**3GPP TSG-RAN WG4 Meeting # 98-e R4-2103750**

**Electronic Meeting, 25th Jan. – 5th Feb., 2021**

**Agenda item:** 11.8.3

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [98e][311] NTN\_Solutions\_Part2

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion 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 11.8.3 at TSG-RAN WG4 #98e, 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 Annex) and 5 topics are listed as below to cover proposals and contents in these documents as appropriate.

* Topic #1: Scope of coexistence study
* Topic #2: Coexistence simulation scenarios
* Topic #3: Network layout model
* Topic #4: Simulation assumptions
* Topic #5: HAPS

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

* 1st round: Focus on Topic #1 and Topic #2 and target on narrowing down the scope and scenarios in GTW session if arranged.
* 2nd round: Focus on other Topics based on the outcome of topic #1/#2 and also GTW sessions. Target to agree on WFs for simulation assumptions to provide results in RAN4 #99e

# Topic #1: Scope of coexistence study

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2102174 | Ericsson | Proposal 1: Co-channel coexistence and coexistence with adjacent services are out of NTN WI’s scope. |

## Open issues summary

### Sub-topic 1-1

*Sub-topic description:*

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

**Issue 1-1: Scope of coexistence study**

* Proposals
  + Option 1: Co-channel coexistence and coexistence with adjacent services are out of NTN WI’s scope.
* Recommended WF
  + Only consider adjacent channel cases in NTN WI.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 1-1: Yes for Option 1, as it has already been discussed in RAN Plenary.  WF: Yes, as per RAN4 process.  ….  Others: |
| Qualcomm | Issue 1-1: Scope of coexistence study:  We support option 1. This is what we did for co-existence study in RAN4. |
| Samsung | Issue 1-1  Agree with the WF. |
| ZTE | Issue 1-1  Agree with the WF.  In addition, whether GEO and LEO could be operated at the co-channel should also be clarified, this has direct impact on RRM MG design. |
| Xiaomi | Issue 1-1  Fine with the recommended WF |
| CATT | Support the recommended WF. |
| Huawei | Only consider adjacent channel cases from RAN4 RF perspective. (Wording should be changed)  Probably, co-channel coexistence simulations are needed in RAN1 or ITU. |
| Ericsson | Issue 1-1: option 1 RAN4 never did co-channel coexistence studies. |
| Nokia | Issue 1-1 We agree with option 1. |
| Hughes/EchoStar | Agree with WF |
| Eutelsat | Agree with WF |
| Inmarsat | Issue 1-1 Agree with WF for NTN-TN co-existence. |

## 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.*

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|  | **Status summary** |
| **Sub-topic#1 Scope of coexistence study** | Common views on NTN-TN scenarios have been reached and some companies raised the question whether co-channel cases need to be considered.  *Tentative agreements:*   * For NTN-TN, only consider adjacent channel cases from RAN4 RF perspective. (common consensus) * For NTN-NTN, only consider adjacent channel cases from RAN RF perspective (majority views) * Whether GEO and LEO could be operated at the co-channel should also need to be clarified   *Recommendations for 2nd round:*  Discuss the Tentative agreements and recommend to handle this in GTW. Moreover, consideration of RRM MG is not within the scope of this email thread. |

----------------------GTW Note on Feb.1-------------------

Agreements:

* For NTN-TN, only consider adjacent channel cases from RAN4 co-existence study
* For NTN-NTN, only consider adjacent channel cases from RAN4 co-existence study

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Way forward on [311] NTN\_Solutions\_Part2 | Samsung, WF |
|  |  |  |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Co-existence simulation scenarios

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100399 | CATT | Proposal 4: It is proposed to focus on fixed beam scenario for satellite.  Proposal 5: It is proposed to consider the NTN scenarios in Table 2.2-1 for co-existence study.  Proposal 6: It is proposed to consider Rural and Dense urban scenario with priority for terrestrial network.  Based on the above proposal, the scenarios for co-existence study can be further down selected as the following table.  **Table 3-1. Proposed scenarios for co-existence study**   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | | | **Set 1** | | | **Set 2** | | | | **GEO** | **LEO 1200km** | **HAPS** | **GEO** | **LEO 1200km** | **HAPS** | | **NR / NB-IoT** | **Rural** | | X | X | X | X | X | X | | **Dense Urban** | | X | X | X | X | X | X | | **NTN** | **GEO** | **Set 1** | X | X | X | N/A | N/A | N/A | | **LEO 1200km** | X | X | X | N/A | N/A | N/A | | **HAPS** | X | X | X | N/A | N/A | N/A | | **GEO** | **Set 2** | N/A | N/A | N/A | X | X | X | | **LEO 1200km** | N/A | N/A | N/A | X | X | X | | **HAPS** | N/A | N/A | N/A | X | X | X | |
| R4-2100486 | CATT | It is proposed that only earth fixed beams is used and only FDD is used for co-existence study. So 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 | Assuming TN BS ACLR is not impacted. | | 2 | TN with NTN | TN UL | NTN UL | Assuming TN UE ACLR is not impacted | | 3 | TN with NTN | NTN DL | TN DL | Assuming TN UE ACS is not impacted. | | 4 | TN with NTN | NTN UL | TN UL | Assuming TN BS ACS is not impacted | | 5 | TN with NTN | NTN UL | TN DL | Co-existence between NTN and adjacent TDD bands. E.g. TDD in 2010-2025MHz. | | 6 | TN with NTN | TN UL | NTN DL | Co-existence between NTN and adjacent TDD bands. E.g. TDD in 2010-2025MHz. | | 7 | TN with NTN | NTN DL | TN UL | Co-existence between NTN and adjacent TDD bands. E.g. TDD in 2010-2025MHz. | | 8 | TN with NTN | TN DL | NTN UL | Co-existence between NTN and adjacent TDD bands. E.g. TDD in 2010-2025MHz. | | 9 | NTN with NTN | NTN DL | NTN DL |  | | NTN UL | NTN UL |  | |  | | | | |   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** | Note | | Rural | 2 GHz | 30 MHz | Include both FDD and TDD | | Dense Urban | 2 GHz | 30 MHz | Include both FDD and TDD | | GEO | 2 GHz | 30 MHz | FDD | | LEO 1200km | 20 GHz | 200 MHz | FDD | | 2 GHz | 30 MHz | low priority, FDD | | HAPS | 2 GHz | 30 MHz | FDD | |
| R4-2100904 | Samsung | Proposal 1: For coexistence study of FR1, 2GHz can be assumed as the simulation frequency no matter L-band or S-band to be chosen as the exemplary band.  Proposal 2: Coexistence scenarios for FR1 in the table below are suggested to be captured at least.  Table 1 Scenarios for FR1 coexistence study   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **No.** | **Usage scenario** | **Aggressor** | **Victim** | **Direction** | **Simulation frequency** | | 1 | eMBB | NTN | TN | DL to DL | 2 GHz | | 2 | eMBB | NTN | TN | UL to UL | 2 GHz | | 3 | eMBB | NTN | NTN | DL to DL | 2 GHz | | 4 | eMBB | NTN | NTN | UL to UL | 2 GHz |   Proposal 3: For initial coexistence study of FR1, scenarios of LEO@600km and GEO@35,786km are taken into account with higher priority.  With the deployment related parameters in Table 6.1.1.1-5 as baseline, for details assumption such as deployment scenarios (such as rural etc.), BW per beam, frequency re-use factor etc., the typical deployment requirements of satellite based NTN system should be well take into account. |
| R4-2101105 | Xiaomi | Proposal 1: It is proposed that rural scenario shall be as priority coexistence cases between NTN and TN for FR1.  Proposal 2: Rural scenario shall be removed when do the coexistence between NTN and TN in FR2. |
| R4-2101812 | Huawei, HiSilicon | Proposal 1: It’s proposed to down-select the NTN co-existence scenarios as table 2.  Table 2 The items and candidate options   |  |  | | --- | --- | | Items | Proposal | | Frequency range | L-band | | NTN scenarios | LEO-600, HIBS (priority)  GEO, LEO-1200 | | Parameter Set | Merge both set1 and set2 as one parameter set | | Beam configurations | Earth Fixed Beam | | NR scenarios | Rural, Urban macro (priority)  Dense Urban, Micro/small cell outdoor, Indoor hotspot | | UE type for NTN | Handheld UE | |
| R4-2101859 | Thales | Proposal 1: NTN-TN and NTN-NTN coexistence scenarios should consider realistic deployments with different number of users and cell densities.    Proposal 2: RAN4 should consider and evaluate the following interference types in adjacent channels for NTN-TN coexistence:  1) Interference Type 1 (i1) in adjacent bands from UL TN to UL NTN;  2) Interference Type 2 (i2) in adjacent bands from UL NTN to UL TN;  3) Interference Type 3 (i3) in adjacent bands from DL TN to DL NTN;  4) Interference Type 4 (i4) in adjacent bands from DL NTN to DL TN.  Proposal 3: NTN-TN coexistence impact in adjacent bands has to be considered at different levels:  1) At satellite level for Interference Type 1;  2) At gNB level for Interference Type 2;  3) At NTN UE level for Interference Type 3;  4) At TN UE level for Interference Type 4.  Proposal 4: Based on simulation and evaluation results for described NTN-TN coexistence scenarios in adjacent bands, work may further focus on reducing:  1) Interference Type 1;  2) Interference Type 3;  as the NTN system may be severely impacted.    Proposal 7: RAN4 should evaluate potential impact of special type of UL-DL interference in adjacent bands such as:  1) Interference Type 5 (i5) in adjacent bands from DL TN to UL NTN;  2) Interference Type 6 (i6) in adjacent bands from DL NTN to UL TN;  3) Interference Type 7 (i7) in adjacent bands from UL TN to DL NTN;  4) Interference Type 8 (i8) in adjacent bands from UL NTN to DL TN.  Proposal 8: Based on simulation and evaluation results for described NTN-TN coexistence scenarios in adjacent bands, work may further focus on reducing:  1) Interference Type 5;  2) Interference Type 7. |
| R4-2101880 | Thales | Proposal 1: Consider only NTN extreme cases e.g. 1 worst case and 1 best case (in terms of Doppler, received power) for 2 types of configurations (Earth Fixed Beam, Earth Moving Beam) with 3-4 BW configurations.  Proposal 2: RAN4 should focus the work on satellite scenarios C1.1, C2.1 (LEO Earth Fixed Beams and Earth Moving Beams) and A1 (GEO):  • C1.1: LEO @ 600 km altitude, FR1, Earth fixed beams;  • C2.1: LEO @ 600 km altitude, FR1, Earth moving beams;  • A1: GEO @ 35,786 km altitude, FR1, Earth fixed beams;  and only if sufficient RAN4 resources, consider also LEO @ 1200 km altitude. |
| R4-2101964 | ZTE Corporation | Proposal 1: to prioritize the rural and sub-urban macro scenario for NR or NB-IoT coexisting with satellite.  Proposal 2: whether GEO and LEO could operate at the same frequency should be clarified at the beginning. |
| R4-2102174 | Ericsson | A down-selection of the scenarios would be needed to optimize the simulations effort. Following aspects might be a starting point to agree on a down-selection:   * Rural scenario is usually not considered in FR2. * Most likely, indoor scenario would be less impacted especially in FR2 due to path loss and building isolation. * In the agreed WF ([6]), LEO @1200km was already down-prioritized for FR1, it should be discussed if it could then be considered as out of scope for the simulations and so, from the scope of RF requirements that will be worked on. * A deeper analysis of set 1 and set 2 would be needed to identify if one set would be more stringent and so, if all simulations would be needed for both sets.   Observation: Relevant ITU studies should be a good starting point to discuss the simulation assumptions in RAN4. |
| R4-2102508 | Qualcomm | Proposal 1: For NTN deployment scenarios, GEO satellite, LEO satellite and HAPS with FDD carrier at 2GHz (UL&DL), and 20GHz (UL) and 30GHz (DL) should be considered for co-existence simulation in RAN4 as the starting point.  Proposal 2: Fixed earth beams shall be assumed in the NTN co-existence study.  Proposal 3: For TN deployment scenarios, Rural and Urban Marco scenario with the carrier frequency adjacent to TN network should be prioritized for NTN-TN co-existence study. The simulation results for other scenarios can be provided. For TN networks, NR could be selected as the reference.  Proposal 4: RAN4 to agree co-existence scenarios listed in Table 1.  **Table 1: co-existence scenarios**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | | NTN | | | | | **GEO** | **LEO 600km** | **LEO 1200km** | **HAPS** | | NTN | **GEO** | Yes | Yes | Yes | Yes | | **LEO 600km** | Yes | Yes | Yes | Yes | | **LEO 1200km** | Yes | Yes | Yes | Yes | | **HAPS** | Yes | Yes | Yes | Yes | | TN | **Rural** | Yes | Yes | Yes | Yes | | **Urban Marco** | Yes | Yes | Yes | Yes | | Note 1: For FR1, FDD carrier frequency at 2GHz is considered. For FR2, FDD carrier frequency at 20GHz and 30GHz is considered.  Note 2: Rural and Urban Marco with 100% outdoor UE distribution is prioritized for TN scenario. The simulation results for other scenarios can be provided.  Note 3: For TN networks, NR is considered as the reference. | | | | | | |

## Open issues summary

### Sub-topic 2-1

*Sub-topic description*

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

**Issue 2-1: Frequency for coexistence study**

* Proposals
  + Option1 (Huawei): L-band
  + Option2 (CATT, Samsung, ZTE, Qualcomm): 2GHz (for both UL&DL)
  + Option4 (Qualcomm, ZTE, CATT): 20GHz (UL), 30GHz (DL)
* Recommended WF
  + TBA

### Sub-topic 2-2

*Sub-topic description: To down-select TN deployment scenarios*

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

**Issue 2-2: TN deployment scenario**

* Proposals
  + Option 1:

|  |  |  |
| --- | --- | --- |
|  | FR1 | FR2 |
| TN | Rural,  Urban Macro,  Dense Urban | Remove Rural |
| Note： The simulation results for other scenarios can be provided. | | |

* + Option 2: TBA
* Recommended WF
  + Agree on TN deployment scenarios shown as Option 1 and further down-select scenarios in FR2. Note that whether FR2 shall be considered at current stage relies on discussions in thread [310].

