**3GPP TSG-RAN WG4 Meeting #** **102-e R4-22xxxxx**

**Electronic Meeting, February 21 – March 3, 2022**

**Agenda item:** 6.13.6

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [102-e][325] NR\_NTN\_Demod

**Document for:** Information

# Introduction

*The summary covers the contributions submitted under the following agendas*

* *10.13.6.1 - General*
* *10.13.6.2 - Satellite Access Node demodulation requirements*
* *10.13.6.3 - UE demodulation requirements*
* *10.13.6.4 - CSI requirements*

# Topic #1: General aspects

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

## Open issues summary and Companies views’ collection for 1st round

### Issue 1-1: General aspects

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2205763 | Huawei, HiSilicon | Proposal 1: Only consider fixed SNR at the UE or BS side to facilitate testing even if the SNR may be changed in the real network.  Proposal 4: Do not consider explicit model UE speed for NTN demodulation requirements. |

**Issue 1-1-1: Power control model**

* Proposals
  + Option 1: (Huawei)
    - Only consider fixed SNR at the UE or BS side to facilitate testing even if the SNR may be changed in the real network.
* Recommended WF
  + Companies are encouraged to provide their views on this issue.

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| **Company** | **Comments** |
| Samsung | Ok with option 1 |
| Qualcomm | We are fine with Option 1 |
| Intel | Support Option 1 |
| Apple | We are fine with option 1 |
| Ericsson | We support Option 1. |
| Huawei | Support Option 1. |

**Issue 1-1-2: UE speed**

* Proposals
  + Option 1: (Huawei)
    - Do not consider explicit model UE speed for NTN demodulation requirements.
* Recommended WF
  + Companies are encouraged to provide their views on this issue.

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| **Company** | **Comments** |
| Samsung | OK with option 1, only considering different Doppler shift |
| Qualcomm | We are fine with not considering an explicit model for UE speed, but Doppler shift should reflect a reasonable UE speed. |
| Intel | Ok with Option 1 |
| Apple | We would like clarification on what the proposal means. We typically model Doppler spread for UE speed and other scattering. How is this different. We agree not to model UE speed explicitly. |
| Ericsson | For UL demodulation, UE might estimate its speed by GNSS and then estimate the relative Doppler shift to Satellite together with ephemeris. In that case, Option 1 couldmight be OK considering pre-compensation by UE, but the total residual error is not quite clear especially when UE can’t get precise its position/speed by GNSS.  We encourage companies, especially UE vendors, to check if this is the common understanding.  For DL demodulation, different UE speed might have clear impact on performance. We suggest checking the simulation results at the first. |
| Huawei | We clarify that we don’t need to consider explicit model UE speed into channel model such as HST. |

## Summary for 1st round

*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.*

### Issue 1-1: General aspects

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|  | **Status summary** |
| **Issue 1-1-1: Power control model** | *Tentative agreements:*  Only consider fixed SNR at the UE or BS side to facilitate testing even if the SNR may be changed in the real network  *Recommendations for 2nd round:*  No need for 2nd round discussion |
| **Issue 1-1-2: UE speed** | *Tentative agreements:*  Do not consider explicit model UE speed into channel model for NTN demodulation requirements. Companies are encouraged to check the impact of different UE speed on the simulation results.  *Recommendations for 2nd round:*  No need for 2nd round discussion |

### CRs/TPs

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

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

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

## Discussion on 2nd round (if applicable)

Discussion on 2nd round is not needed.

# Topic #2: Satellite Access Node demodulation requirements

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

## Open issues summary and Companies views’ collection for 1st round

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

### Issue 2-1: General assumptions

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204027 | Ericsson | Proposal 1: Select one NLOS and LOS channel model for NTN demodulation requirement. Companies could deliver simulation results based on following options.   * Option 1: NTN-TDL-A/C * Option 2: NTN-TDL-B/D   Proposal 2: Use maximum delay spread 100ns for NTN NLOS channel models. For LOS channel, smaller delay spread could be considered.  Observation 2: The residual Doppler error in NLOS scenario could be higher than LOS scenario after UE pre-compensation.  Proposal 3: To simplify the channel model, only consider maximum Doppler shift as ±0.1+∆d ppm where ∆d is residual Doppler error in feeder link. Satellite companies are encouraged to provide a proper value for ∆d. Otherwise, take ∆d as 0.05ppm as the worst case.  Proposal 4: Define SAN demodulation requirements with 1Tx 1Rx and 1Tx 2Rx.  Proposal 6: Only consider QPSK for NTN SAN demodulation requirement. |
| R4-2205763 | Huawei, HiSilicon | Proposal 2: Select 250ns delay spread and 200Hz Doppler shift for NTN demodulation requirements for both DL and UL.  Proposal 3: Do not considering any Doppler shift and delay spread for the feeder link.  Proposal 4: Do not consider explicit model UE speed for NTN demodulation requirements.  Proposal 5: Select NTN-TDL-A and NTN-TDL-C for NTN demodulation requirements definition. |
| R4- 2206003 | Intel Corporation | Proposal 2: RAN4 will not consider different scenarios and elevations for delay spread but define short, nominal and long delay spread instead.  Proposal 3: RAN4 to consider the DS values for requirements definition as shown in Table 2-1  Table 2-1 Scaling parameters for TDL channel model   |  |  | | --- | --- | | Model | DS | | Short delay spread | 10 ns | | Nominal delay spread | 50 ns | | Long delay spread | 150 ns |   Proposal 4: RAN4 to consider frequency shift of 200Hz which covers both UE motion and pre-compensation residual error  Proposal 5: For UL demodulation requirements definintion RAN4 to focus on 1Tx, 2Rx configuration as a starting point |

**Issue 2-1-1: Doppler shift model**

* Proposals
  + Option 1: (Huawei, Intel)
    - Consider 200Hz as the maximum Doppler shift (0.1ppm)
    - Do not consider the Doppler shift for the feeder link
  + Option 2: (Ericsson)
    - Only consider maximum Doppler shift as ±0.1+∆d ppm where ∆d is residual Doppler error in feeder link. Satellite companies are encouraged to provide a proper value for ∆d. Otherwise, take ∆d as 0.05ppm as the worst case.
* Recommended WF
  + Companies are encouraged to provide their views on this issue.

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| **Company** | **Comments** |
| Samsung | We support option 1, reusing the similar assumption for gNB requirement defined in TN. Regarding the Doppler shift for feeder link, it can be covered by TE side with test uncertainty |
| Qualcomm | We are okay assuming 200Hz Doppler for UL in the service link. However, our understanding for DL transmission from Satellite is that, no compensation of Doppler shift can be assumed since satellite does not know the speed relative to UE. |
| Intel | Support Option 1.  We also would like to raise additional issue on timing/frequency pre-compensation. How can we emulate UE pre-compensation in the test? Do we need to provide any satellite information in the test? |
| Ericsson | We propose to take Option 2 at current stage. Option 2 actually includes Option 1 condition when ∆d =0. For SAN conformance test, satellite will not be tested. Feeder link impact should be considered in that case. 0.1ppm is usually taken as general TN UE residual frequency shift error. It could be worse if feeder link has to be considered. |
| Huawei | We prefer Option 1. Only Doppler from the service link should be considered. For the uplink test, we usually design simpler test to reduce the test cost, so we don’t think any high layer parameters can be considered, similar as the legacy BS testing. However, for the downlink test, we are open to discuss whether we need to verify correctly UE pre-compensation function. |

**Issue 2-1-2: Delay spread model**

* Proposals
  + Option 1: (Huawei)
    - 250ns delay spread
    - Do not consider the delay spread for the feeder link
  + Option 2: (Ericsson)
    - Use maximum delay spread 100ns for NTN NLOS channel models. For LOS channel, smaller delay spread could be considered.
  + Option 3: (Intel)
    - Not consider different scenarios and elevations for delay spread but define short, nominal and long delay spread instead.
    - To consider the DS values for requirements definition as shown in Table 2-1.
      * Table 2-1 Scaling parameters for TDL channel model

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| Model | DS |
| Short delay spread | 10 ns |
| Nominal delay spread | 50 ns |
| Long delay spread | 150 ns |

* Recommended WF
  + Companies are encouraged to provide their views on this issue.

