round:* N/A |
| **Issue 3-8: Active NTN UE number per beam/cell** | Diverse views have been expressed and no agreements can be foreseen so far..  *Tentative agreements:* N/A  *Candidate options:*   * Option 1 * Option 2 * Option 3   *Recommendations for 2nd round:*  Further discuss these options in 2nd round. Satellite companies are encouraged to provide information on practical development. |
| **Issue 3-9: Throughput ~ SNR mapping** | All agree with Option 2  *Tentative agreements:*  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.  *Candidate options:* N/A  *Recommendations for 2nd round:* N/A |
| **Issue 3-10: Performance metric for NTN** | All agree with Option 2. However, one concern was raised and it was proposed that NTN performance metrics values can be considered different as for TN if Option 2 is adopted.  *Tentative agreements:*  Apply same criteria with TN if NTN performance metrics values can be considered different as for TN.  *Candidate options:*N/A  *Recommendations for 2nd round:*  Try to agree on the tentative agreements in 2nd round. |
| **Issue 3-11: Potential TR for coexistence simulation** | All agree that coexistence simulations in adjacent bands should consider a dedicated TR (similar to e.g. TR 38.803).  *Tentative agreements:*  Coexistence simulations in adjacent bands should consider a dedicated TR (similar to e.g. TR 38.803).  *Candidate options:* N/A  *Recommendations for 2nd round:* N/A |

### 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)

### Open issues summary

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 3-1: Satellite and NR Bandwidth** | *Tentative agreements:* TN NR: 20MHz  *Candidate options:*  Satellite bandwidth will be   * Option 1: 5MHz * Option 2: Depending on FRF value   *Recommendations for 2nd round:*  Further discuss Satellite bandwidth in 2nd round. Satellite companies are encouraged to provide information on this. |
| **Issue 3-3: NTN FRF** | *Candidate options:*  To consider FRF in 2 phases as following:   * FRF=1 in phase 1 for simplification. * FRF=3 in phase 2 or it is found FRF=1 is too stringent.   *Recommendations for 2nd round:*  Further discuss and try to agree the candidate option in 2nd round |
| **Issue 3-4: FR1 TN BS and UE antenna pattern** | *Tentative agreements:*   * For UE antenna, an omni-directional radiation pattern with antenna gain 0dBi is assumed. * For BS antenna, align AAS pattern with latest LS Reply to ITU-R (R4-2008924). Non-AAS pattern will also be considered.   *Recommendations for 2nd round:*  Try to agree on the tentative agreements in 2nd round. |
| **Issue 3-5: TPC model for UL NTN power control** | *Tentative agreements:*  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.  *Candidate options:*  *Recommendations for 2nd round:*  Try to agree on the tentative agreements in 2nd round. |
| **Issue 3-8: Active NTN UE number per beam/cell** | *Candidate options:*   * 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.   *Recommendations for 2nd round:*  Further discuss these options in 2nd round. Satellite companies are encouraged to provide information on practical development. |
| **Issue 3-10: Performance metric for NTN** | *Tentative agreements:*  Apply same criteria with TN if NTN performance metrics values can be considered different as for TN.  *Recommendations for 2nd round:*  Try to agree on the tentative agreements in 2nd round. |

### Companies views’ collection for 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | **Issue 3-1: Satellite and NR Bandwidth**  Option 2. 30MHz BW has been agreed for NTN in last meeting. The satellite BW should be further be divided by FRF.   * **Issue 3-3: NTN FRF**   The two phases procedure is for calibration or requirements definition?  We prefer to use FRF=3 which is more reasonable in NTN deployment. The simulation results with FRF = 1 will lead to outage for the cell edge. We could not get the ACIR results in this case.  **Issue 3-4: FR1 TN BS and UE antenna pattern**  For BS antenna, does it mean either AAS or non-AAS can be used for co-ex study? Suggest to considering non-AAS since the interference with non-AAS should be worse than AAS case.  **Issue 3-5: TPC model for UL NTN power control**  Further discuss how to to revise CLx-ile in next RAN4 meeting.  **Issue 3-8: Active NTN UE number per beam/cell**  Option 1.  **Issue 3-10: Performance metric for NTN**  Agree |
| Samsung | Issue 3-1: We support tentative agreements for TN NR as 20MHz. For NTN BW, we are open to the discussion and agreement from this meeting.  Issue 3-3: We support the 2-phase approach in candidate option for 2nd round.  Issue 3-4: We are OK with the tentative agreements for 2nd round.  Issue 3-8: We prefer option 3: 1 for UL and DL for simplification purpose. We are open to other options. |
| Moderator | Response to Qualcomm’s question on NTN FRF: The two phases procedure is for calibration or requirements definition?  > In alignment of the phase-by-phase approach proposed and agreed in Section 1 (which is for co-existence study, not calibration), this is for the co-existence simulation assumptions which targets on requirements definition. It can also be considered in calibration procedure first as well. But one NTN FRF value for calibration, maybe FRF=1, is suggested to simplify the procedure. |
| ZTE | **Issue 3-1: Satellite and NR Bandwidth**  Fine to start with 20MHz for simulation calibration, actual BW used could be further discussed.  **Issue 3-3: NTN FRF**  For calibration phase, FRF 1 is fine for us.  **Issue 3-4: FR1 TN BS and UE antenna pattern**  For BS antenna, we prefer to align with LS Reply to ITU-R (R4-2008924), if we also consider the non-AAS case, the simulation cases would be doubled.  **Issue 3-5: TPC model for UL NTN power control**  Fine for us and details could be further discussed.  **Issue 3-8: Active NTN UE number per beam/cell**  Maybe we could start with option 3.  **Issue 3-10: Performance metric for NTN**  Agree |