### Sub-topic 2-3

*Sub-topic description: To confirm TN types*

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

**Issue 2-3: TN Type**

* Proposals
  + Option 1 (Qualcomm): NR
  + Option 2 (Ericsson, ZTE): NR/NB-IoT
* Recommended WF
  + TBA

### Sub-topic 2-4

*Sub-topic description: To down-select NTN deployment scenarios.*

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

**Issue 2-4: Satellite based NTN deployment**

* Proposals
  + Option 1(Qualcomm): GEO, LEO@600km, LEO@1200km
  + Option 2 (CATT): GEO, LEO@1200km
  + Option 3 (Thales): GEO and LEO@600km
  + Option 4 (Huawei): LEO@600km
  + Option 5: in addition to Options above, whether GEO and LEO could operate at the same frequency should be clarified.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| THALES | Sub topic 2-1:   * Option 2 revised to FR1 S-Band (NTN FDD), 2170-2200 MHz (DL) and 1980-2010 MHz (UL) * Option 4 revised to “above FR1 (NTN FDD): 17.7 - 20.2 (DL) and 27.5 - 30.0 GHz (UL)”   Sub topic 2-2:   * FR1: LEO constellation with omnidirectional UE, and GEO constellation with UE with directional (or external) antenna, underserved/unserved (e.g. **rural scenarios**) * FR2: LEO and GEO, with UE with directional (or external) antenna, **rural and urban** scenarios * WF: need to first decide UE types, satellite constellation, and deployment scenarios.   Sub topic 2-3:   * Option 1   Sub topic 2-4:   * Option 3 (the most extreme use cases, otherwise too many coexistence scenarios)   ….  Others: Interference types (i1, i2, i3, i4 and potentially i5, i6, i7, i8) should be further discussed. |
| Qualcomm | **Issue 2-1: Frequency for coexistence study**  We prefer option 2 for FR1, and option 4 for the frequencies above FR1.  **Issue 2-2: TN deployment scenario**  We support option 1. We couldn’t preclude LEO/GEO satellites provide service for UEs with omnidirectional antenna in Urban Marco/Dense urban scenario. Therefore, we should consider Urban Marco/Dense urban for TN in co-ex study.  **Issue 2-3: TN Type**  We proposed option 1 since we thought NR would be the worst case for TN-NTN co-existence study. We are OK to go with option 2 if companies agree to run the simulation for both NR and NB-IoT.  **Issue 2-4: Satellite based NTN deployment**  We agree that the worst case should be considered to reduce the simulation workload. But we are not sure which scenario, i.e., LEO600km or LEO1200km is the worst case. Usually, the scenario that has worse performance for single operator is the worst co-ex scenario, e.g. LEO1200km. We are OK to down-select from LEO600km and LEO1200km if the worst case can be identified. |
| ZTE | **Issue 2-1 Frequency for coexistence study**  Prefer Option 2  **Issue 2-2 TN deployment scenario**  support Option 1, in addition, dense urban scenairo could be deprioritized.  **Issue 2-3 TN Type**  support Option 2  Iss**ue 2-4 Satellite based NTN deployment**  Need to further discuss, in addition, whether GEO and LEO could have the same requirements is still questionable. |
| Xiaomi | **Issue 2-1 Frequency for coexistence study**  No strong view, it may depend on which band as example bands.  **Issue 2-2 TN deployment scenario**  Fine with option 1  **Issue 2-3 TN Type**  Fine with option 2. For the first coexistence study, we are OK to include both NR/NB-IoT.  **Issue 2-4 Satellite based NTN deployment**  Which is the worst case needs FFS. |
| CATT | **Issue 2-1 Frequency for coexistence study**  Wait the decision on example band.  **Issue 2-2 TN deployment scenario**  Fine with option 1  **Issue 2-3 TN Type**  Prefer to prioritize NR at the first stage.  **Issue 2-4 Satellite based NTN deployment**  Proposals are quite diverge. We propose to pick one GEO and one LEO case. |
| Huawei | **Issue 2-1 Frequency for coexistence study**  Option 1: it may depend on which band as example bands.  **Issue 2-2: TN deployment scenario**  OK with recommended WF  **Issue 2-3: TN Type**  Support option 2  **Issue 2-4: Satellite based NTN deployment**  For different scenarios, it’s very hard to find the worst case. It depends on the transmitter power, propagation model and antenna gain. |
| Ericsson | Issue 2-1: option 1. No need to look at FR2 for the time being, there is no candidate NTN band and ESIM should be further investigated  Issue 2-2: Option 2: too early to remove indoor scenario: NTN is very new area, we can’t reuse conclusions from past RAN4 studies without further analysis.  Issue 2-3: option 2, we can’t just ignore NB-IoT for FR1.  Issue 2-4: option 1 a priori, so far there is no good reason to down-select other deployment. If one of them should remove then, it shall be either demonstrated this is a less stringent scenario, or it should be considered as out of scope. |
| Samsung | **Issue 2-1 Frequency for coexistence study**  Prefer Option 2  **Issue 2-2 TN deployment scenario**  We are OK with Option 1 and the WF could be agreeable.  **Issue 2-4 Satellite based NTN deployment**  Prefer Option 3 as the agreement of last RAN 4 meeting. |
| Nokia | Issue 2-1: We prefer option 2 for FR1. For FR2 we still think more discussion is needed since no FDD FR2 bands currently have been defined.  Issue 2-2: We are fine with the proposed WF  Issue 2-3: Preference for option 2  Issue 2-4: Option 1 but we are fine to down select if we ensure we then study worst case. In our understanding the worst case corresponds to option 3 so we would be fine with this. |
| Hughes/EchoStar | **Issue 2-1: Frequency for coexistence study**  Option 2 and Option 3  **Issue 2-2 TN deployment scenario**  Option 1: FRI - Urban Macro, Dense Urban and FR2 - Remove Rural  **Issue 2-3 TN Type**  Option 1  **Issue 2-4 Satellite based NTN deployment**  Prefer Option 1 |
| Inmarsat | Issue 2-1 - Frequency for coexistence study   * Option 2 for FR1 * Revised Option 4 as suggested by THALES - “above FR1 (NTN FDD): 17.7 - 20.2 (DL) and 27.5 - 30.0 GHz (UL)”   **Issue 2-2 - TN deployment scenario**   * Option 1   **Issue 2-3 - TN Type**   * Preference for Option 2   **Issue 2-4 - Satellite based NTN deployment**  GEO and LEO will have different requirements – worst case scenario for both cases is a good assumption but what that means is FFS. |

## 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.*

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|  | **Status summary** |
| **Sub-topic#1**  Frequency for coexistence study | Different views have been expressed to support several options. As summary, candidate options have been proposed by the Moderator.  *Tentative agreements: N/A*  *Candidate options:*   |  |  |  | | --- | --- | --- | | A | 3 companies | FR1: S-Band 2170-2200 MHz (DL) and 1980-2010 MHz (UL)  Above FR1 (NTN FDD): 17.7 - 20.2 (DL) and 27.5 - 30.0 GHz (UL) | | B | 2 companies | L-Band | | C | 4 companies | 2GHz for both UL & DL | | D | 1 | 20GHz (UL) & 30GHz (DL) | | Note:  One view is that such selection depends on the out come of exemplary bands in thread [310]  Another view is that there’s no need to look at FR2 now and FDD FR2 is not defined yet. | | |     *Recommendations for 2nd round:*   * Further discuss candidate options in 2nd round * Recommend this topic to be handled in GTW. |
| **Sub-topic#2**  TN deployment scenario | 8 companies are OK with the proposed WF. Yet there are different views on details of the inclusion/exclusion/prioritization of scenarios.  *Tentative agreements: N/A*  *Candidate options:*   |  |  |  | | --- | --- | --- | |  | FR1 | FR2/Above FR1 | | TN | Rural (FFS)  Urban Macro,  Dense Urban (FFS)  Indoor (FFS) | ~~Rural,~~  Urban macro,  Dense Urban,  Micro/small cell outdoor,  Indoor hotspot | | Note：  1. Whether FR2/Above FR1 shall be remained depends on the outcome of [310]  2. The simulation results for other scenarios can be provided. | | |   *Recommendations for 2nd round:*   * Further discuss and down-select items in 2nd round * Recommend this topic to be handled in GTW. |
| **Sub-topic#3**  TN type | 4 companies support Option 1 and 6 companies support Option 2.  *Candidate options:*  To consider NR/NB-IoT in coexistence study  *Recommendations for 2nd round:*   * Further discuss the candidate option in 2nd round * Recommend this topic to be handled in GTW. |
| **Sub-topic#4**  Satellite based NTN deployment | Diverse views have been expressed supporting 4 options as listed.  *Candidate options:*   * Option 1: GEO, LEO@600km, LEO@1200km * Option 2: GEO and LEO@600km   *Recommendations for 2nd round:*   * Further discuss and down-select these options in 2nd round and recommend this topic to be handled in GTW. * Further analysis on which scenario is the worst case between LEO@600km and LEO@1200km is suggested. |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Way forward on [311] NTN\_Solutions\_Part2 | Samsung, WF |
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## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Network layout model