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| **Company** | **Comments** |
| Samsung | We support option 3 to cover different delay |
| Qualcomm | Option 2: We think 100ns delay spread is a reasonable compromise between short and long delay spread. |
| Intel | Support Option 3. Different combinations of DS and NTN-TDL channel model can be used to increase test coverage. |
| Ericsson | Prefer Option 2 to define one delay spread for NLOS or LOS channel seperatly. In Rel-15 requirement, different modulation is selected for different channel models (different DS and Doppler shift) to check the performance. In NTN study, there are NLOS and LOS channels evaluated.  According to UL link budget, maybe only QPSK is feasible. In that case, one delay spread for NLOS or LOS channel could be enough for checking the performance.  For DL demodulation, it could be further check if different delay spread is feasible for different modulation etc. |
| Huawei | We prefer Option 1 as the maximum delay spread value. Based on TR38.811 section 7.3.5.2.2, 250ns delay spread can cover most of cases. We are also OK to consider different delay spread value, such as 10ns/50ns/250ns. |

### Issue 2-2: PUSCH requirements

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204028 | Ericsson | Proposal 1: Use MCS2 for NLOS channel and consider MCS4 for LOS channel if simulation results can fulfil test metric.  Proposal 2: NTN SAN PUSCH demodulation requirements could be defined as follows:  • NLOS channel: 15kHz SCS 5M/20MHz and 30kHz SCS 10M/20MHz  • LOS channel: 15kHz SCS 20MHz and 30kHz SCS 20MHz  Proposal 3: Take simulation assumptions in Table 2.2-1 for NTN PUSCH demodulation requirements discussion.  Proposal 4: Take simulation assumptions in Table 2.3-1 and 2.3-2 for NTN UL TA demodulation requirements discussion.  Proposal 5: Take simulation assumptions in Table 2.4-1 for NTN PUSCH repetition type A demodulation requirements discussion.  Proposal 6: Define NTN SAN demodulation requirements for 2-step RA PUSCH.  Proposal 7: Take simulation assumptions in Table 2.5-1 for NTN MsgA PUSCH for 2-step RA type demodulation requirements discussion.  Proposal 8: Do not define requirements for Mapping Type B with non-slot transmission. |
| R4-2205764 | Huawei,HiSilicon | Proposal 1: For NTN PUSCH, do not define requirements for mapping Type B with non-slot transmission requirements.  Proposal 2: For NTN PUSCH, define requirements for 2-step RA type requirement.  Proposal 3: For NTN satellite PUSCH performance requirements, select 5MHz, 10MHz and 20MHz bandwidth for 15kHz SCS while 10MHz and 20MHz bandwidth for 30kHz SCS.  Proposal 4: Only consider QPSK for NTN PUSCH requirements for NTN PUSCH requirements definition. |
| R4- 2206003 | Intel Corporation | Proposal 1: RAN4 to use one NTN-TDL channel model for PUCCH requirements definition, one NTN-TDL channel model for PRACH requirements definition and consider different combinations of NTN-TDL channels and FRC for PUSCH requirements definition.  Proposal 6: RAN4 to focus on the list of PUSCH requirements to be defined agreed during the RAN4 101-bis-e meeting. No need to extend the list  Proposal 7: RAN 4 to consider the following SCS/CBW set for PUSCH requirements definition: 15kHz SCS: 5/10/20MHz, 30kHz SCS: 10/20MHz |

**Issue 2-2-1: Scope of PUSCH requirements**

* Proposals
  + Option 1: (Intel)
    - Focus on the list of PUSCH requirements agreed during the RAN4 101-bis-e meeting. No need to extend the list.
  + Option 2: (Huawei, Ericsson)
    - In addition to the list of PUSCH requirements agreed during the RAN4 101-bis-e meeting, further define requirements for 2-step RA type requirement. No need to define requirements for Mapping Type B with non-slot transmission.
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Samsung | We support option 1. We would like to know whether 2–step RA type and mapping type B with non-slot transmission is typical scenario for NTN use cases. |
| Intel | Prefer Option 1 |
| Ericsson | Support Option 2. We think 2-step RA could be helpful for NTN UE to reduce the RACH time when condition is good enough. |
| Huawei | Maybe we can agree to not consider Mapping Type B with non-slot transmission and FFS 2-step RACH. |

**Issue 2-2-2: Channel model for PUSCH**

* Proposals
  + Option 1: (Huawei, Ericsson)
    - Select NTN-TDL-A and NTN-TDL-C
  + Option 2: (Ericsson)
    - Select NTN-TDL-B and NTN-TDL-D
  + Option 3: (Intel)
    - Consider different combinations of NTN-TDL channels and FRC for PUSCH requirements definition
* Recommended WF
  + To agree with option 1.

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| **Company** | **Comments** |
| Samsung | Ok with recommended WF |
| Intel | Ok with Option 1 |
| Ericsson | No strong opinion, either Option 1 or 2 is fine for us. |
| Huawei | OK with recommended WF. |

**Issue 2-2-3: SCS/CBW set for PUSCH requirements**

* Proposals
  + Option 1: (Huawei, Intel)
    - 15kHz SCS: SCS 5MHz/10MHz/20MHz, 30kHz SCS: 10MHz/20MHz
  + Option 2 (Ericsson)
    - NLOS channel: 15kHz SCS 5MHz/20MHz and 30kHz SCS 10MHz/20MHz
    - LOS channel: 15kHz SCS 20MHz and 30kHz SCS 20MHz
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Samsung | We support option 1, there is no need to differentiate SCS/BW for PUSCH requirement under different channel condition |
| Intel | Support Option 1 |
| Ericsson | Prefer Option 2, but no strong opinion.  We suggest also consider a few PRB allocated for UL demodulation regarding to poor link budget results. |
| Huawei | We prefer Option 1. |

**Issue 2-2-4: Modulation order for PUSCH requirements**

* Proposals
  + Option 1: (Huawei)
    - Only consider QPSK
  + Option 2: (Ericsson)
    - MCS2 for NLOS
    - MCS4 for LOS
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Samsung | In Rel-15, different MCS level requirements are applied with different channel condition to guarantee the test coverage. From baseband processing, it is expected the same. To reduce the test effort, only one MCS for PUSCH is preferred. |
| Intel | Support Option 2 |
| Ericsson | Prefer Option 2. Based on the link budget results from TS38.821, only QPSK looks feasible for UL demodulation. Appling different MCS is based on the different channel condition. It would be good to test on high MCS if possible. |
| Huawei | We prefer to only consider one MCS for different propagation conditions. Either MCS2 or MCS4 is OK for us. |