## Summary 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 4-1: 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 |
| Ericsson | Issue 4-1 Option 1 is ok |
| Nokia | Issue 4-1: Option 1 |

Sub topic 4-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 4-2  Issue 4-3 |
| Huawei | Issue 4-2: We can find that the number of elements for 1st and 2nd layer are different, but the element gain is same. Does it mean antenna gains are different between 1st and 2nd layer?  A clarification: is the cell radius 100km ? |
| Ericsson | Issue 4-2 The proposed parameters would be ok except may be the element gain (8dBi); isn’t it too high value for those parameters? To be further checked.  Issue 4-3 Option 1 is ok |
| Nokia | Issue 4-2: Option 1  Issue 4-3: Option 1  For Huawei’s questions: The reference model of HAPS consists of 7 cells in two layers (see Figure 2), which provide a total coverage area of 100 Km radius (from the center up to the outer edge of 2nd layer of cells). The antenna for the 1st layer has fewer elements in order to maintain a good coverage area in the center cell. The antenna for the 2nd layer needs more elements to overcome the path loss and reach farther to the outer layer of cells. |

### 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** |
| **Issue 4-1: Co-existence scenarios for HAPS** | *Tentative agreements:* Option 1  *Candidate options:* N/A  *Recommendations for 2nd round:* N/A |
| **Issue 4-2: HAPS antenna and cell layout** | Questions were raised towards element gains and response has been provided.  *Tentative agreements:* N/A  *Candidate options:* Option 1  *Recommendations for 2nd round:*  Further discuss Option 1 in 2nd round. |
| **Issue 4-3: UL TPC for HAPS UE** | *Tentative agreements:* Option 1  *Candidate options:* N/A  *Recommendations for 2nd round:* N/A |

### 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)

### Open issues summary

|  |  |
| --- | --- |
| **Issue 4-2: HAPS antenna and cell layout** | Questions were raised towards element gains and response has been provided.  *Candidate options:* Option 1  *Recommendations for 2nd round:*  Further discuss Option 1 in 2nd round. |

### Companies views’ collection for 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 4-2 The proposed parameters would be ok except may be the element gain (8dBi); isn’t it too high value for those parameters? To be further checked. |
| Qualcomm | Clarifications: The co-ex simulation assumptions listed in Topic#4 assumes HAPS and TN are in adjacent channel, right? |
| ZTE | We have the same question as Qualcomm, |

## Summary on 2nd round (if applicable)

# Topic #5: Calibration 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** |
| Qualcomm | Issue 5-1: We are OK with Option 1. Suggest to starting the offline email discussion to calibrate the simulator after April meeting. |
| Huawei | Issue 5-1: Coupling loss can be considered. |
| Ericsson | Issue 5-1 We can do option 1 + option 2 to make sure we are all aligned. That’s fine. |
| ZTE | Issue 5-1, option 1+option 2 could be considered. |
| THALES | Issue 5-1: We are fine with Option 1. |
| Samsung | Issue 5-1: We are OK with both options, and prefer to settle down the metrics in this meeting, so we can bring up the numbers for calibration. |
| Nokia | Issue 5-1: Both Option 1 and Option 2. Coupling loss in NTN/HAPS should be calibrated. |

### 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** |
| **Issue 5-1: Which KPIs/parameters will be used for alignment?** | All agree with Option 1, and 4 are OK with Option 1+ Option 2. In addition, it is proposed to start offline email discussion to calibrate simulators after this meeting.  *Tentative agreements:*   * Use Coupling loss, DL SINR cdf, UE Tx power cdf and UL SINR cdf of TN, NTN and HAPS for alignment. * Start offline email discussion to calibrate simulators after this meeting.   *Candidate options:* N/A  *Recommendations for 2nd round:*  Try to agree on the tentative agreements in 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)

### Open issues summary

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 5-1: Which KPIs/parameters will be used for alignment?** | *Tentative agreements:*   * Use Coupling loss, DL SINR cdf, UE Tx power cdf and UL SINR cdf of TN, NTN and HAPS for alignment. * Start offline email discussion to calibrate simulators after this meeting.   *Recommendations for 2nd round:*  Try to agree on the tentative agreements in 2nd round. |

### Companies views’ collection for 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Agree |
| ZTE | Agree |

## Summary on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| R4-2106104\_WF on [308] NTN\_Solutions\_Part2 | Samsung |  |
| R4-2106105\_Simulation assumptions for NTN co-existence | Samsung, CATT |  |
| R4-2106106\_Simulation assumptions for HAPS co-existence | Nokia |  |

**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 |
| R4-2106000 | 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 |