Note: RAN4 has decided that “Use TR 38.821 as a baseline/starting point”.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100486 | CATT | The network layout between NTN and TN is depicted in the Figure 2.2-1. Since the satellite beam coverage is quite large, it is proposed only one satellite is considered in the co-existence study between NTN and TN.    **Figure 2.2-1 layout for coexistence between NTN and TN system**  The network layout between NTN and NTN is depicted in the Figure 2.2-2 and figure 2.2-3.  In Figure 2.2-2, only one satellite carry two neighbour carriers is assumed and the footprints of the 2 carriers are the same.    **Figure 2.2-2 layout for coexistence between NTN systems**  In Figure 2.2-3, two satellites operating on two neighbour carriers but at different height are assumed, where the GEO have larger cell coverage and LEO has smaller coverage.    **Figure 2.2-3 layout for coexistence between NTN systems (different height satellites)**  For NTN UE distribution, at least X = [10] UEs per beam with uniform distribution in all the cell coverage area associated to each beam.  The TN UE distribution could refer to TR38.803, which also considered uniform UE distribution.  For both TN and NTN network, it is proposed frequency reuse factor 1 is considered in the coexistence study.  The wrap around mechanism should be considered in system level simulations. |
| R4-2100904 | Samsung | Proposal 4: Use Satellite and UE parameters as well as network deployment assumptions in TR 38.821 as the baseline/starting point for FR1 coexistence study.  Beam layout definition is suggested to be aligned with TR38.821 in Table 6.1.1.1-4. |
| R4-2101105 | Xiaomi | Proposal 3: For the coexistence study between NTN and NTN, the layout in TR38.821 for system level simulation could be as baseline.  Proposal 4: For the coexistence study between NTN and TN, only one satellite is considered but how many beam cells for the satellite needs to be studied with the following three options as the starting point.   * Option 1: 19 beam cell * Option 2: 19 beam cell with a new wrap around mechanism as mentioned in TR38.821 based on different frequency reuse factor * Option 3: only one beam cell |
| R4-2101812 | Huawei, HiSilicon | Observation 1: The figure 1 can be used as heterogeneous network layout between NR legacy network and NTN network for one beam cell.    **Figure 1 The heterogeneous network layout**  Observation 2: The equation (1) and (3) can be used to calculate the number of layers and sites for NR legacy network.  Layer = D-beam/ISD/2 + 1 (1)  Site\_total = 3\*n\*(n-1) + 1 (3)  Observation 3: Even if the minimum beam diameter was chosen in table 6.1.1.1-1 from TR 38.821, thousands of sectors will be used. Thus, RAN4 need to further check whether there is a method to further decrease the complexity of simulations. |
| R4-2101859 | Thales | Proposal 9: NTN deployments should consider FFR techniques with frequency reuse factor>1.  Proposal 10: NTN-NTN coexistence scenarios should consider interference reduction techniques for both UL and DL. |
| R4-2101964 | ZTE Corporation | Proposal 2: whether GEO and LEO could operate at the same frequency should be clarified at the beginning.  Proposal 3: only one satellite is assumed for coexistence study at the beginning.  Proposal 4: consider the frequency reuse factor 1 as worst case for coexistence study.  **Table 2.2.7-3: Beam layout definition for single satellite simulation**   |  |  | | --- | --- | | Scenario | Scenario A, C2 and D2 | | Beam layout definition | Baseline: Hexagonal mapping of the beam bore sight directions on UV plane defined in the satellite reference frame.  Only the 3dB beam width parameters should be used. The beam diameter and beam spacing values can be computed directly from the 3 dB beam width assumptions and should be considered as informative. | | Number of beams | Baseline: 19-beam layout considering wrap-around mechanism (i.e. 18 beams surrounding the central beam and allocated on 2 distinct "tiers") | | UV plane illustration (extracted from [19]) |  | | UV plane convention | U axis is defined as the perpendicular line to the satellite-earth line on the orbital plane as illustrated here after:    The straight line being orthogonal to UV plane is pointing towards the Earth centre.  UV coordinates of the nadir of the reference satellite is (0,0) | | Adjacent beam spacing on UV plane | Baseline: Adjacent beam spacing computation based on 3dB beam width of the satellite antenna pattern:  ABS = sqrt(3) x sin(HPBW/2 [rad]) | | Central beam bore sight direction definition | Baseline:  Case 1: Central beam center is considered at nadir point  Case 2: Central beam boresight direction computed based on elevation angle target |   **Table 2.2.7-4: System Level Simulation assumptions for calibration**   |  |  | | --- | --- | | Configuration scenario | A, C2 and D2 | | Frequency band | S-band (i.e. 2 GHz) / Ka-band (i.e. 20 GHz DL, 30 GHz UL) | | Maximum Bandwidth per beam (DL + UL) | S-band: DL 30 MHz and UL 30 MHz  Ka-band: DL 400 MHz and UL 400 MHz  The bandwidth per beam must be adapted based on the frequency factor and the polarization re-use option considered. | | Satellite characteristics (G/T, EIRP density, antenna diameter) | See Table 6.1.1.1-1 and Table 6.1.1.1-2  Note: Same satellite characteristics should be considered for both single and multi-satellite simulations | | Satellite antenna pattern | See section 6.4.1 in [2]: Bessel function | | Satellite polarization configuration | Circular | | Beam layout definition | For singles satellite simulation: See Table 6.1.1.1-4  For multi satellites simulation: FFS | | Frequency re-use factor | Option1: 1[worst case preferred for co-existence study] | | Polarization re-use | Option 1: Disable  Option 2: Enable  Note: Polarization re-use should apply only if circular polarization for terminal antenna is considered | | Channel model | Large scale model of [2] (Note 2) | | Deployment scenarios | Base-line: Rural  Additional deployment scenario results can be provided | | Propagation conditions | Base-line:  Clear Sky  Line of sight | | UEs outdoor/indoor distribution | 100% outdoor distribution for UEs | | UE distribution | Base-line for calibration: at least X=10 UEs per beam with uniform distribution in all the Voronoi cell area associated to each beam.  The cell area associated to a given beam is defined as the Voronoi cell associated with the corresponding beam centers. | | UE configuration | S-band:  Handheld (optional for scenario A)  Ka-band:  VSAT  Others (optional for scenario A)  See Table 6.1.1.1-3 | | UE orientation | VSAT and Others: Ideal Tracking serving beam;  Handheld: Random | | Handover Margin | 0 dB | | UE attachment | RSRP | | Metrics for calibration | Base-line: Coupling loss, Geometry  Note: Coupling loss is defined as the signal loss from the antenna port to the antenna port | | NOTE 1: Typical impairment values (additional frequency error, SNR loss) due to the feeder link except for delay can be considered to be negligible. When available, specific values can be considered in the evaluation and should be reported.  NOTE 2: For the calibration purpose, the ionospheric scintillation loss shall be considered equal to zero (i.e., the UEs are located between 20 and 60 degrees of latitude). The atmospheric absorptions loss shall be considered. | |   The beam layout parameters captured in the following table are adopted as a starting point for single satellite simulations.  **Table 2.2.7-3-6: Beam layout parameters for single satellite simulation**   |  |  |  | | --- | --- | --- | | Scenario | Scenario A | Scenario C2/D2 | | Carrier frequency | S-band: 2 GHz  Ka-band: 20 GHz for DL | S-band: 2 GHz  Ka-band: 20 GHz for DL | | Adjacent beam spacing (ABS) on UV plane | S-band:  Set 1: ABS = 0.0061  Set 2:ABS = 0.0111  Ka-band:  Set 1: ABS = 0.0027  Set 2: ABS = 0.0067 | S-band:  Set 1: ABS = 0.0668  Set 2: ABS = 0.1334  Ka-band:  Set 1: ABS = 0.0267  Set 2: ABS = 0.0667 | | Satellite location | Any position on the geostationary orbit | Any position on the LEO orbit | | Central beam center elevation angle target | Baseline: 45 deg | Baseline: 90 deg | | Central beam bore sight direction coordinates in UV plane | Baseline: (0.107,0) | Baseline: (0,0) | | Gateway direction coordinates in UV plane | Baseline: Same as central beam bore sight direction coordinates in UV plane  Note: Not needed for calibration | | |
| R4-2102174 | Ericsson | Observation: Relevant ITU studies should be a good starting point to discuss the simulation assumptions in RAN4. |
| R4-2102508 | Qualcomm | Proposal 5: Single satellite with 19 inner beams and FRF of 3 shall be used for NTN co-existence simulation.  Proposal 6: RAN4 to consider both coordinated and uncoordinated NTN-NTN deployment. For uncoordinated deployment, the cell layout listed in Table 2 shall be evaluated.  **Table 2: Cell layout for uncoordinated deployment**   |  |  |  | | --- | --- | --- | |  | Attitude and footprint size | Uncoordinated deployment | | GEO-GEO  LEO 600km-LEO 600km  LEO 1200km-LEO 1200km  HAPS-HAPS | Same attitude and footprint size |  | | GEO-LEO 600km/LEO 1200km/HAPS  LEO 600km- GEO/LEO 1200km/HAPS  LEO 1200km- GEO/LEO 600km/HAPS  HAPS - GEO/ LEO 600km/LEO 1200km | Different attitude and footprint size | Option 1: The locations of beams centre are the identical.    Option 2: The locations of beams centre are not identical. | |

## Open issues summary

### Sub-topic 3-1

*Sub-topic description:*

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

**Issue 3-1: Baseline/Starting point**

* Proposals
  + Option 1 (Samsung): Use Satellite and UE parameters as well as network deployment assumptions in TR 38.821 as the baseline/starting point for FR1 coexistence study.
  + Option 2 (Ericsson): Relevant ITU studies should be a good starting point to discuss the simulation assumptions in RAN4.
* Recommended WF
  + TBA

### Sub-topic 3-2

*Sub-topic description:*

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

**Issue 3-2: Number of satellite**

* Proposals
  + Option 1: only 1 satellite at the beginning
  + Option 2: multiple satellites
* Recommended WF
  + Consider only 1 satellite at current stage and further consider multiple satellites if time and resources allow in RAN 4.

### Sub-topic 3-3

*Sub-topic description:*

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

**Issue 3-3: Number of beams for each satellite**

* Proposals
  + Option 1: 19 beams
  + Option 2: 19 beam cell with a new wrap around mechanism as mentioned in TR38.821 based on different frequency reuse factor
  + Option 3: only one beam cell
* Recommended WF
  + TBA

### Sub-topic 3-4

*Sub-topic description:*

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

**Issue 3-4: Frequency reuse factor (FRF)**

* Proposals
  + Option 1: FRF=1
  + Option 2: FRF>1
  + Option 3: FRF=3
* Recommended WF
  + TBA

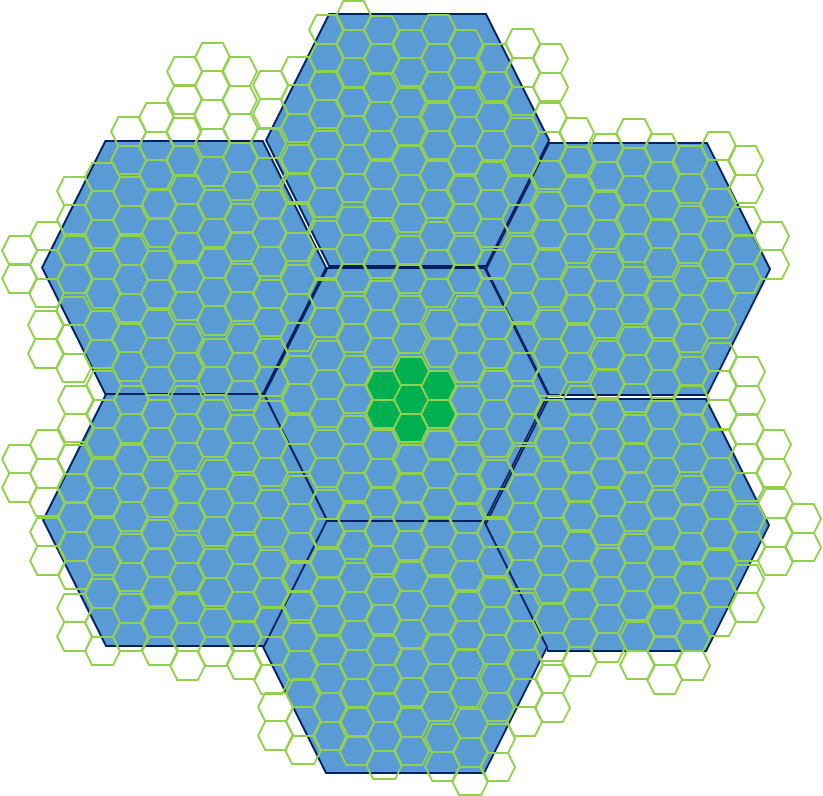
### Sub-topic 3-5

*Sub-topic description:*

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

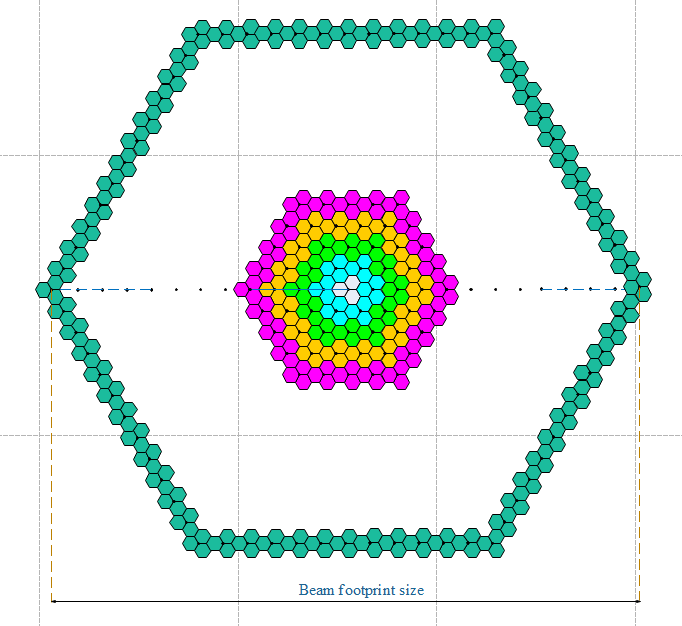
**Issue 3-5: Network Layout between NTN & TN**

* Proposals
  + Option 1 (CATT): The network layout between NTN and TN is depicted in the Figure 3.2.5-1. Since the satellite beam coverage is quite large, it is proposed only one satellite is considered in the co-existence study between NTN and TN.



**Figure 3.2.5-1 Network layout for coexistence between NTN and TN system**

* + Option 2 (Huawei): The Figure 3.2.5-2 can be used as heterogeneous network layout between NR legacy network and NTN network for one beam cell.



**Figure 3.2.5-2 The heterogeneous network layout**

The equation (1) and (3) can be used to calculate the number of layers and sites for NR legacy network.

Layer = D-beam/ISD/2 + 1 (1)

Site\_total = 3\*n\*(n-1) + 1 (3)

* Recommended WF
  + TBA

### Sub-topic 3-6

*Sub-topic description:*

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

**Issue 3-6: Network Layout between NTN & NTN**

* Proposals
  + Option 1 (Xiaomi): For the coexistence study between NTN and NTN, the layout of NTN in TR38.821 for system level simulation could be as baseline.
  + Option 2 (CATT): The network layout between NTN and NTN is depicted in the Figure 3.2.6-1 and figure 3.2.6-2.

In Figure 3.2.6-1, only one satellite carry two neighbour carriers is assumed and the footprints of the 2 carriers are the same.



**Figure 3.2.6-1 Network layout for coexistence between NTN systems**

In Figure 3.2.6-2, two satellites operating on two neighbour carriers but at different height are assumed, where the GEO have larger cell coverage and LEO has smaller coverage.