**Issue 2-2-5: Antenna configuration for PUSCH requirements**

* Proposals
  + Option 1: (Ericsson)
    - UE 1Tx – SAN 1Rx and UE 1Tx – SAN 2Rx
  + Option 2: (Intel)
    - UE 1Tx – SAN 2Rx
  + Option 3: (Huawei)
    - UE 2Tx – SAN 2Rx, UE 2Tx – SAN 4Rx and UE 2Tx – SAN 8Rx
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Samsung | We prefer option 2, similar antenna configuration as in existing BS requirement |
| Intel | Support Option 2 |
| Ericsson | Prefer Option 1. For the service link, 1Rx and 2Rx are typical in satellite antenna configuration based on TS38.821. Most of satellite networks use 1Rx (linear polarization) and 2Rx (right-hand or left-hand circular polarizations). If polarization is used, network could indicate UE the information. In link level simulation assumptions in TR38.821, 1Rx is baseline configuration for RACH and data transmission, and 2Rx is optional for RACH.  As we mentioned above, satellite would not be included during SAN conformance test.  But RAN4 have agreement that no requirement will be defined for feeder link, satellite and 5G node are considered as one box. We think satellite antenna will be considered as receiver antenna based on this assumption. |
| Huawei | We prefer Option 3. We think it is benefit for the link budget to consider higher number of Rx antenna. Maybe manufacture declaration can be defined to report the highest supporting number of Rx antenna. |

**Issue 2-2-6: Test parameters for NTN PUSCH**

* Proposals
  + Option 1: (Ericsson)
    - Take simulation assumptions in Table 2.2-1 for NTN PUSCH demodulation requirements discussion.

Table 2.2-1: Test parameters for NTN PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Channel model | | NTN-TDLB100-300 (NLOS)  NTN-TDLD100-300 (LOS) |
| MCS | | MCS2 for NLOS  MCS4 for LOS |
| Transform precoding | | Disabled/Enabled |
| Default TDD UL-DL pattern (Note 1) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| HARQ | Maximum number of HARQ transmissions | 4 |
|  | RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
|  | DM-RS duration | single-symbol DM-RS |
|  | Additional DM-RS position | Pos1 |
|  | Number of DM-RS CDM group(s) without data | 2 |
|  | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
|  | DM-RS port(s) | {0} |
|  | DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
|  | Start symbol | 0 |
|  | Allocation length | 14 |
| Frequency domain resource assignment | RB assignment | FFS |
|  | Frequency hopping | Disabled |
| TPMI index for 2Tx two layer spatial multiplexing transmission | | 0 |
| Code block group based PUSCH transmission | | Disabled |
| NOTE 1: The same requirements are applicable to FDD and TDD with different UL-DL patterns. | | |

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Samsung | Pending on issue of channel model and MCS |
| Intel | NTN system is FDD only. Why do we need to consider Default TDD UL-DL pattern? |
| Ericsson | We suggest FFS on RB assignment and Eencourage companies to check the parameters in Option 1. |
| Huawei | Only FDD should be considered. Also the parameter such as channel model and MCS should be changed to FFS since there is discussion in other issues. |

**Issue 2-2-7: Test parameters for NTN UL timing adjustment**

* Proposals
  + Option 1: (Ericsson)
    - Take simulation assumptions in Table 2.3-1 and 2.3-2 for NTN UL TA demodulation requirements discussion.

Table 2.3-1 Test parameters for NTN UL timing adjustment

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| MCS | | 2 |
| Transform precoding | | Disabled |
| Uplink-downlink allocation for TDD (Note1) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| HARQ | Maximum number of HARQ transmissions | 4 |
|  | RV sequence | 0, 2, 3, 1 |
| DM-RS | DM-RS configuration type | 1 |
|  | DM-RS duration | single-symbol DM-RS |
|  | Additional DM-RS position | Pos2 |
|  | Number of DM-RS CDM group(s) without data | 2 |
|  | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
|  | DM-RS port(s) | {0} |
|  | DM-RS sequence generation | NID0=0, nSCID =0 for moving UE  NID0=1, nSCID =1 for stationary UE |
| Time domain resource assignment | PUSCH mapping type | A, B |
|  | Allocation length | 14 |
| Frequency domain resource assignment | RB assignment | FFS |
|  | Starting PRB index | FFS |
|  | Frequency hopping | Disabled |
| SRS resource allocation | Slots in which sounding RS is transmitted (Note2) | For FDD: slot #1 in radio frames  For TDD:  last symbol in slot #3 in radio frames for 15kHz  last symbol in slot #7 in radio frames for 30kHz |
|  | SRS resource allocation | FFS |
| NOTE 1: The same requirements are applicable to FDD and TDD with different UL-DL patterns.  NOTE 2: The transmission of SRS is optional. And the transmission comb and SRS periodic are configured as KTC = 2, and TSRS = 10 respectively. | | |

Table 2.3-2: Parameters for NTN UL timing adjustment

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| Parameter | Scenario X |
| Channel model | Stationary UE: AWGN  Moving UE: NTN-TDLB100-300 |
| UE speed | 120 km/h |
| CP length | Normal |
| A | 15 kHz: 10 s  30 kHz: 5 s |
|  | 15 kHz: 0.04 s-1  30 kHz: 0.08 s-1 |

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Samsung | In general, option 1 can be used as starting point, CBW, MCS and channel model can be further discussed. |
| Intel | NTN system is FDD only. Why do we need to mention TDD case? |
| Ericsson | We suggest FFS on RB assignment, start RB index and SRS allocation. Encourage companies to check other parameters in Option 1. |
| Huawei | Only FDD should be considered. Also the parameter such as channel model and MCS should be changed to FFS since there is discussion in other issues. |

**Issue 2-2-8: Test parameters for NTN PUSCH repetition type A**

* Proposals
  + Option 1: (Ericsson)
    - Take simulation assumptions in Table 2.4-1 for NTN PUSCH repetition type A demodulation requirements discussion.

Table 2.4-1: Test parameters for NTN PUSCH repetition Type A

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| --- | --- | --- |
| Parameter | | Value |
| MCS | | 5 in Table 3 |
| Channel model | | NTN-TDLB100-300 |
| Transform precoding | | Disabled |
| Default TDD UL-DL pattern (Note 1) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| HARQ | Maximum number of HARQ transmissions | 4 |
| RV sequence | 0, 3, 0, 3 [Note 2] |
| DM-RS | DM-RS configuration type | 1 |
| DM-RS duration | single-symbol DM-RS |
| Additional DM-RS position | pos1 |
| Number of DM-RS CDM group(s) without data | 2 |
| Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
| DM-RS port | 0 |
| DM-RS sequence generation | NID0=0, nSCID =0 |
| Time domain resource assignment | PUSCH mapping type | A, B |
| Start symbol | 0 |
| Allocation length | 14 |
| PUSCH aggregation factor | 30 kHz SCS: n2  15 kHz SCS: n2 for FDD and n8 for TDD [Note 3] |
| Frequency domain resource assignment | RB assignment | FFS |
| Frequency hopping | Disabled |
| Code block group based PUSCH transmission | | Disabled |
| Note 1: The same requirements are applicable to FDD and TDD with different UL-DL pattern.  Note 2: The effective RV sequence is {0, 2, 3, 1} with slot aggregation.  Note 3: The intention of this configuration is to have two effective transmissions of the transport block. To achieve this for the standard TDD pattern captured in this table, a value of n8 is necessary, while for FDD a value of n2 is necessary. | | |

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Samsung | Option 1 can be used as starting point, MCS, channel model and CBW can be further discussed |
| Intel | NTN system is FDD only. Why do we need to mention TDD case? |
| Ericsson | We suggest FFS on RB allocation and encourage companies to check other parameters in Option 1. |
| Huawei | Only FDD should be considered. Also the parameter such as channel model and MCS should be changed to FFS since there is discussion in other issues. |

**Issue 2-2-9: Test parameters for NTN msgA PUSCH for 2-step RA type**

* Proposals
  + Option 1: (Ericsson)
    - Take simulation assumptions in Table 2.5-1 for NTN MsgA PUSCH for 2-step RA type demodulation requirements discussion

Table 2.5-1: Test parameters for NTN msgA PUSCH for 2-step RA type

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| Transform precoding | | Disabled |
| Channel bandwidth | | 15 kHz SCS: 10 MHz |
|  | | 30 kHz SCS: 20 MHz |
| MCS | | 2 or 1 |
| DM-RS | DM-RS configuration type | 1 |
|  | DM-RS duration | single-symbol DM-RS |
|  | DM-RS position (*l0*) | 2 |
|  | Additional DM-RS position | pos1 |
|  | Number of DM-RS CDM group(s) without data | 2 |
|  | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
|  | DM-RS port | {0} |
|  | DM-RS sequence generation | NID0=0, nSCID = 0 |
| Time domain resource assignment | PUSCH mapping type | Both A and B |
| Allocation length | 14 |
| Frequency domain resource assignment | RB assignment | 2 PRBs |
| Starting PRB index | 0 |
| Frequency hopping | Disabled |
| Time offset (TO) Cycling (µs) | start:step:end | 15k SCS: FFS |
|
|  |  | 30k SCS: FFS |
|
| Test Metric | BLER | 0.01 |
| Note 1: The same requirements are applicable to FDD and TDD with different UL-DL patterns.  Note 2: For FR1, either pos 1 or pos 2 may be used for the test FRC. A pass with either of these possibilities is sufficient to demonstrate compliance to the core requirement.  Note 3: The power ratio between preamble and msgA (msgA-DeltaPreamble) is set to be sufficient to achieve 100% preamble detection. The SNR for the requirement is defined on the msgA PUSCH. | | |

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Samsung | Pending on the issue whether to define Msg A PUSCH requirement for SAN, we prefer not to define Msg A PUSCH requirement for SAN |
| Intel | Need to agree on Issue 2-2-1 first |
| Ericsson | Encourage companies to check the parameters in Option 1. |
| Huawei | Only FDD should be considered. Also the parameter such as channel model and MCS should be changed to FFS since there is discussion in other issues. |

### Issue 2-3: PUCCH requirements

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204029 | Ericsson | Proposal 1: Prioritize UCI with HARQ on PUCCH demodulation requirement.  Proposal 2: Define NTN PUCCH demodulation requirement with 1Tx 1Rx and 1Tx 2Rx.  Proposal 3: NTN SAN PUCCH demodulation requirements could be defined for 15kHz SCS 5M/20MHz bandwidth and 30kHz SCS 10M/20MHz bandwidth.  Proposal 4: Take simulation parameters in Table 2-1 to 2-5 for NTN PUCCH demodulation requirement discussion.  Proposal 5: Define NTN multi-slot PUCCH demodulation requirements which could take assumptions in Table 2-6 as the start point |
| R4-2205765 | Huawei, HiSilicon | Proposal 1: For PUCCH formant 0/1/2/3/4, define 2/4/8 Rx antenna performance requirements for NTN satellite PUCCH. Introduce manufacture declaration to decide which number of Rx antenna performance requirements should be tested.  Proposal 2: Define multi-slot PUCCH format 1, 2 Rx requirement for NTN satellite PUCCH.  Proposal 3: For NTN satellite performance requirements, select 5MHz, 10MHz and 20MHz bandwidth for 15kHz SCS while 10MHz and 20MHz bandwidth for 30kHz SCS. |
| R4- 2206003 | Intel Corporation | Proposal 1: RAN4 to use one NTN-TDL channel model for PUCCH requirements definition, one NTN-TDL channel model for PRACH requirements definition and consider different combinations of NTN-TDL channels and FRC for PUSCH requirements definition.  Proposal 8: RAN 4 to consider the following SCS/CBW set for PUCCH requirements definition: 15kHz SCS: 5/10/20MHz, 30kHz SCS: 10/20MHz |

**Issue 2-3-1: Scope of PUCCH requirements**

* Proposals
  + Option 1: (Huawei, Ericsson)
    - In addition to PUCCH format 0/1/2/3/4, RAN4 to define NTN multi-slot PUCCH demodulation requirements
    - Prioritize UCI with HARQ on PUCCH demodulation requirement
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Samsung | In general, we are ok to define PUCCH format 0/1/2/3/4, and multi-slot PUCCH requirement, similar as Rel-15.  For detail UCI type, my understanding both HARQ and CSI should be considered in the requirement, similar as Rel-15. |
| Intel | Ok with Option 1. |
| Ericsson | Prefer Option 1. |
| Huawei | We are OK with Option 1. |

**Issue 2-3-2: Channel model for PUCCH requirements**

* Proposals
  + Option 1: (Huawei, Ericsson)
    - Select NTN-TDL-A and NTN-TDL-C
  + Option 2: (Ericsson)
    - Select NTN-TDL-B and NTN-TDL-D
  + Option 3: (Intel)
    - RAN4 to use one NTN-TDL channel model for PUCCH requirements definition
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Samsung | In general, we are ok with option 3. For which channel applied to which PUCCH formats, it can be further discussed |
| Intel | Support Option 3. It follows the Rel-15 approach where all the PUCCH requirements (except interlaced PUCCH) are defined only for TDLC-300-100 |
| Ericsson | Channel model could follow PUSCH discussion. |
| Huawei | We are OK with Option 3. We think the Doppler and delay should be select from the maximum value of the NTN PUSCH requirements. |

**Issue 2-3-3: SCS/CBW set for PUCCH requirements**

* Proposals
  + Option 1: (Huawei, Intel)
    - 15kHz SCS: 5MHz/10MHz/20MHz, 30kHz SCS: 10MHz/20MHz
  + Option 2 (Ericsson)
    - 15kHz SCS 5MHz/20MHz, 30kHz SCS 10MHz/20MHz
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Samsung | We support option 2 to reduce the test effort |
| Intel | Support Option 1 |
| Ericsson | SCS and BW could follow PUSCH discussion. |
| Huawei | We prefer Option 1. |

**Issue 2-3-4: Antenna configuration for PUCCH**

* Proposals
  + Option 1: (Ericsson)
    - UE 1Tx – SAN 1Rx and UE 1Tx – SAN 2Rx
  + Option 2: (Intel)
    - UE 1Tx – SAN 2Rx
  + Option 3: (Huawei)
    - For PUCCH formant 0/1/2/3/4, define 2/4/8 Rx antenna performance requirements for NTN satellite PUCCH. Introduce manufacture declaration to decide which number of Rx antenna performance requirements should be tested.
    - For multi-slot PUCCH format 1, define 2 Rx requirement
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Samsung | We support option 2, 2Rx can fulfill the basic performance verification. We are also ok with option 3 |
| Intel | Support Option 2. Larger number of Rx antenna considered in Option 3 sound reasonable for satellite |
| Ericsson | Follow PUSCH discussion. |
| Huawei | We prefer Option 3. We think it is benefit for the link budget to consider higher number of Rx antenna. Maybe manufacture declaration can be defined to report the highest supporting number of Rx antenna. |