**Figure 3.2.6-2 Network layout for coexistence between NTN systems (different height satellites)**

* Recommended WF
  + TBA

### Sub-topic 3-7

*Sub-topic description:*

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

**Issue 3-7: Cell layout for uncoordinated NTN-NTN deployment**

* Proposals
  + Option 1 (Qualcomm): RAN4 to consider both coordinated and uncoordinated NTN-NTN deployment. For uncoordinated deployment, the cell layout listed in Table below shall be evaluated.

|  |  |  |
| --- | --- | --- |
|  | Attitude and footprint size | Uncoordinated deployment |
| GEO-GEO  LEO 600km-LEO 600km  LEO 1200km-LEO 1200km  HAPS-HAPS | Same attitude and footprint size |  |
| GEO-LEO 600km/LEO 1200km/HAPS  LEO 600km- GEO/LEO 1200km/HAPS  LEO 1200km- GEO/LEO 600km/HAPS  HAPS - GEO/ LEO 600km/LEO 1200km | Different attitude and footprint size | Option 1: The locations of beams centre are the identical.    Option 2: The locations of beams centre are not identical. |

* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 3-1:   * Option 1, with parameters from TR 38.821   Sub topic 3-2:   * Option 1: if only NTN-TN coexistence studies (with 1 satellite) * Option 2: if also NTN-NTN coexistence studies (with more than 1 satellite) * WF: Agree.   Sub topic 3-3:   * Option 2   Sub topic 3-4:   * Option 2 (FRF>1) & Option 3 (FRF=3). * Moreover, both NTN-TN and NTN-NTN coexistence scenarios should consider interference mitigation techniques for both UL and DL.     Sub topic 3-5:   * Partially agree with Option 1. Please note that in NTN-TN coexistence scenarios with TN cell (as victim), the worst cases are:   + **For DL:** **Cellular TN in the center of a satellite beam** (DL satellite signal is received at maximum power by a UE operating in TN mode at TN cell edge);     - **Please see Interference Type 4 (i4)**   + **For UL:** **Cellular TN at the edge of a satellite beam** (NTN UE signal is transmitted at full power towards the satellite, and received at full power by the TN BS); However, it should be assumed that the distance between the NTN UE and the TN BS will be greater than BS cell range.     - **Please see Interference Type 2 (i2)** * Therefore, we do not have to consider interference in all cells, but only worst cases with only 2 configurations:   + Satellite beam center   + Satellite beam edge   Sub topic 3-6:   * Depends on subtopic 3-2, * Partly Option 2 in principle, preference for addressing **NTN-NTN coexistence scenarios with same altitude** (e.g. LEO-LEO) only **if time allows.** **NTN-TN coexistence scenarios should be prioritized.**   Sub topic 3-7:   * Depends on subtopic 3-2 * In a first step we could consider (with some priority, for down-scoping coexistence scenarios) “Same altitude and footprint size” (1st line), without LEO@1200km.   ….  Others: Both NTN-TN and NTN-NTN coexistence scenarios should consider interference mitigation techniques for both UL and DL. |
| Qualcomm | **Issue 3-1: Baseline/Starting point**  Support option 1 for both FR1 and frequencies above FR1.  **Issue 3-2: Number of satellite**  To be more accurate, only one satellite for each operator for NTN. For NTN-NTN, if two operators use different satellites, then two satellite should be considered. See Issue 3-7.  **Issue 3-3: Number of beams for each satellite**  We support option 2.  **Issue 3-4: Frequency reuse factor (FRF)**  Option 2 or Option 3.  Based on the simulation results listed in Table 6.1.1.2-1 of TR 38.821, the UL and DL SINR with FRF=1 is very bad. The SINR for most of UE is below 0dB. At 5% geometry, both UL and DL SINR would be even smaller than -10dB in some cases which will lead to UE outage. So Option 1 is not feasible.  **Issue 3-5: Network Layout between NTN & TN**  In general, option 1 is OK. The layout for NTN might be needed to update once FRF is decided.   * + One question to THALES, for cellular TN at the edge of a satellite beam UL case, why we need to assume distance between the NTN UE and the TN BS is greater than BS cell range? I think NTN UE could be at the cell edge of TN network (i.e., TN BS cell edge).   **Issue 3-6: Network Layout between NTN & NTN**  We assume Issue 3-6 is focusing on the coordinated NTN-NTN deployment. It can be used for the case that two operators share the satellite.  **Issue 3-7: Cell layout for uncoordinated NTN-NTN deployment**  Issue 3-7 is focusing on uncoordinated NTN-NTN in which two operators use different satellites. We think this scenario is necessary for NTN-NTN co-existence.  Option 1 can be the starting point for uncoordinated NTN-NTN deployment. |
| Samsung | **Issue 3-1: Baseline/Starting point**  Option 1. However relevant studies in ITU could also be reference.  **Issue 3-2: Number of satellite**  We have the same understanding of Qualcomm and we are OK with the WF. |
| ZTE | **Issue 3-1: Baseline/Starting point**  Support the option 1, if reusing the ITU-R like simulation platform, there would be lots of changes as coverage scenario for coeixstence study is quite different from 3GPP and ITU.  **Issue 3-2: Number of satellite**  Tend to agree with QC, for single NTN network, then only one satellite is assumed.  **Issue 3-3: Number of beams for each satellite**  support option 2.  **Issue 3-4: Frequency reuse factor (FRF)**  Prefer to have option 1 which is worst case.  **Issue 3-5: Network Layout between NTN & TN**  Both option 1 and option 2 should be fine.  **Issue 3-6/7: Network Layout between NTN & NTN**  Encourage more operator’s input, no strong opinions on that. |
| Xiaomi | **Issue 3-1: Baseline/Starting point**  Option 1  **Issue 3-2: Number of satellite**  Agree with Qualcomm  **Issue 3-3: Number of beams for each satellite**  Option 2  **Issue 3-4: Frequency reuse factor (FRF)**  Option 2 and 3  **Issue 3-6: Network Layout between NTN & NTN**  Prefer option 1,but OK for FFS |
| Huawei | **Issue 3-1: Baseline/Starting point**  Both option 1 and option 2 can be considered.  **Issue 3-2: Number of satellite**  Tend to agree with QC  **Issue 3-3: Number of beams for each satellite**  Option 3  **Issue 3-4: Frequency reuse factor (FRF)**  **Option 1**  **Issue 3-5: Network Layout between NTN & TN**  **Option 2**. I have to clarify that we need to both consider NTN -> TN and TN -> NTN for both DL and UL.  **Issue 3-6: Network Layout between NTN & NTN**  We can consider both network shift or network alignment. |
| Panasonic | Sub-topic 3-2: We agree to the Recommended WF.  Sub-topic 3-3: We prefer to Option 2.  Sub-topic 3-4: We prefer to Option 1 (FRF=1) as the worst case. |
| Ericsson | Issue 3-1: further analysis would be needed to check if option 1 would not miss any key aspect that option 2 would address.  Issue 3-2: option 1 should be ok for TN/NTN, NTN/NTN would need further discussion with satellite companies to define a realistic and representative scenario.  Issue 3-3: option 2  Issue 3-4: Option 1 should be the worst case so if option 1 is not selected, then is shall be clearly stated that FRF=1 is not acceptable for NTN.  Issue 3-5: Propose to come back on this in next meeting, keep FFS, we should also compare/align the proposed layout with ITU-R studies to confirm our assumptions are realistic.  Issue 3-6: Propose to come back on this in next meeting, keep FFS for the time being  Issue 3-7: Propose to come back on this in next meeting, keep FFS for the time being |
| Nokia | Issue 3-1: Option 1 - This can be the starting point but relevant ITU studies and assumptions need to be considered. Most of the scenarios covered by option 1 completely neglect beam footprint distortion due to Earth curvature and the limited beam-shaping capabilities son-board the satellite. For very large satellite footprints these effects cannot be neglected. Further, Differentiation has to be made between earth moving cells and earth fixed cells scenarios.  Issue 3-2: The proposed WF is fine for earth moving scenarios but for earth fixed cells at least 2 satellites on the same orbit need to be included, due to interference between the active beams of the different satellites  Issue 3-3: Option 1 - At least 19 beams should be considered. The wrap-around model makes sense only if the satellite deployment actually provides full coverage of large geo-areas. The wraparound model currently specified in TR neglects the effects of beam footprint distortion (ellipses not circles) due to earth curvature and imperfect beam-shaping on-board the satellite.  Issue 3-4: Option 2 – we acknowledge that option 1 might be too stringent as worst case scenario.  Issue 3-5: Option 1 – is a good starting point. However, it might be needed to have TN rural and TN urban differentiated, with TN urban including small cells for FR2.  Issue 3-6: Option 2 - However, co-existence between LEO and MEO (LEO with different heights) might not be needed  Issue 3-7: Option 1 – However, it might not be needed to consider coordinated GEO-LEO |
| THALES to Qualcomm | Qualcomm: “One question to THALES, for cellular TN at the edge of a satellite beam UL case, why we need to assume distance between the NTN UE and the TN BS is greater than BS cell range? I think NTN UE could be at the cell edge of TN network (i.e., TN BS cell edge).”  THALES: Because if the distance is less, then the UE will be served by terrestrial base station. If distance is less, the UE will connect to the TN BS. |
| Hughes/EchoStar | **Issue 3-1: Baseline/Starting point**  Support option 1 for both FR1 and frequencies above FR1.  **Issue 3-2: Number of satellites**  Option 1, only one satellite for each operator for NTN.  **Issue 3-3: Number of beams for each satellite**  option 2  **Issue 3-4: Frequency reuse factor (FRF)**  Option 2 or Option 3.  **Issue 3-5: Network Layout between NTN & TN**  In general, option 1 is OK. The layout for NTN might be needed to update once FRF is decided.  **Issue 3-6: Network Layout between NTN & NTN**  Option 1. |
| Inmarsat | **Issue 3-1: Baseline/Starting point**  Both Option 1 and Option 2 are valid.  **Issue 3-2: Number of satellite**  WF is agreeable  NOTE: NTN-TN co-existence, 1 satellite should be sufficient. For NTN-NTN, at least one satellite per operator is required. GEO-GEO and GEO-LEO scenarios have different considerations.  **Issue 3-3: Number of beams for each satellite**  Option 2  **Issue 3-4: Frequency reuse factor (FRF)**  Option 1 AND Option 2 (FRF for Option 2 can be 3 or more, as typically used today in NTN )  **Issue 3-5: Network Layout between NTN & TN**  Option 1 is ok but requires revising depending on FRF  **Issue 3-6: Network Layout between NTN & NTN**  Option 1 is ok |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1**  Baseline/Starting point | It is common consensus that Option 1 is agreeable but it’s hard to reach an agreement on Option 2. A compromised combination with a soft wording is proposed by Moderator.  *Candidate options:*  Use Satellite and UE parameters as well as network deployment assumptions in TR 38.821 as the baseline/starting point for FR1 coexistence study. And further analysis is needed to check if any additional key aspect could be addressed by relevant ITU studies.  *Recommendations for 2nd round:*  Further discuss the candidate option in 2nd round. |
| **Sub-topic#2**  Number of satellites | The WF in NTN-TN scenarios is agreeable. Concerns on further consideration for NTN-NTN have been expressed.  *Tentative agreements:*   * For NTN-TN, consider only 1 satellite for each NTN operators at current stage and further consider multiple satellites if time and resources allow in RAN 4. * For NTN-NTN, further discuss numbers of satellites based on different scenarios.   *Recommendations for 2nd round:*  Further discuss the NTN-NTN scenario in 2nd round. |
| **Sub-topic#3**  Number of beams for each satellite | Option 2 got the most supports. However, a concern on the missing point of current wrap-around model has been raised.  Option 1: 1  Option 2: 7  Option 3: 1  *Recommendations for 2nd round:*  It is suggested to compromise on Option 2. Otherwise we can further discuss this topic esp. the concern on wrap-around model in 2nd round. |
| **Sub-topic#4**  Frequency reuse factor (FRF) | Diverse views are expressed to support 3 options and it’s hard to reach a consensus at current stage.  Option 1: 3  Option 2: 1  Option 2 or 3: 2  Option 2+3: 3  *Candidate options:*  Alt 1: FRF=1  Alt 2: FRF>1 (=2 and/or 3)  *Recommendations for 2nd round:*  Further discuss two alternatives in Candidate options in 2nd round. |
| **Sub-topic#5**  Network Layout between NTN & TN | 4 companies support Option 1, 1 support Option 2 and 1 support both.  Most agree that further updates to these options may be needed.  *Recommendations for 2nd round:*  Further discuss this topic in 2nd round. |
| **Sub-topic#6**  Network layout between NTN & NTN | 3 companies are OK with Option 1. 2 are OK with Option 2. Some additional considerations have been proposed.  *Recommendations for 2nd round:*  Further discuss this topic in 2nd round. |
| **Sub-topic#7**  Cell layout for uncoordinated NTN-NTN deployment | 3 companies are OK with Option 1 or some cases thereof.  *Tentative agreement:*  Take Option 1 as the starting point.  *Recommendations for 2nd round:*  Further discuss Option 1 in 2nd round. |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Way forward on [311] NTN\_Solutions\_Part2 | Samsung, WF |
|  |  |  |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #4: Simulation assumptions

## Companies’ contributions summary

## Open issues summary

Note: RAN4 has decided that “Use TR 38.821 as a baseline/starting point”.