**Issue 2-3-5: : Test parameters for NTN PUCCH format 0/1/2/3/4**

* Proposals
  + Option 1: (Ericsson)
    - Take simulation parameters in Table 2-1 to 2-5 for NTN PUCCH demodulation requirement discussion

Table 2-1: Test Parameters for NTN PUCCH format 0

|  |  |
| --- | --- |
| Parameter | Test |
| Number of UCI information bits | 1 |
| Number of PRBs | 1 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | N/A for 1 symbol |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 13 for 1 symbol |
| Channel model | NTN-TDLB100-300 |
| Antenna Configuration | 1Tx1Rx/1Tx2Rx |
| SCS and bandwidth | 15kHz: 5MHz/20MHz  30kHz: 10MHz/20MHz |
| Test metric | SNR@ ACK miss <1% |

Table 2-2: Test Parameters for NTN PUCCH format 1

|  |  |
| --- | --- |
| Parameter | Test |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Channel model | NTN-TDLB100-300 |
| Antenna Configuration | 1Tx1Rx/1Tx2Rx |
| SCS and bandwidth | 15kHz: 5MHz/20MHz  30kHz: 10MHz/20MHz |
| Test metric | SNR@NACK 🡪 ACK<0.1%  SNR@ ACK miss <1% |

Table 2-3: Test Parameters for NTN PUCCH format 2

|  |  |
| --- | --- |
| Parameter | Value |
| Modulation order | QSPK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | N/A |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Number of PRBs | 4 |
| Number of symbols | 1 |
| The number of UCI information bits | 4 |
| First symbol | 13 |
| DM-RS sequence generation | *NID*0=0 |
| Channel model | NTN-TDLB100-300 |
| Antenna Configuration | 1Tx1Rx/1Tx2Rx |
| SCS and bandwidth | 15kHz: 5MHz/20MHz  30kHz: 10MHz/20MHz |
| Test metric | SNR@ ACK miss <1% |

Table 2-4: Test Parameters for NTN PUCCH format 3

|  |  |
| --- | --- |
| Parameter | Test 1 |
| Modulation order | QPSK |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| The number of UCI information bits | 16 |
| First symbol | 0 |
| Channel model | NTN-TDLB100-300 |
| Antenna Configuration | 1Tx1Rx/1Tx2Rx |
| SCS and bandwidth | 15kHz: 5MHz/20MHz  30kHz: 10MHz/20MHz |
| Test metric | SNR@ BLER <1% |

Table 2-5: Test parameters for NTN PUCCH format 4

|  |  |
| --- | --- |
| Parameter | Value |
| Modulation order | QPSK |
| First PRB prior to frequency hopping | 0 |
| Number of PRBs | 1 |
| Intra-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index – (Number of PRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Number of symbols | 14 |
| The number of UCI information bits | 22 |
| First symbol | 0 |
| Length of the orthogonal cover code | n2 |
| Index of the orthogonal cover code | n0 |
| Channel model | NTN-TDLB100-300 |
| Antenna Configuration | 1Tx1Rx/1Tx2Rx |
| SCS and bandwidth | 15kHz: 5MHz/20MHz  30kHz: 10MHz/20MHz |
| Test metric | SNR@ BLER <1% |

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Samsung | We are fine with option 1 as start point, regarding antenna configuration, we prefer only with 2Rx |
| Intel | Prefer to get agreements on issues for Channel model, Antenna Configuration and SCS/BW first |
| Ericsson | Encourage companies to check the parameters in Option 1. |
| Huawei | This can be informative and we can discuss other issues firstly. |

**Issue 2-3-6: : Test parameters for NTN PUCCH multi-slot PUCCH format 1**

* Proposals
  + Option 1: (Ericsson)
    - Define NTN multi-slot PUCCH demodulation requirements which could take assumptions in Table 2-6 as the start point

Table 2-6: Test Parameters for multi-slot PUCCH format 1

|  |  |
| --- | --- |
| Parameter | Test |
| Number of information bits | 2 |
| Number of PRBs | 1 |
| Number of symbols | 14 |
| First PRB prior to frequency hopping | 0 |
| Intra-slot frequency hopping | disabled |
| Inter-slot frequency hopping | enabled |
| First PRB after frequency hopping | The largest PRB index  – (nrofPRBs – 1) |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Number of slots for PUCCH repetition | 2 |
| Channel model | NTN-TDLB100-300 |
| Antenna Configuration | 1Tx1Rx/1Tx2Rx |
| SCS and bandwidth | 15kHz: 20MHz |
| Test metric | SNR@ NACK 🡪 ACK <0.1%  SNR@ ACK miss <1% |

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Samsung | We are fine with option 1 as start point, regarding antenna configuration, we prefer only with 2Rx |
| Intel | Prefer to get agreements on issues for Channel model, Antenna Configuration and SCS/BW first |
| Ericsson | Encourage companies to check the parameters in Option 1. |
| Huawei | This can be informative and we can discuss other issues firstly. |

### Issue 2-4: PRACH requirements

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204030 | Ericsson | Proposal 1: Define NTN SAN PRACH demodulation requirement for AWGN and NLOS multi-path channel.  Proposal 2: Take simulation assumptions in Table 2-1 for NTN PRACH demodulation requirement. Time error tolerance could be decided when multipath channel delay profile is agreed. |
| R4-2205766 | Huawei, HiSilicon | 1. For NTN PRACH requirements, use the following simulation assumption.  |  |  | | --- | --- | | **Parameter** | **Value** | | Preamble format | B4/C2 | | Antenna | 2/4/8 Rx for LRA=839, 2Rx for LRA=1151 and 571 | | SCS | 15kHz for LRA=839 and 1151, 30kHz for LRA=839 and 571 | | Propagation | NTN fading channel only | | Time error tolerance | (Same formula as legacy BS requirements) | | Doppler | 200Hz | | Delay spread | 250ns | |
| R4- 2206003 | Intel Corporation | Proposal 1: RAN4 to use one NTN-TDL channel model for PUCCH requirements definition, one NTN-TDL channel model for PRACH requirements definition and consider different combinations of NTN-TDL channels and FRC for PUSCH requirements definition. |

**Issue 2-4-1: Channel model for PRACH**

* Proposals
  + Option 1: (Ericsson)
    - Define NTN SAN PRACH demodulation requirement for AWGN and NLOS multi-path channel.
  + Option 2: (Huawei)
    - Not consider AWGN channel for NTN satellite PRACH requirements
  + Option 3: (Intel)
    - Define one NTN-TDL channel model for PRACH requirements definition
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Samsung | We support option 3 |
| Intel | Support Option 1 |
| Ericsson | Prefer Option 1. AWGN channel is useful to check the baseline receiver performance for PRACH demodulation. All Rel-15 and Rel-16 PRACH requirements include AWGN performance. NTN SAN requirements will be captured in a new specification and Rel-15/16 requirements are not mandatory for NTN SAN. In that case, it is necessary to define PRACH requirements for AWGN. For fading channel requirements, it is no need to consider LOS scenario which is close to AWGN while only NLOS scenario should be considered. |
| Huawei | We prefer Option 2. |

**Issue 2-4-2: Test parameters for NTN PRACH demodulation requirement**

* Proposals
  + Option 1: (Ericsson)
    - Take simulation assumptions in Table 2-1 for NTN PRACH demodulation requirement. Time error tolerance could be decided when multipath channel delay profile is agreed.

Table 2-1: Test parameters for NTN PRACH demodulation requirement

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PRACH | PRACH SCS | Time error tolerance | | Frequency offset (Hz) | | Antenna configuration |
| preamble | (kHz) | AWGN | NTN-TDLB100-300 | AWGN | NTN-TDLB100-300 |
| 0 | 1.25 | 1.04 us | FFS | 0 | 300 | 1Tx1Rx  1Tx2Rx |
| A2, B4, C2 | 15 | 0.52 us | FFS |
| FFS on other formats | 30 | 0.26 us | FFS |

* + Option 2: (Huawei)
    - Use the following simulation assumption.

|  |  |
| --- | --- |
| Parameter | Value |
| Preamble format | B4/C2 |
| Antenna | 2/4/8 Rx for LRA=839, 2Rx for LRA=1151 and 571 |
| SCS | 15kHz for LRA=839 and 1151, 30kHz for LRA=839 and 571 |
| Propagation | NTN fading channel only |
| Time error tolerance | (Same formula as legacy BS requirements) |
| Doppler | 200Hz |
| Delay spread | 250ns |

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Samsung | Regarding the PRACH format, we would like to check whether short format is feasible for NTN, considering cell coverage. ?  Regarding the time error tolerance, we can apply the same formula as legacy BS requirement  Regarding the delay spread, pending on agreed channel model |
| Ericsson | We are open for the format and LRA discussion. NLOS multi-path channel could following PUSCH discussion. Te tolerance needs further checking RF and RRM conclusion. |
| Huawei | We prefer to only consider short format B4/C2. Format 0 may exceed maximum frequency tolerance. |

## Summary for 1st round

*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.*

### Issue 2-1: General assumptions

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 2-1-1: Doppler shift model** | *Tentative agreements:*  *Consider 200Hz as the maximum Doppler shift for UL in service link*  *Recommendations for 2nd round:*  *Further discuss whether to consider the residual Doppler error for UL in feeder link. 0.05ppm can be worst case.* |
| **Issue 2-1-2: Delay spread model** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Further discuss to use a single delay spread, e.g., 100ns and 250ns, or a different delay spread. e.g., 10ns/50ns/150ns or 10ns/50ns/250ns.* |

### Issue 2-2: PUSCH requirements

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 2-2-1: Scope of PUSCH requirements** | *Tentative agreements:*  *Not to consider the requirements for mapping Type B with non-slot transmission*  *Recommendations for 2nd round:*  *Further discuss whether to consider the 2 step RACH case* |
| **Issue 2-2-2: Channel model for PUSCH** | *Tentative agreements:*  *Select NTN-TDL-A and NTN-TDL-C as the channel model for PUSCH requirements*  *Recommendations for 2nd round:*  *No need for 2nd round discussion.* |
| **Issue 2-2-3:** **SCS/CBW set for PUSCH requirements** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Further discuss if a few of PRB allocation rather than full bandwidth could be defined.* |
| **Issue 2-2-4: Modulation order for PUSCH requirements** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Further discuss whether it is OK to select MCS4 for PUSCH requirements* |
| **Issue 2-2-5: Antenna configuration for PUSCH requirements** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Further discuss if 2Rx, 4Rx, and 8Rx can be used for SAN. Satellite companies’ input are encouraged.* |
| **Issue 2-2-6: Test parameters for NTN PUSCH** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Postpone the discussion until having the conclusion for channel model, MCS, etc.* |
| **Issue 2-2-7: Test parameters for NTN UL timing adjustment** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Postpone the discussion until having the conclusion for channel model, MCS, etc.* |
| **Issue 2-2-8: Test parameters for NTN PUSCH repetition type A** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Postpone the discussion until having the conclusion for channel model, MCS, etc.* |
| **Issue 2-2-9: Test parameters for NTN msgA PUSCH for 2-step RA type** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Postpone the discussion until having the conclusion for channel model, MCS, etc.* |

### Issue 2-3: PUCCH requirements

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 2-3-1: Scope of PUCCH requirements** | *Tentative agreements:*  *In addition to PUCCH format 0/1/2/3/4, RAN4 to define NTN multi-slot PUCCH demodulation requirements*  *Prioritize UCI with HARQ on PUCCH demodulation requirement*  *Recommendations for 2nd round:*  *No need for 2nd round discussion* |
| **Issue 2-3-2: Channel model for PUCCH requirements** | *Tentative agreements:*  *RAN4 to use one NTN-TDL channel model for PUCCH requirements definition*  *Recommendations for 2nd round:*  *Down select from NTN-TDL-A and NTN-TDL-C* |
| **Issue 2-3-3: SCS/CBW set for PUCCH requirements** | *Tentative agreements:*  *To follow the same SCS/CBW set as PUSCH as the start point*  *Recommendations for 2nd round:*  *Further discuss whether to reduce the test efforts* |
| **Issue 2-3-4: Antenna configuration for PUCCH** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Further discuss if 2Rx, 4Rx, and 8Rx can be used for SAN. Satellite companies’ input are encouraged.* |
| **Issue 2-3-5: Test parameters for NTN PUCCH format 0/1/2/3/4** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Postpone the discussion until having the conclusion for channel model, MCS, etc.* |
| **Issue 2-3-6: Test parameters for NTN PUCCH multi-slot PUCCH format 1** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Postpone the discussion until having the conclusion for channel model, MCS, etc.* |

### Issue 2-4: PRACH requirements

|  |  |
| --- | --- |
| **Issue 2-4-1: Channel model for PRACH** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Further discuss channel model for PRACH* |
| **Issue 2-4-2: Test parameters for NTN PRACH demodulation requirement** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Postpone the discussion until having the conclusion for channel model, MCS, etc.* |

### CRs/TPs

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

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

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

## Discussion on 2nd round (if applicable)

### Issue 2-1: General assumptions

**Issue 2-1-1: Doppler shift model**

* Proposals
  + Option 1: Do not consider the residual Doppler error for UL in feeder link
  + Option 2” Consider the residual Doppler error for UL in feeder link. 0.5pp. is the worst case.
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Thales | Our understanding is that RAN1 and RAN4 concluded that the residual frequency shifts introduced by the Doppler shifts on the feeder links or the satellite transponder shall be considered to have no significant impact on the system performance from both the base station and UE perspective and as such without any specification impacts in Release 17. Then, it may be ok to support Option 1.  Option 2 and the 0.05 ppm could be further discussed. However, this frequency offfset (= 0.05 ppm) parameter seems difficult to justify. It is difficult to provide typical values since feeder pre-compensation is not implemented in every satellite systems and each implementation is different and designed to match requirements associated to specific considerations (types of terminal, payload design, proprietary physical layer protocols, …). Moreover, the error is also directly related to the frequencies used on the feeder links and will vary accordingly.  We see the benefits to define ∆d = 0.xx ppm as a target design for the feeder pre-compensation with sufficient margin to enable realistic implementation but not too large so as not to degrade detection and demodulation performance too severely. However, reach consensus on the “right” value may be challenging. |

**Issue 2-1-2: Delay spread model**

* Proposals
  + Option 1: Single delay spread
    - Option 1a: 100ns
    - Option 1b: 250ns
  + Option 2: Different delay spread
    - Option 2a: 10ns/50ns/150ns
    - Option 2b: 10ns/50ns/250ns.
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Thales | No strong views as long as the values considered are representative of realistic satellite LOS/NLOS channel model. |