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100486 | CATT | **2.3. Simulation parameters assumptions**  The simulation assumptions defined in section 6.1.1 in TR38.821 can be as baseline.  **Table 2.3-1 Set-1 satellite parameters for co-existence study**   |  |  |  |  | | --- | --- | --- | --- | | Satellite orbit | | GEO | LEO-1200 | | Satellite altitude | | 35786 km | 1200 km | | Payload characteristics for DL transmissions | | | | | Satellite EIRP density | 2GHz | 59 dBW/MHz | 40 dBW/MHz | | Satellite Tx max Gain | 51 dBi | 30 dBi | | 3dB beamwidth | 0.4011 deg | 4.4127 deg | | Satellite beam diameter | 250 km | 90 km | | Satellite EIRP density | 20GHz | 40 dBW/MHz | 10 dBW/MHz | | Satellite Tx max Gain | 58.5 dBi | 38.5 dBi | | 3dB beamwidth | 0.1765 deg | 1.7647 deg | | Satellite beam diameter | 110 km | 40 km | | Payload characteristics for UL transmissions | | | | | G/T | 2 GHz | 19 dB K-1 | 1.1 dB K-1 | | Satellite Rx max Gain | 51 dBi | 30 dBi | | G/T | [20] GHz | 28 dB K-1 | 13 dB K-1 | | Satellite RX max Gain | 58.5 dBi | 38.5 dBi |   Table 2.3-2 Set-2 satellite parameters for co-existence study   |  |  |  |  | | --- | --- | --- | --- | | Satellite orbit | | GEO | LEO-1200 | | Satellite altitude | | 35786 km | 1200 km | | Payload characteristics for DL transmissions | | | | | Satellite EIRP density | 2GHz | | 53.5 dBW/MHz | 34 dBW/MHz | | Satellite Tx max Gain | 45.5 dBi | 24 dBi | | 3dB beamwidth | 0.7353 deg | 8.8320 deg | | Satellite beam diameter | 450 km | 190 km | | Satellite EIRP density | 20GHz | 32 dBW/MHz | 2 dBW/MHz | | Satellite Tx max Gain | 50.5 dBi | 30.5 dBi | | 3dB beamwidth | 0.4412 deg | 4.4127 deg | | Satellite beam diameter | 280 km | 90 km | | Payload characteristics for UL transmissions | | | | | G/T | 2 GHz | 14 dB K-1 | -4.9 dB K-1 | | Satellite Rx max Gain | 45.5 dBi | 24 dBi | | G/T | [20] GHz | 20 dB K-1 | 5 dB K-1 | | Satellite RX max Gain | 50.5 dBi | 30.5 dBi |   UE characteristics are considered as in Table 2.3-3.  Table 2.3-3 UE characteristics for co-existence study   |  |  |  | | --- | --- | --- | | Characteristics | VSAT | Handheld | | Frequency band | [30 GHz UL and 20 GHz DL] | 2 GHz | | Polarisation | circular | Linear: +/-45°X-pol | | Rx Antenna gain | 39.7 dBi | 0 dBi per element | | Antenna temperature | 150 K | 290 K | | Noise figure | 1.2 dB | 7 dB | | Tx transmit power | 2 W (33 dBm) | 200 mW (23 dBm) | | Tx antenna gain | 43.2 dBi | 0 dBi per element |   **2.4 Antenna and beam forming pattern modelling**  Satellite and UE Antenna and beam forming pattern modelling of satellite could be referred to section 6.4.1 in TS 38.811 [5].  Antenna and beam forming pattern modelling of TN BS and UE could be referred to TR38.803 [6].  **2.3. Propagation model**  Propagation model between NTN and UE could be referred to section 6.6 in TR 38.811 [5].  Propagation model between TN BS and UE could be referred to section 5.2.2 in TR 38.803 [6].  **2.4. Transmission power control model**  For downlink scenario, no power control scheme is applied.  For uplink scenario, TPC model specified in Section 9.1 TR 36.942 could be applied with following parameters.    Where, Pmax = 24dBm, Rmin = -54dB if UE minimum power is -30dBm (or Rmin = -64dB if UE minimum power is -40dBm), 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  **2.5. Received power model**  The received power in downlink and uplink scenarios is defined as below:  RX\_PWR = TX\_PWR – Path loss + G\_TX + G\_RX  Where,  RX\_PWR is the received power  TX\_PWR is the transmitted power  G\_TX is the transmitter antenna gain (directional array gain)  G\_RX is the receiver antenna gain (directional array gain).  **2.6. Performance metric**  Same criteria as previous study, e.g. the throughput loss of victim system should be below 5%. |
| R4-2100904 | Samsung | Proposal 4: Use Satellite and UE parameters as well as network deployment assumptions in TR 38.821 as the baseline/starting point for FR1 coexistence study.  Table 2 Set-1 satellite parameters for FR1 coexistence study   |  |  |  | | --- | --- | --- | | Satellite orbit | GEO | LEO-600 | | Satellite altitude | 35786 km | 600 km | | Satellite antenna pattern | TR 38.811  Section 6.4.1 | TR 38.811  Section 6.4.1 | | Payload characteristics for DL transmissions | | | | Equivalent satellite antenna aperture (Note 1) | 22 m | 2 m | | Satellite EIRP density | 59 dBW/MHz | 34 dBW/MHz | | Satellite Tx max Gain | 51 dBi | 30 dBi | | 3dB beamwidth | 0.4011 deg | 4.4127 deg | | Satellite beam diameter (Note 2) | 250 km | 50 km | | Payload characteristics for UL transmissions | | | | Equivalent satellite antenna aperture (Note1) | 22 m | 2 m | | G/T | 19 dB K-1 | 1.1 dB K-1 | | Satellite Rx max Gain | 51 dBi | 30 dBi | | NOTE 1: This value is equivalent to the antenna diameter in TR 38.811 Sec. 6.4.1.  NOTE 2: This beam size refers to the Nadir pointing of the satellite  NOTE 3: All these satellite parameters are applied per beam.  NOTE 4: The EIRP density values are considered identical for all frequency re-use factor options.  NOTE 5: The EIRP density values are provided assuming the satellite HPA is operated with a back-off of [5] dB. | | |   Table 3 Set-2 satellite parameters for FR1 coexistence study   |  |  |  | | --- | --- | --- | | Satellite orbit | GEO | LEO-600 | | Satellite altitude | 35786 km | 600 km | | Satellite antenna pattern | TR 38.811  Section 6.4.1 | TR 38.811  Section 6.4.1 | | Payload characteristics for DL transmissions | | | | Equivalent satellite antenna aperture (Note 1) | 12 m | 1 m | | Satellite EIRP density | 53.5 dBW/MHz | 28 dBW/MHz | | Satellite Tx max Gain | 45.5 dBi | 24 dBi | | 3dB beamwidth | 0.7353 deg | 8.8320 deg | | Satellite beam diameter (Note 2) | 450 km | 90 km | | Payload characteristics for UL transmissions | | | | Equivalent satellite antenna aperture (Note1) | 12 m | 1 m | | G/T | 14 dB K-1 | -4.9 dB K-1 | | Satellite Rx max Gain | 45.5 dBi | 24 dBi | | NOTE 1: This value is equivalent to the antenna diameter in TR 38.811 Sec. 6.4.1.  NOTE 2: This beam size refers to the Nadir pointing of the satellite  NOTE 3: All these satellite parameters are applied per beam.  NOTE 4: The EIRP density values are considered identical for all frequency re-use factor options. | | |   Table 4 Handheld UE characteristics for FR1   |  |  | | --- | --- | | **Characteristics** | **Handheld** | | Frequency band | 2 GHz | | Antenna type and configuration | omni-directional antenna | | Polarisation | Linear: +/-45°X-pol | | Rx Antenna gain | 0 dBi | | Antenna temperature | 290 K | | Noise figure | 7 dB | | Tx transmit power | 200 mW (23 dBm) | | Tx antenna gain | 0 dBi | |
| R4-2101105 | Xiaomi | Proposal 5: the existing RF requirements (i.e. ACS and ACLR for both BS and UE) of TN in the spec should be reused when doing the coexistence study between NTN and TN. |
| R4-2101812 | Huawei, HiSilicon | Proposal 1: It’s proposed to down-select the NTN co-existence scenarios as table 2.  Table 2 The items and candidate options   |  |  | | --- | --- | | Items | Proposal | | Frequency range | L-band | | NTN scenarios | LEO-600, HIBS (priority)  GEO, LEO-1200 | | Parameter Set | Merge both set1 and set2 as one parameter set | | Beam configurations | Earth Fixed Beam | | NR scenarios | Rural, Urban macro (priority)  Dense Urban, Micro/small cell outdoor, Indoor hotspot | | UE type for NTN | Handheld UE | |
| R4-2101964 | ZTE Corporation | **2.2.2 Propagation model**  For propagation model between NTN and UE or gateway, this could be referred to section 6.6 in TR 38.811.  For propagation model between TN BS and UE, this could be referred to TR 38.901 or section 5.2.2 in TR 38.803.  **2.2.3 Antenna and beam forming pattern modelling**  For antenna and beam forming pattern for NTN BS and UE, it could be referred in section 6.4 of TR 38.811.  For antenna and beam forming pattern of TN FR2 NR BS and UE, it could be referred in section 5.2.3 of TR 38.803.  For antenna and beam forming pattern for TN FR1 NR BS and UE, it could be referred in section 8 of TR 38.912 [6] and in reply LS to ITU WP5D [7].  **2.2.4 Transmission power control model**  For downlink scenario, no power control scheme is applied.  For uplink scenario, TPC model specified in Section 9.1 TR 36.942 is applied with following parameters.  - 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  **2.2.5 Received power model**  The received power in downlink and uplink scenarios is defined as below:  *RX\_PWR = TX\_PWR – Path loss + G\_TX + G\_RX*  where:  RX\_PWR is the received power  TX\_PWR is the transmitted power  G\_TX is the transmitter antenna gain (directional array gain)  G\_RX is the receiver antenna gain (directional array gain).  **2.2.6 Link level performance for 5G NR coexistence**  For the throughput of a modem for NTN and TN, it could be referred in section 5.2.7 of TR 38.803.  **2.2.7 Other simulation parameters**  **Table 2.2.7-1: Other simulation parameters**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Satellite orbit | | GEO | LEO-1200 | LEO-600 | | Satellite altitude | | 35786 km | 1200 km | 600 km | | Satellite antenna pattern | | Section 6.4.1 in [2] | Section 6.4.1 in [2] | Section 6.4.1 in [2] | | Payload characteristics for DL transmissions | | | | | | Equivalent satellite antenna aperture (Note 1) | S-band  (i.e. 2 GHz) | 22 m | 2 m | 2 m | | Satellite EIRP density | 59 dBW/MHz | 40 dBW/MHz | 34 dBW/MHz | | Satellite Tx max Gain | 51 dBi | 30 dBi | 30 dBi | | 3dB beamwidth | 0.4011 deg | 4.4127 deg | 4.4127 deg | | Satellite beam diameter (Note 2) | 250 km | 90 km | 50 km | | Equivalent satellite antenna aperture (Note 1) | Ka-band  (i.e. 20 GHz for DL) | 5 m | 0.5 m | 0.5 m | | Satellite EIRP density | 40 dBW/MHz | 10 dBW/MHz | 4 dBW/MHz | | Satellite Tx max Gain | 58.5 dBi | 38.5 dBi | 38.5 dBi | | 3dB beamwidth | 0.1765 deg | 1.7647 deg | 1.7647 deg | | Satellite beam diameter (Note 2) | 110 km | 40 km | 20 km | | Payload characteristics for UL transmissions | | | | | | Equivalent satellite antenna aperture (Note1) | S-band  (i.e. 2 GHz) | 22 m | 2 m | 2 m | | G/T | 19 dB K-1 | 1.1 dB K-1 | 1.1 dB K-1 | | Satellite Rx max Gain | 51 dBi | 30 dBi | 30 dBi | | Equivalent satellite antenna aperture (Note1) | Ka-band (i.e. 30 GHz for UL) | 3.33 m | 0.33 m | 0.33 m | | G/T | 28 dB K-1 | 13 dB K-1 | 13 dB K-1 | | Satellite RX max Gain | 58.5 dBi | 38.5 dBi | 38.5 dBi | | NOTE 1: This value is equivalent to the antenna diameter in Sec. 6.4.1 of [2].  NOTE 2: This beam size refers to the Nadir pointing of the satellite  NOTE 3: All these satellite parameters are applied per beam.  NOTE 4: The EIRP density values are considered identical for all frequency re-use factor options.  NOTE 5: The EIRP density values are provided assuming the satellite HPA is operated with a back-off of [5] dB. | | | | |   The following table is agreed for UE characteristics for System Level Simulations  Table 2.2.7-2: UE characteristics for system level simulations   |  |  |  |  | | --- | --- | --- | --- | | Characteristics | VSAT (Note 2) | Handheld | Other (Note 1) | | Frequency band | Ka band(i.e. 30 GHz UL and 20 GHz DL) | S band (i.e. 2 GHz) | Ka band(i.e. 30 GHz UL and 20 GHz DL) | | Antenna type and configuration | Directional  Section 6.4.1 of [2] with 60 cm equivalent aperture diameter | (1, 1, 2) with omni-directional antenna element | Directional  (M,N,P,Mg,Ng) = (TBD,TBD,2,1,1); (dV,dH) = (TBD, TBD)λ with directional antenna element (HPBW=65 deg) | | Polarisation | circular | Linear: +/-45°X-pol | Linear: +/-45°X-pol | | Rx Antenna gain | 39.7 dBi | 0 dBi per element | TBD dBi per element | | Antenna temperature | 150 K | 290 K | TBD K | | Noise figure | 1.2 dB | 7 dB | TBD dB | | Tx transmit power | 2 W (33 dBm) | 200 mW (23 dBm) | [TBD W (TBD dBm)] | | Tx antenna gain | 43.2 dBi | 0 dBi per element | TBD dBi per element | | NOTE 1: Moving platforms (e.g., aircrafts, vessels), building mounted devices. These values are provided for information.  NOTE 2: VSAT terminal characteristics could be implemented with phased array antenna | | | | |
| R4-2102174 | Ericsson | A down-selection of the scenarios would be needed to optimize the simulations effort. Following aspects might be a starting point to agree on a down-selection:   * A deeper analysis of set 1 and set 2 would be needed to identify if one set would be more stringent and so, if all simulations would be needed for both sets.   Observation: Relevant ITU studies should be a good starting point to discuss the simulation assumptions in RAN4.  Proposal 2: For NR and NB-IoT, ACLR and ACS specified in TS 38.104 and 38.101 shall be assumed for NR BS and NR UE when running coexistence simulations. |
| R4-2102508 | Qualcomm | **2.2.1 Propagation model** For NTN, the propagation model from section 6.6 of TR 38.811 can be referred. For TN, the propagation model mode from TR 36.942 can be referred for 2GHz and propagation model mode from TR 38.803 for 20GHz&30GHz carrier frequency. **2.2.2 Power Control Modelling** For downlink, there is no power control for both NTN and TN networks.  For uplink, the UE output power formula in TR 36.942 shown as equation (1) is applied for both NTN and TN networks.  (1)  Where *P*max is the maximum transmit power, *R*min is the minimum power reduction ratio to prevent UEs with good channels to transmit at very low power level, *CL* is the path coupling loss defined as max{path loss-G\_Tx-G\_Rx, MCL}, where path loss is propagation loss plus shadow fading, G\_TX is the transmitter antenna gain in the direction of the receiver, G\_RX is the receiver antenna gain in the direction of the transmitter and 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. Finally, 0<γ<=1 is the balancing factor for UEs with bad channel and UEs with good channel.  The CLx-ile parameters defined in Table 5.3 of TR36.942 (FR1) and section 5.2.4 of TR38.803 (FR2) could be reference for TN and NTN uplink power control setting.  **2.2.4 Other simulation assumptions**  For NTN, other simulation assumptions could refer to section 6.1.1.1 of TR38.821.  For TN, other simulation assumptions for 2GHz could refer to TR36.942. And TR 38.803 could be the reference for the other simulation assumptions in 20GHz and 30GHz carrier frequencies. |