### Issue 2-2: PUSCH requirements

**Issue 2-2-1: Scope of PUSCH**

* Proposals
  + Option 1: Do not consider 2 step RACH case
  + Option 2: Consider the 2 step RACH case
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Thales | No strong views but we see the benefits to support 2-step RA in some NTN scenarios. Support Option 2. |

**Issue 2-2-3: SCS/CBW set for PUSCH requirements**

* Proposals
  + Option 1: 15kHz SCS: SCS 5MHz/10MHz/20MHz, 30kHz SCS: 10MHz/20MHz
  + Option 2: A few of PRBs for all SCS.
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Thales | No Strong Opinion. |

**Issue 2-2-4: Modulation order for PUSCH requirements**

* Proposals
  + Option 1: Select MCS4 for PUSCH requirements
  + Option 2: others
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Thales | No strong views as long as the MCS considered is aligned with the expected SNR levels in UL.  Adding a test for a higher MCS index can also be considered since NTN SAN with better RF performance than the legacy values captured in TR 38.821 can be considered if possible. |

**Issue 2-2-5: Antenna configuration for PUSCH requirements**

* Proposals
  + Option 1: UE 1Tx – SAN 1Rx and UE 1Tx – SAN 2Rx
  + Option 2: UE 1Tx – SAN 2Rx
  + Option 3: UE 2Tx – SAN 2Rx, UE 2Tx – SAN 4Rx and UE 2Tx – SAN 8Rx

Moderator’s note: companies can agree with UE with 1Tx first? *Satellite companies’ input are encouraged.*

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Thales | We propose to consider SAN 1 or 2 RX using either circular polarization or linear polarization. Option 1 is preferred but a clarification about the polarization is required. |

### Issue 2-3: PUCCH requirements

**Issue 2-3-2: Channel model for PUCCH requirements**

* Proposals
  + Option 1: Select NTN-TDL-A and NTN-TDL-C
  + Option 2: Select one of channel model from NTN-TDL-A and NTN-TDL-C
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Thales | Support Option 1. With handheld terminals, it makes sense to evaluate LOS and NLOS channel conditions. |

**Issue 2-3-3: SCS/CBW set for PUCCH requirements**

* **Proposals**
  + Option 1: Follow the same SCS/CBW set as PUSCH and no need to reduce test
  + Option 2: Follow the same SCS/CBW set as PUSCH and need to reduce test cases (specify if any)
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

**Issue 2-3-4: Antenna configuration for PUCCH**

* Proposals
  + Option 1: UE 1Tx – SAN 1Rx and UE 1Tx – SAN 2Rx
  + Option 2: UE 1Tx – SAN 2Rx
  + Option 3: UE 2Tx – SAN 2Rx, UE 2Tx – SAN 4Rx and UE 2Tx – SAN 8Rx

Moderator’s note: companies can agree with UE with 1Tx? Satellite companies’ input are encouraged.

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Thales | We propose to consider SAN 1 or 2 RX using either circular polarization or linear polarization. Option 1 is preferred but a clarification about the polarization is required. |

### Issue 2-4: PRACH requirements

**Issue 2-4-1: Channel model for PRACH**

* Proposals
  + Option 1: Define NTN SAN PRACH demodulation requirement for AWGN and NLOS multi-path channel.
  + Option 2: Define NTN SAN PRACH demodulation requirement for one multi-path channel.
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Thales | We prefer Option 1. |

# Topic #3: NTN UE demodulation and CSI reporting requirements

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

## Open issues summary and Companies views’ collection for 1st round

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

### Issue 3-1: General assumptions

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204027 | Ericsson | Proposal 1: Select one NLOS and LOS channel model for NTN demodulation requirement. Companies could deliver simulation results based on following options.  Option 1: NTN-TDL-A/C  Option 2: NTN-TDL-B/D  Proposal 2: Use maximum delay spread 100ns for NTN NLOS channel models. For LOS channel, smaller delay spread could be considered.  Proposal 3: To simplify the channel model, only consider maximum Doppler shift as ±0.1+∆d ppm where ∆d is residual Doppler error in feeder link. Satellite companies are encouraged to provide a proper value for ∆d. Otherwise, take ∆d as 0.05ppm as the worst case.  Proposal 5: Define NTN UE demodulation requirements with 1Tx 2Rx and 1Tx 4Rx. |
| R4-2205763 | Huawei, HiSilicon | Proposal 2: Select 250ns delay spread and 200Hz Doppler shift for NTN demodulation requirements for both DL and UL.  Proposal 3: Do not considering any Doppler shift and delay spread for the feeder link.  Proposal 5: Select NTN-TDL-A and NTN-TDL-C for NTN demodulation requirements definition. |
| R4- 2206004 | Intel Corporation | Proposal 3: RAN4 will not consider different scenarios and elevations for delay spread but define short, nominal and long delay spread instead.  Proposal 4: RAN4 to consider the DS values for requirements definition as shown in Table 2-1  Table 2-1 Scaling parameters for TDL channel model   |  |  | | --- | --- | | Model | DS | | Short delay spread | 10 ns | | Nominal delay spread | 50 ns | | Long delay spread | 150 ns |   Proposal 5: RAN4 to decide whether special Doppler model need to be designed to be used for NTN PDSCH requirements definition.  Proposal 6: The test parameters from Table 2-2 are proposed as the starting point for PDSCH performance requirements definition.  Table 2-2 Minimum performance for NTN PDSCH   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | | | Fraction of maximum throughput (%) | SNR (dB) | | 1-1 | R.PDSCH.1-1.1  FDD | 10 / 15 | QPSK,  0.30 | NTN-TDL-C  [+NTN Doppler model] | 2x2, ULA Low | 70 | [TBD] | | 1-2 | R.PDSCH.2-2.1  FDD | 20 / 30 | 16QAM, 0.48 | NTN-TDL-A  [+NTN Doppler model] | 2x2, ULA Low | 70 | [TBD] | |
| R4-2206123 | Qualcomm Incorporated | Proposal 3: The performance requirement should not be defined with the assumption of Doppler compensation at satellite payload.  Proposal 4: Parameters in Table 1 can be assumed to compute the total frequency offset (without Doppler compensation at the satellite) and frequency drift for LEO600.  Table 1: Simulation assumptions for Doppler shift and drift   |  |  | | --- | --- | | Max Doppler shift (Note 1) | 24 ppm | | Max Doppler rate | 0.27 ppm/s |   Note 1: Min. Elevation angle for both sat- user equipment is equal to 10 degrees.  Proposal 5: RAN4 should consider a baseline compensation method for simulation efforts to account for the sampling frequency offset given the time-varying propagation delay. |

**Issue 3-1-1: Channel model**

* Proposals
  + Option 1: (Huawei, Ericsson, Intel)
    - Select NTN-TDL-A and NTN-TDL-C for NTN UE demodulation requirements
  + Option 2: (Ericsson)
    - Select NTN-TDL-B and NTN-TDL-D for NTN UE demodulation requirements
* Recommended WF
  + To agree with option 1.