### Sub-topic 4-1

*Sub-topic description:*

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

**Issue 4-1: Satellite parameters**

* Proposals
  + Option 1 (ZTE): Set 1
  + Option 2 (Huawei): Merge both Set1 and Set2 as one parameter set.
  + Option 3 (Ericsson) : A deeper analysis of Set 1 and Set 2 would be needed to identify if one set would be more stringent and so, if all simulations would be needed for both sets.
  + Option 4 (CATT, Samsung): Set 1 & Set 2
  + Option 5: TBA

*Note:*

1. *Set 1 satellite parameters refer to Table 6.1.1.1-1 in TR 38.821 and Set 2 satellite parameters refer to Table 6.1.1.1-2 in TR 38.821.*
2. *Selection of NTN deployment and frequency bands depend on the result of section 2.*

* Recommended WF
  + TBA

### Sub-topic 4-2

*Sub-topic description*

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

**Issue 4-2: Satellite antenna beam configurations**

* Proposals
  + Option 1 (CATT, Huawei, Qualcomm): Earth fixed beam only
  + Option 2 (THALES): Earth Fixed Beams and Earth Moving Beams
* Recommended WF
  + Prioritize Earth Fixed Beams and consider Earth Moving Beams later.

### Sub-topic 4-3

*Sub-topic description:*

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

**Issue 4-3: NTN UE parameters**

* Proposals
  + Option 1 (ZTE, CATT, Samsung, Huawei): Table 6.1.1.1-3 in TR 38.821

*Note: Selection of UE type depends on the result of section 2.*

* Recommended WF
  + Adopt Table 6.1.1.1-3 in TR 38.821 and down select UE types based on the result of Section 2.

### Sub-topic 4-4

*Sub-topic description:*

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

**Issue 4-4: TN UE & BS parameters**

* Proposals
  + Option 1: the existing RF requirements (i.e. ACS and ACLR for both BS and UE) of TN in the spec (i.e. TS 38.104 and 38.101) should be reused when doing the coexistence study between NTN and TN.
* Recommended WF
  + TBA

### Sub-topic 4-5

*Sub-topic description:*

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

**Issue 4-5: Antenna & beam forming pattern modelling**

* Proposals
  + Option 1(CATT, ZTE):
* For antenna and beam forming pattern for NTN BS and UE, it could be referred in section 6.4.1 of TR 38.811.
* For antenna and beam forming pattern of TN FR2 NR BS and UE, it could be referred in section 5.2.3 of TR 38.803.
* For antenna and beam forming pattern for TN FR1 NR BS and UE, it could be referred in section 8 of TR 38.912 and in reply LS to ITU WP5D (R4-2008924)
* Recommended WF
  + TBA

### Sub-topic 4-6

*Sub-topic description*

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

**Issue 4-6: Bandwidth configuration for coexistence study**

* Proposals
  + Option 1 (CATT): FR1-30MHz
  + Option 2 (CATT): FR2-200MHz
  + Option 3 (ZTE): FR2-400MHz
  + Option 4 (Thales): 3-4 BW configurations to be considered
* Recommended WF
  + TBA

### Sub-topic 4-7

*Sub-topic description:*

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

**Issue 4-7: Propagation model**

* Proposals
  + Option 1 (CATT, ZTE):
* Propagation model between NTN and UE could be referred to section 6.6 in TR 38.811.
* Propagation model between TN BS and UE for 20GHz & 30GHz could be referred to section 5.2.2 in TR 38.803.
* Propagation model between TN BS and UE for 2GHz could be referred to TR 36.942
* Recommended WF
  + Agree on Option 1.

### Sub-topic 4-8

*Sub-topic description:*

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

**Issue 4-8: Transmission power control model**

* Proposals
  + Option 1 (CATT, ZTE, Qualcomm):

|  |  |
| --- | --- |
| Downlink scenario | No power control scheme is applied |
| Uplink scenario | TPC model specified in Section 9.1 TR 36.942 could be applied with following parameters.    Where, Pmax = 24dBm, Rmin = -54dB if UE minimum power is -30dBm (or Rmin = -64dB if UE minimum power is -40dBm), 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 |

* Recommended WF
  + TBA

### Sub-topic 4-9

*Sub-topic description:*

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

**Issue 4-9: Received power model**

* Proposals
  + Option 1 (CATT, ZTE):

The received power in downlink and uplink scenarios is defined as below:

*RX\_PWR = TX\_PWR – Path loss + G\_TX + G\_RX*

Where,

RX\_PWR is the received power

TX\_PWR is the transmitted power

G\_TX is the transmitter antenna gain (directional array gain)

G\_RX is the receiver antenna gain (directional array gain).

* Recommended WF
  + TBA

### Sub-topic 4-10

*Sub-topic description:*

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

**Issue 4-10: Performance metric**

* Proposals
  + Option 1 (CATT, ZTE): Same criteria as previous study, e.g. the throughput loss of victim system should be below 5%. Note that for the throughput of a modem for NTN and TN, it could be referred in section 5.2.7 of TR 38.803.
* Recommended WF
  + TBA

### Sub-topic 4-11

*Sub-topic description:*

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

**Issue 4-11: Other simulation assumptions**

* Proposals
  + Option 1 (Qualcomm):
* For NTN, other simulation assumptions could refer to section 6.1.1.1 of TR38.821.
* For TN, other simulation assumptions for 2GHz could refer to TR36.942. And TR 38.803 could be the reference for the other simulation assumptions in 20GHz and 30GHz carrier frequencies.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 4-1:   * Option 1, Set 1 (with priority)   Sub topic 4-2:   * Option 2, however * Agree with the WF: Prioritize Earth Fixed Beams and consider Earth Moving Beams later.   Sub topic 4-3:   * Option 1. Ok to reuse 38.821 for UE parameterization (Table 6.1.1.1-3 in TR 38.821). * WF: Agree   Sub topic 4-4:  - Downscope from Option 1.  - RAN4 RF [97e][312] & [98e][311]: “For the purpose of simulations for the coexistence study between TN & NTN, the TN BS/UE ACLR & ACS parameters need to be further discussed. It may depend on FR and BW configuration.”  Sub topic 4-5:   * Option 1 could be agreeable.   Sub topic 4-6:   * max channel bandwidth in FR1 may go up to 20 MHz * max channel bandwidth in FR2 may go up to 400 MHz * 3-4 BW configurations may be considered   Sub topic 4-7:   * Option 1 seems ok, but there is a typo for the last paragraph. “2Hz” to be replaced by “2GHz”? * WF can be agreed.   Sub topic 4-8:   * Option 1 is reasonable (even if LTE spec.) * In simulation we could also consider 23dBm instead of 24dBm.   Sub topic 4-9:   * Option 1 seems to be reasonable for NTN scenarios.   Sub topic 4-10:   * Option 1 if the victim is the TN (UE or gNB). For NTN should be further studied.   + Please note that RAN plenary meeting already decided (see RP-202907): “Satellite bands introduced in 3GPP for NTN shall neither impact the existing specifications of nor cause **degradation (in the sense of RAN4 co-existence studies) to present and future networks in 3GPP specified terrestrial bands**   + Note 1: The degradation caused to present and future networks in 3GPP specified terrestrial bands shall be understood as the performance degradation caused by the transmission of a NTN channel onto an adjacent TN channel. **Simulations should be set such that no more than 5% loss in average and 5th percentile throughput in the adjacent channel of the victim network is seen in the same manner as Rel-15 NR.**” * WF: evaluation required after coexistence scenarios/simulations.   Sub topic 4-11:   * Option 1 is a reasonable approach * The study may also consider other frequency ranges, see e.g. “3GPP TR 38.820: NR; 7-24 GHz frequency range”.   ….  Others: |
| Qualcomm | **Issue 4-1: Satellite parameters**  We support option 3. Need to identify which set is the worst case.  **Issue 4-2: Satellite antenna beam configurations**  Prefer option 1 but OK with WF.  **Issue 4-3: NTN UE parameters**  Option 1  **Issue 4-4: TN UE & BS parameters**  Option 1  **Issue 4-5: Antenna & beam forming pattern modelling**  Option 2:  For antenna and beam forming pattern for TN FR1 NR BS and UE, if we select 2GHz as the carrier frequency, the antenna and BF pattern from TR36.942 should be used. TR 38.912 is for 6GHz and 10GHz.  **Issue 4-10: Performance metric**  Option 1 |
| Samsung | **Issue 4-1: Satellite parameters**  We are OK with Option 3.  **Issue 4-2: Satellite antenna beam configurations**  We are OK with the WF.  **Issue 4-3: NTN UE parameters**  We are OK with the WF.  **Issue 4-5: Antenna & beam forming pattern modelling**  Option 1  **Issue 4-7: Propagation model**  Option 1  **Issue 4-10: Performance metric**  Option 1  **Issue 4-11: Other simulation assumptions**  Option 1 |
| ZTE | **Issue 4-1: Satellite parameters**  Fine Option 3.  **Issue 4-2: Satellite antenna beam configurations**  Fine with the WF.  **Issue 4-3: NTN UE parameters**  Fine with the WF.  **Issue 4-4: TN UE & BS parameters**  Fine with option 1  **Issue 4-5: Antenna & beam forming pattern modelling**  Option 1  **Issue 4-7/8/9/10/11:**  Option 1. |
| Xiaomi | **Issue 4-1: Satellite parameters**  OK with option 3  **Issue 4-2: Satellite antenna beam configurations**  Ok with WF  **Issue 4-3: NTN UE parameters**  Ok with WF  **Issue 4-4: TN UE & BS parameters**  Option 1  **Issue 4-5/6/7**  Depends on the example band |
| Huawei | **Issue 4-1: Satellite parameters**  option 2  **Issue 4-2: Satellite antenna beam configurations**  Option 1. Adjacent coexistence simulations are static.  **Issue 4-3: NTN UE parameters**  Option 1  **Issue 4-4: TN UE & BS parameters**  Option 1  **Issue 4-5: Antenna & beam forming pattern modelling**  The interface should be specified for NTN satellite, conducted, RIB or TAB. If conducted interface is only considered, then we can refer to 38.821.  **Issue 4-6: Bandwidth configuration for coexistence study**  20MHz in FR1  **Issue 4-7: Propagation model**  Option 1  **Issue 4-8: Transmission power control model**  Clarification: is this power control model used for both NTN UE and TN UE? If so, we need to further check it for NTN UE,  **Issue 4-9: Received power model**  Option 1  **Issue 4-10: Performance metric**  Option 1  **Issue 4-11: Other simulation assumptions**  We should discuss it one by one. |
| Ericsson | Issue 4-1: option 3: it’s worth spending some time to analyze the 2 sets if we could save considerable simulation efforts. Also, we expect that satellite companies will help doing such analysis thanks to their expertise.  Issue 4-2: agree with the recommended WF, earth moving beams and how it should be considered would need further discussions.  Issue 4-3: Disagree. The frequency band mentioned in table 6.1.1.1-3 / TR 38.821 is not yet agreed. For FR2, there is no candidate NTN band so far, we should most likely not spend any time on FR2 NTN UE for the time being. We can’t re-use this table as is.  Issue 4-4: option 1, RAN already agreed that existing network specifications are not impacted-  Issue 4-5: Again, as long as there is no candidate band for FR2, we should not spend time on this. For FR1, NTN UE should have omni antenna, right? Why referring to TR 38.111 then?  Issue 4-6: FFS, may be 20MHz is more common for FR1.  Issue 4-7: 2 GHz is not yet decided. This might be acceptable but we’d like to come back in next meeting to confirm.For 20 and 30GHz, agreement might be postponed as long as there is no FR2 candidate band for NTN.  Issue 4-8: It’s ok to use this TPC for TN, but for NTN we would like to come back in next meeting and keep it FFS for the time being.  Issue 4-9: ok  Issue 4-10: option 1  Issue 4-11: No, 2 GHz is not yet decided. Those TRs might be used as baseline, but to be confirmed case by case. |
| Nokia | Issue 4-1: Option 3 - OK  Issue 4-2: Option 2 - These scenarios are different from interference pattern point of view. Therefor we can not agree to the proposed WF as they both need to be considered.  Issue 4-3: Should this not be aligned to the UE assumptions discussed in 310?  Issue 4-4: Option 1 - OK  Issue 4-5: This is dependent on the chosen FRF – we should conclude that discussion first.  Issue 4-6: Option 1 - OK  Issue 4-7: Option 1 - OK  Issue 4-8: Option 1 - OK  Issue 4-9: We do think this has to be aligned with the link-budget assumptions in TR 38.811-821 – further discussion is needed.  Issue 4-10: Option 1 is fine for hand-held UE deployments but for VSAT deployments further discussion is needed.  Issue 4-11: Option 1 - OK |
| Hughes/EchoStar | **Issue 4-1: Satellite parameters**  Option 3.  **Issue 4-2: Satellite antenna beam configurations**  Option 2  **Issue 4-3: NTN UE parameters**  We are OK with the WF.  **Issue 4-5: Antenna & beam forming pattern modelling**  Option 1  **Issue 4-6:**  Option 1 and Option 3  **Issue 4-7: Propagation model**  Option 1  **Issue 4-11: Other simulation assumptions**  Option 1 |
| Inmarsat | **Issue 4-1: Satellite parameters**  Option 3  **Issue 4-2: Satellite antenna beam configurations**  Agree with WF  **Issue 4-3: NTN UE parameters**  Option 1 should suffice, but Agree with WF  **Issue 4-4: TN UE & BS parameters**  We agree with THALES view, may need further downscoping as per:  - RAN4 RF [97e][312] & [98e][311]: “For the purpose of simulations for the coexistence study between TN & NTN, the TN BS/UE ACLR & ACS parameters need to be further discussed. It may depend on FR and BW configuration.”  **Issue 4-5: Antenna & beam forming pattern modelling**  Option 1 seems agreeable.  **Issue 4-6: Bandwidth configuration for coexistence study**  Option 4  FR1 max BW up to 20 MHz  FR2 max BW up to 400 MHz  **Issue 4-7: Propagation model**  We agree with WF |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1**  Satellite parameters | Supports to options  Option 1: 1  Option 2: 1  Option 3: 8  It seems Option 3 could cover Option 1 & 2 as it is intended to figure out the more stringent one between Set 1 & 2.  *Candidate options:*  Further analyze Set 1 and Set 2 to identify if one set would be more stringent and so, if all simulations would be needed for both sets.  *Recommendations for 2nd round:*  It is suggested to compromise on the candidate option. Otherwise we can further discuss the original 3 options in 2nd round. |
| **Sub-topic#2**  Satellite Antenna beam configurations | 7 companies agree with the WF. One support Option 1 and two support Option 2  *Candidate options:*  Option 1: Earth fixed beam only  Option 2: Earth Fixed Beams and Earth Moving Beams  Option 3: Prioritize Earth Fixed Beams and consider Earth Moving Beams later.  *Recommendations for 2nd round:*  Further discuss what’s the difference between Earth Fixed Beams and Earth Moving Beams in the circumstance of co-existence study and then make decisions as appropriate. |
| **Sub-topic#3**  NTN UE parameters | 6 companies agree with the WF and one don’t. Moreover, 2 companies support Option 1.  *Recommendations for 2nd round:*  Further discuss the WF in 2nd round based on results of exemplary bands selection & UE assumptions in thread [310] |
| **Sub-topic#4**  TN UE&BS parameters | 6 companies agree with the WF and 2 companies would like to downs cope the WF.  *Candidate options:*  Option 1: The existing RF requirements (i.e. ACS and ACLR for both BS and UE) of TN in the spec (i.e. TS 38.104 and 38.101) should be reused when doing the coexistence study between NTN and TN.  Option 2：For the purpose of simulations for the coexistence study between TN & NTN, the TN BS/UE ACLR & ACS parameters need to be further discussed. It may depend on FR and BW configuration.  *Recommendations for 2nd round:*  Further discuss candidate options in 2nd round. |
| **Sub-topic#5**  Antenna & beam forming pattern modelling | 5 companies support Option 1. 2 companies are of the view that this topic depend on FRF or exemplary bands. And 2 companies raised questions to the details.  *Candidate options:*  - For antenna and beam forming pattern for NTN BS and UE, it could be referred in section 6.4 of TR 38.811. [Note: there is “Quasi Isotropic - Linear polarisation” for UE in 6.4.2]  - For antenna and beam forming pattern for TN FR1 NR BS and UE, it could be referred in TR36.942, section 8 of TR 38.912 and in reply LS to ITU WP5D (R4-2008924)  - For antenna and beam forming pattern of TN FR2 NR BS and UE, it could be referred in section 5.2.3 of TR 38.803.  *Recommendations for 2nd round:*  Further discuss candidate options in 2nd round. |
| **Sub-topic#6**  Bandwidth configuration for coexistence study | Companies expressed supports to Option 1, 3 & 4, proposed 20MHz in FR1 as a new option.  *Candidate options:*   * Option 1: FR1-30MHz * Option 2: FR1-20MHz * Option 3: FR2-400MHz * Option 4: 3-4 BW configurations to be considered   *Recommendations for 2nd round:*  Further discuss candidate options based on outcome of exemplary band selection in thread [310] |
| **Sub-topic#7**  Propagation model | 7 companies support Option 1. And it is also proposed that selection of exemplary bands will affect the models.  *Candidate options:*   * Propagation model between NTN and UE could be referred to section 6.6 in TR 38.811. * Propagation model between TN BS and UE for 20GHz & 30GHz could be referred to section 5.2.2 in TR 38.803. * Propagation model between TN BS and UE for 2GHz could be referred to TR 36.942   *Recommendations for 2nd round:*  Further discuss candidate options based on outcome of exemplary band selection in thread [310] |
| **Sub-topic#8**  Transmission power control model | It seems agreeable the TPC model in Option 1 can be applied to TN UEs. However, there are questions on whether such model applies to NTN UE. Further clarification is needed.  *Tentative agreements:*  For TN UE, adopt TPC model in Option 1  For NTN UE, further clarification and discussion is needed.  *Recommendations for 2nd round:*  Further clarify and discuss the applicability for NTN UE in 2nd round. |
| **Sub-topic#9**  Received power model | 4 companies support Option 1 and one company doesn’t.  *Recommendations for 2nd round:*  Further discuss Option 1 in 2nd round. |
| **Sub-topic#10**  Performance metric | 5 companies support the traditional metric in Option 1. Yet there are views that metrics for NTN or metric for VSAT need further discussion.  *Tentative agreements:*  For TN, the Option 1 applies.  For NTN, further discussion and evaluation is needed depending on the result of co-existence studies.  *Recommendations for 2nd round:*  Try to agree on the tentative agreements and further discuss the VSAT issue in 2nd round. |
| **Sub-topic#11**  Other simulation assumptions | 4 companies are OK with Option 1. 2 companies believe this should be discussed 1 by 1.  *Tentative agreements:*  Option 1 could be a starting point and detailed items need to be discussed 1 by 1.  *Recommendations for 2nd round:*  Try to agree on the tentative agreements. |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Way forward on [311] NTN\_Solutions\_Part2 | Samsung, WF |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #5: HAPS

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2101934 | Nokia, Nokia Shanghai Bell | Proposal 1: Existing UE adjacent channel requirements apply to HAPS and TN co-existence scenarios.  Proposal 2: Determine the adjacent channel requirements for HAPS based on a 5% throughput degradation in the victim network in HAPS and TN co-existence scenarios.  Proposal 3: RAN4 to use frequency reuse factor 1 for co-existence studies.  Proposal 4: Consider both densely deployed TN and sparsely deployed TN in HAPS-TN co-existence scenarios.    **Figure 1. HAPS and TN co-existence scenario 1**  Diagram  Description automatically generated  **Figure 2. HAPS and TN co-existence scenario 2**  Proposal 5: Adjacent channel interference in co-existence scenarios should be studied for both FDD and TDD.  Proposal 6: Adopt a reference HAPS antenna array for adjacent channel co-existence simulations.   |  |  | | --- | --- | |  | A picture containing dome, tiled, net  Description automatically generated | | (a) | (b) |   **Figure 3. Example of HAPS antenna array and cell layout**  **Table 1. Example HAPS antenna parameters for IMT bands below 2.7 GHz**   |  |  | | --- | --- | | 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 | for 1st layer cell  for 2nd layer cell | | Tx power per antenna panel | 46 dBm |   Proposal 7: Determine simulation assumptions based on the HAPS co-existence scenarios and the terrestrial bands for HAPS deployment.  Table . Example system level simulation parameters for rural scenario   |  |  |  | | --- | --- | --- | | Frequency band | Band n1 (UL: 1920-1980 MHz, DL: 2110-2170 MHz) | | | Terrestrial environment | Urban Macro | Rural Macro | | Channel bandwidth | 20 MHz | 20 MHz | | HAPS altitude | 20 Km | 20 Km | | HAPS coverage radius | 100 Km | 100 Km | | HAPS and TN coverage center distance | 0, 20, 40 Km | 0, 20, 40 Km | | HAPS channel model | NTN urban [7] | NTN rural [7] | | HAPS indoor UE percentage | 0% | 0% | | TN inter-site distance | 1 Km | 2 Km | | TN BS antenna height | 25 m | 35 m | | TN BS transmit power | 46 dBm | 46 dBm | | TN BS antenna array configuration | 8 x 8 x 2 (M=8, N=8, P=2)  0.5 wavelength spacing | 8 x 1 x 2 (M=8, N=1, P=2)  0.5 wavelength spacing | | TN BS antenna downtilt | 10⁰ | 6⁰ | | TN channel model | UMa model [8] | RMa model [8] | | TN BS element gain | 8 dBi | 8 dBi | | TN BS element HPBW horizontal/vertical | 65⁰ for H/V | 65⁰ for H/V | | TN BS element radiation pattern | As in Table 7.3-1 of [8] | As in Table 7.3-1 of [8] | | TN indoor UE percentage | 70% | 50% | | Body loss | 4 dB | 4 dB | | UE antenna gain | -3 dBi | -3 dBi | | UE antenna array | 1 x 1 x 2 (M=1, N=1, P=2) | 1 x 1 x 2 (M=1, N=1, P=2) | | UE transmit power | 23 dBm | 23 dBm | |
| R4-2101935 | Nokia, Nokia Shanghai Bell | Observation 1: HAPS are already deployed in the LTE spectrum.  Observation 2: No additional UE requirements are needed for the terminal when applying already defined terrestrial bands for HAPS support.  Proposal 1: Adjacent channel coexistence studies to prioritize FDD bands.  Proposal 2: RAN4 to study (FDD) band n1 for HAPS and TN coexistence studies.  Proposal 3: RAN4 to study (TDD) band n41 for HAPS and TN coexistence studies.  Proposal 4: RAN4 to study ACLR requirements on HAPS BS for adjacent channel coexistence with terrestrial IMT systems.  Proposal 5: RAN4 to study ACS requirements on HAPS BS for adjacent channel coexistence with terrestrial IMT systems.  Proposal 6: RAN4 to study HAPS to HAPS adjacent channel interference. |

## Open issues summary

### Sub-topic 5-1

*Sub-topic description:*

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

**Issue 5-1: Coexistence study scenarios**

* Proposals
  + Option 1:
* Consider both densely deployed TN and sparsely deployed TN in HAPS-TN co-existence scenarios.
* RAN4 to study HAPS to HAPS adjacent channel interference.

|  |  |  |
| --- | --- | --- |
| HAPS – TN ACI | HAPS may cover a large area with multiple cells.  A cellular layout of 7 sites, 21 cells with a certain ISD may be used to model TN | Diagram  Description automatically generated  HAPS coverage overlaps spotty TN cells |
| Duplex mode: FDD(prioritized), TDD | |
| HAPS-HAPS ACI | FFS | |

* Recommended WF
  + TBA

### Sub-topic 5-2

*Sub-topic description:*

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

**Issue 5-2: Frequency band**

* Proposals
  + Option 1: RAN4 to study and prioritize (FDD) band n1 for HAPS and TN coexistence studies.
  + Option 2: RAN4 to study (TDD) band n41 for HAPS and TN coexistence studies.
* Recommended WF
  + TBA

### Sub-topic 5-3

*Sub-topic description:*

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

**Issue 5-3: Antenna Model of HAPS**

* Proposals
  + Option 1: Adopt a reference HAPS antenna array for adjacent channel co-existence simulations.

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

**Figure 5.2.3.1 Example of HAPS antenna array and cell layout**

**Table 5.2.3.1. Example HAPS antenna parameters for IMT bands below 2.7 GHz**

|  |  |
| --- | --- |
| 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 | for 1st layer cell  for 2nd layer cell |
| Tx power per antenna panel | 46 dBm |

* Recommended WF
  + TBA

### Sub-topic 5-4

*Sub-topic description:*

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

**Issue 5-4: Simulation assumptions for HAPS-TN coexistence study**

* Proposals
  + Option 1: Determine simulation assumptions based on the HAPS co-existence scenarios and the terrestrial bands for HAPS deployment.

**Table 5.2.4.1 Example system level simulation parameters for rural scenario**

|  |  |  |
| --- | --- | --- |
| Frequency band | Band n1 (UL: 1920-1980 MHz, DL: 2110-2170 MHz) | |
| Terrestrial environment | Urban Macro | Rural Macro |
| Channel bandwidth | 20 MHz | 20 MHz |
| HAPS altitude | 20 Km | 20 Km |
| HAPS coverage radius | 100 Km | 100 Km |
| HAPS and TN coverage center distance | 0, 20, 40 Km | 0, 20, 40 Km |
| HAPS channel model | NTN urban [7] | NTN rural [7] |
| HAPS indoor UE percentage | 0% | 0% |
| TN inter-site distance | 1 Km | 2 Km |
| TN BS antenna height | 25 m | 35 m |
| TN BS transmit power | 46 dBm | 46 dBm |
| TN BS antenna array configuration | 8 x 8 x 2 (M=8, N=8, P=2)  0.5 wavelength spacing | 8 x 1 x 2 (M=8, N=1, P=2)  0.5 wavelength spacing |
| TN BS antenna downtilt | 10⁰ | 6⁰ |
| TN channel model | UMa model [8] | RMa model [8] |
| TN BS element gain | 8 dBi | 8 dBi |
| TN BS element HPBW horizontal/vertical | 65⁰ for H/V | 65⁰ for H/V |
| TN BS element radiation pattern | As in Table 7.3-1 of [8] | As in Table 7.3-1 of [8] |
| TN indoor UE percentage | 70% | 50% |
| Body loss | 4 dB | 4 dB |
| UE antenna gain | -3 dBi | -3 dBi |
| UE antenna array | 1 x 1 x 2 (M=1, N=1, P=2) | 1 x 1 x 2 (M=1, N=1, P=2) |
| UE transmit power | 23 dBm | 23 dBm |

* Recommended WF
  + TBA

### Sub-topic 5-5

*Sub-topic description:*

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

**Issue 5-5: Performance metric**

* Proposals
  + Option 1: Determine the adjacent channel requirements for HAPS based on a 5% throughput degradation in the victim network in HAPS and TN co-existence scenarios.
* Recommended WF
  + TBA

### Sub-topic 5-6

*Sub-topic description:*

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

**Issue 5-6: BS & UE requirements**

* Proposals
  + Option 1:
* RAN4 to study ACLR & ACS requirements on HAPS BS for adjacent channel coexistence with terrestrial IMT systems.
* No additional UE requirements are needed for the terminal when applying already defined terrestrial bands for HAPS support.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | **Issue 5-1: Coexistence study scenarios**  We think wrap-around with 19 cells (3 sites per cell) should be considered for TN network. Otherwise, if 7 cells are assumed, only the center cell can be used to collect the results.  **Issue 5-2: Frequency band**  It should depend on input from operator. OK with n1 and n41.  **Issue 5-5: Performance metric**  Agree with option 1. |
| Huawei | **Issue 5-1: Coexistence study scenarios**  We can consider multiple HAPS platform instead of only one.  For HAPS to HAPS, we can consider a network shift.  **Issue 5-2: Frequency band**  Option 1. Not sure whether there is a difference between FDD and TDD.  **Issue 5-3: Antenna Model of HAPS**  Why are the array configurations different between 1st layer and 2nd layer? The height of this platform can be assumed.  Does that mean we only consider the passive antenna? I suppose we need to consider the 3-Dimension.  **Issue 5-4: Simulation assumptions for HAPS-TN coexistence study**  100km coverage means 1 cell or 7 cell for HAPS? Based on the equation (1) in R4-2101812, 25 layers are needed for rural BS sites. 50 layers are needed for urban macro.  For different BS antenna array configuration, the element gain might be different instead of both 8dB.  Generally, we may consider 20% indoor UE for urban Macro. 70% is too high, Considering the scenario for HAPS and ISD, we can pick 20% indoor UE for urban Macro. 10% indoor UE for Rural Macro.  2~3dB BS body loss can be assumed.  Generally, UE antenna gain is 0dB. There is no polarization for FR1 UE.  UE Noise figure should be assumed. |
| Ericsson | Issue 5-1: Agree with Qualcomm, 7 sites is not agreeable, 19 cells is better. Also, TDD should not be considered for the time being, as HAPS network will be unsync with TN one, this would require special attention and additional investigations.  Issue 5-2: It’s true bands 1 885-1 980 MHz, 2 010-2 025 MHz and 2 110-2 170 MHz have been allocated to HIBS in Region 1 and 3. We could assume here 2GHz for FDD but leave it open for TDD as down-prioritized. Moreover, 2 500-2 690 MHz is only candidate for WRC-23.  Issue 5-3: We should may be first agree on a model and then its parameters.  Issue 5-4: to be further discussed.  Issue 5-5: Agree. |
| Nokia | Issue 5-1: We think for the TN network in the co-existence study 7 sites (21 cells) with wrap around should be sufficient, but we are open to other suggestion. (Note that we propose HAPS supports 7 cells.)  Issue 5-2-6: Option 1 - OK |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1**  Coexistence study scenarios | Proposal 1: To consider wrap-around with 19 cells (3 sites per cell) for TN network.  Proposal 2: TDD should not be considered for the time being  Proposal 3: To consider multiple HAPS platform instead of only one.  Proposal 4: To consider a network shift for HAPS to HAPS scenario.  *Tentative agreements:*  - To consider wrap-around with 19 cells (3 sites per cell) for TN network  - Deprioritize TDD mode  *Recommendations for 2nd round:*  Try to agree on tentative agreements and further discuss other proposals in 2nd round. |
| **Sub-topic#2**  Frequency band | 2 companies support Option 1. One supports both options.  *Tentative agreements:*  - 2GHz FDD  *Recommendations for 2nd round:*  Try to agree on tentative agreements and encourage inputs from operators. |
| **Sub-topic#3**  Antenna model of HAPS | Several questions were raised and no agreement has been made.  *Recommendations for 2nd round:*  Further discuss this topic in 2nd round. |
| **Sub-topic#4**  Simulation assumptions for HAPS-TN coexistence study | Several questions were raised and no agreement has been made.  *Recommendations for 2nd round:*  Further discuss this topic in 2nd round. |
| **Sub-topic#5**  Performance metric | Option1 got all supports.  *Tentative agreements:*  Determine the adjacent channel requirements for HAPS based on a 5% throughput degradation in the victim network in HAPS and TN co-existence scenarios.  *Recommendations for 2nd round:*  Try to agree on tentative agreements. |
| **Sub-topic#6**  BS & UE requirements | No objections received.  *Tentative agreements:*   * RAN4 to study ACLR & ACS requirements on HAPS BS for adjacent channel coexistence with terrestrial IMT systems. * No additional UE requirements are needed for the terminal when applying already defined terrestrial bands for HAPS support.   *Recommendations for 2nd round:*  Try to agree on tentative agreements. |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Way forward on [311] NTN\_Solutions\_Part2 | Samsung, WF |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Appendix 1. TDOC list for this agenda

A total of 14 TDOCs have been provided for this agenda listed as below. Note that R4-2100487, R4-2102176 and part of R4-2101859 will be handled in [310] NTN\_Solutions\_Part1 this time.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***TDoc Number*** | ***TDoc Type*** | ***Title*** | ***Company*** | ***Status*** | ***General Purpose*** | ***Agenda Item*** |
| [*R4-2100399*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100399.zip) | discussion | Discussion on frequency band and scenarios for NTN | CATT | available | Discussion | 11.8.3.1 |
| [*R4-2100486*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100486.zip) | discussion | Simulaiton assumptions for NTN co-existence | CATT | available | Discussion | 11.8.3.1 |
| [*R4-2100487*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100487.zip) | discussion | Consideration on BS requirement impact for NTN | CATT | available | Discussion | 11.8.3.3 |
| [*R4-2100904*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100904.zip) | discussion | Simulation assumption for FR1 coexistence study | Samsung | available | Agreement | 11.8.3.1 |
| [*R4-2101105*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101105.zip) | Other | Coexistence study on NR to support non-terrestrial networks | Xiaomi | available | Approval | 11.8.3.1 |
| [*R4-2101812*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101812.zip) | Other | General discussion on NTN simulation assumptions | Huawei, HiSilicon | available | Approval | 11.8.3.1 |
| [*R4-2101859*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101859.zip) | discussion | NTN FR1 Coexistence Scenarios and Related Core Requirements | THALES | available | Decision | 11.8.3 |
| [*R4-2101880*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101880.zip) | discussion | Simulations for NTN FR1 Coexistence Cases | THALES | available | Decision | 11.8.3 |
| [*R4-2101934*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101934.zip) | discussion | NTN - HAPS simulation assumptions for co-existence study | Nokia, Nokia Shanghai Bell | available | Approval | 11.8.3.1 |
| [*R4-2101935*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101935.zip) | discussion | NTN - HAPS adjacent channel coexistence | Nokia, Nokia Shanghai Bell | available | Approval | 11.8.3.3 |
| [*R4-2101964*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101964.zip) | Other | Discussion on simulation assumptions for NTN coexistence study | ZTE Corporation | available | Approval | 11.8.3.1 |
| [*R4-2102174*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102174.zip) | Other | NTN Simulations assumptions discussion | Ericsson | available | Approval | 11.8.3.1 |
| [*R4-2102176*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102176.zip) | discussion | NTN - BS requirements overview | Ericsson | available | Discussion | 11.8.3.3 |
| [*R4-2102508*](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102508.zip) | discussion | Simulation assumptions for NR NTN co-existence study | Qualcomm Incorporated | available | Decision | 11.8.3.1 |

# Appendix 2. Satellite based NTN coexistence scenario table

Following tables are reference to show potential scenarios to be considered for satellite based NTN coexistence studies based on current discussion.

**Table A2-1 Potential Scenarios in FR1 based on current discussion**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **FR1** | | | **Set 1** | | | **Set 2** | | |
| **GEO** | **LEO 600km** | **LEO 1200km** | **GEO** | **LEO 600km** | **LEO 1200km** |
| **NR / NB-IoT** | **Rural** | | X | X | X | X | X | X |
| **Urban macro** | | X | X | X | X | X | X |
| **Dense Urban** | | X | X | X | X | X | X |
| **Indoor hotspot** | | X | X | X | X | X | X |
| **NTN** | **GEO** | **Set 1** | X | X | X | N/A | N/A | N/A |
| **LEO 1200km** | X | X | X | N/A | N/A | N/A |
| **LEO 600km** | X | X | X | N/A | N/A | N/A |
| **GEO** | **Set 2** | N/A | N/A | N/A | X | X | X |
| **LEO 1200km** | N/A | N/A | N/A | X | X | X |
| **LEO 600km** | N/A | N/A | N/A | X | X | X |

**Table A2-2 Potential Scenarios in FR2/Above FR1 based on current discussion**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **FR2/Above FR1** | | | **Set 1** | | | **Set 2** | | |
| **GEO** | **LEO 600km** | **LEO 1200km** | **GEO** | **LEO 600km** | **LEO 1200km** |
| **NR / NB-IoT** | **Urban macro** | | X | X | X | X | X | X |
| **Dense Urban** | | X | X | X | X | X | X |
| **Micro/small cell outdoor** | | X | X | X | X | X | X |
| **Indoor hotspot** | | X | X | X | X | X | X |
| **NTN** | **GEO** | **Set 1** | X | X | X | N/A | N/A | N/A |
| **LEO 1200km** | X | X | X | N/A | N/A | N/A |
| **LEO 600km** | X | X | X | N/A | N/A | N/A |
| **GEO** | **Set 2** | N/A | N/A | N/A | X | X | X |
| **LEO 1200km** | N/A | N/A | N/A | X | X | X |
| **LEO 600km** | N/A | N/A | N/A | X | X | X |