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| **Company** | **Comments** |
| Qualcomm | We support the recommended WF |
| Intel | Support Option 1 |
| Apple | Support the recommended WF. |
| Ericsson | OK with recommended WF. |
| Huawei | Support the recommended WF. |

**Issue 3-1-2: Doppler shift model**

* Proposals
  + Option 1: (Huawei)
    - Consider 200Hz as the maximum Doppler shift (0.1ppm)
    - Do not consider the Doppler shift for the feeder link
  + Option 2: (Ericsson)
    - Only consider maximum Doppler shift as ±0.1+∆d ppm where ∆d is residual Doppler error in feeder link. Satellite companies are encouraged to provide a proper value for ∆d. Otherwise, take ∆d as 0.05ppm as the worst case.
  + Option 3: (Qualcomm)
    - The performance requirement should not be defined with the assumption of Doppler compensation at satellite payload.
    - Parameters in Table 1 can be assumed to compute the total frequency offset (without Doppler compensation at the satellite) and frequency drift for LEO600.
      * Table 1: Simulation assumptions for Doppler shift and drift

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| Max Doppler shift (Note 1) | 24 ppm |
| Max Doppler rate | 0.27 ppm/s |

Note 1: Min. Elevation angle for both sat- user equipment is equal to 10 degrees.

* + Option 4: (Intel)
    - RAN4 to decide whether special Doppler model need to be designed to be used for NTN PDSCH requirements definition.
* Recommended WF
  + Companies are encouraged to provide their views on this issue.

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| **Company** | **Comments** |
| Qualcomm | In general, we think that the maximum Doppler shift (e.g., 24 ppm from option 3) for DL transmission should be assumed since satellite is not able to do proper compensation as the relative speed between satellite and UE is not known to the satellite. We are open to discuss whether frequency drift should also be considered for simulation assumptions. |
| Intel | We would like to ask companies to clarify their assumptions on the NTN time/frequency pre-compensation. In our understanding the pre-compensation based on information of satellite ephemeris is applicable only for UL, and for DL big Doppler shift due to satellite motion should be applied. |
| Apple | We support proposals 1/2/4. We shouldn’t consider the Doppler shift on feeder link. We should assume that there is Doppler shift compensation prior to DL baseband processing. So the demod requirements are defined with a residual Doppler shift after pre-compensation.  We would like more clarification on P3. Is the assumption to compensate for the Doppler shift as part of the demod requirements? We prefer to decouple the two and define demod requirements only with small doppler shift. |
| Qualcomm2 | Our initial comment is only related to service link (DL transmission), not feeder link. Our understanding is that unlike UL pre-compensation by UE, satellite can’t do a proper pre-compensation as the relative speed between satellite and UE is not known to the satellite. If satellite does pre-compensate (which may not be accurate for UEs located elsewhere), it may reduce the Doppler shift seen by UE. However, as far as we know, there is no mechanism in place to signal the pre-compensation amount to the UE. |
| Ericsson | We need to first clarify whether we should consider the pre-compensation in defining UE performance requirement. We agree that the pre-compensation defined in RAN1 is only for UL. But we need to clarify whether UE will have another compensation before demod processing, and if so whether it will be taken into account for defining requirement. |
| Huawei | We prefer Option 1. Only Doppler from the service link should be considered. From our understanding about UE UL pre-compensation, UE firstly pre-compensate DL frequency (by adjust the oscillator) based on satellite ephemeris and UE GNSS before DL demodulation, then UE set UL frequency based on DL frequency (by adding certain DL-UL frequency offset based on the oscillator) so that the UL frequency error at the satellite is within a certain small range. In this procedure, most of frequency offset has been compensated before DL baseband processing and there is only residual frequency offset left that is very small. |

**Issue 3-1-3: Delay spread model**

* Proposals
  + Option 1: (Huawei)
    - 250ns delay spread
    - Do not consider the delay spread for the feeder link
  + Option 2: (Ericsson)
    - Use maximum delay spread 100ns for NTN NLOS channel models. For LOS channel, smaller delay spread could be considered.
  + Option 3: (Qualcomm)
    - Consider a baseline compensation method for simulation efforts to account for the sampling frequency offset given the time-varying propagation delay
  + Option 4: (Intel)
    - Not consider different scenarios and elevations for delay spread but define short, nominal and long delay spread instead.
    - To consider the DS values for requirements definition as shown in Table 2-1.

Table 2-1 Scaling parameters for TDL channel model

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| Model | DS |
| Short delay spread | 10 ns |
| Nominal delay spread | 50 ns |
| Long delay spread | 150 ns |

* Recommended WF
  + Companies are encouraged to provide their views on this issue.

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| **Company** | **Comments** |
| Qualcomm | We are okay with option 2 as we think 100ns delay spread is a reasonable compromise between short and long delay spreads.  However, we also think that it could be useful to consider sampling frequency offset (option 3) to account for the time-varying propagation delay. For example, the UE may drop or add samples, as necessary, based on the estimated sampling frequency offset. |
| Intel | Support Option 4. Different combinations of DS and NTN-TDL channel model can be used to increase test coverage. |
| Apple | Short delay spread for LOS channels and delay spread ≤ 100ns for NLOS channel is a reasonable assumption. For P1-250ns delay spread seems pretty large compared the the values in TR. What is the reason for such large delay spread? |
| Ericsson | For DL demodulation, it could be further check if different delay spread is feasible for different modulation etc. |
| Huawei | We prefer Option 1 as the maximum delay spread value. Based on TR38.811 section 7.3.5.2.2, 250ns delay spread can cover most of cases. We are also OK to consider different delay spread value, such as 10ns/50ns/250ns. |

**Issue 3-1-4: Antenna configuration**

* Proposals
  + Option 1: (Ericsson)
    - SAN 1Tx – UE 2Rx and SAN 1Tx – UE 4Rx.
  + Option 2: (Intel)
    - SAN 2Tx – UE 2Rx
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Qualcomm | We prefer 2Rx from the UE side. |
| Intel | Support Option 2 |
| Apple | Support option 2. |
| Ericsson | Regarding to the antenna configuration for DL transmission, 1Tx has been considered in the TR38.821 LLS simulation assumptions Table 6.1.2-1. In this case, we propose to consider 1Tx to be the baseline assumption, and to assume 1T2R and 1T4R for different test cases. |
| Huawei | We prefer Option 2 that is aligned with the requirements defined for TN. |

### Issue 3-2: PDSCH requirements

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2205767 | Huawei, HiSilicon | Proposal 1: For NTN UE performance requirements, select 10MHz bandwidth for 15kHz SCS and 20MHz bandwidth for 30kHz SCS.  Proposal 2: Define PDSCH performance requirements for 64QAM.  Proposal 3: Define one set of requirements to cover both GEO and LEO.  Proposal 4: Select the K\_offset value equal to or a little greater than the satellite-UE one-way delay. The detailed value should be selected after the channel model has been selected.  Proposal 5: Study a new test method with disabled HARQ feedback, such as using a cable connected between UE and TE to feedback whether correctly decoded PDSCH for the disabled HARQ process or not during the test. |
| R4-2205430 | Ericsson | Proposal 1: Evaluate both scenarios and to see if there is non-negligible performance difference. If so, then separate performance requirement is needed.  Proposal 2: Take option 1 as a start to do the initial evaluation.  Proposal 3: Select one NLOS and LOS channel model for NTN demodulation requirement. Companies could deliver simulation results based on following options.  Option 1: NTN-TDL-A/C  Option 2: NTN-TDL-B/D  Proposal 4: Consider QPSK, 16QAM and 64QAM for NTN UE demodulation requirement according to simulation result.  Proposal 5: Consider 1Tx to be the baseline assumption, and to define NTN UE demodulation requirements with 1Tx 2Rx and 1Tx 4Rx. |
| R4- 2206004 | Intel Corporation | Proposal 6: The test parameters from Table 2-2 are proposed as the starting point for PDSCH performance requirements definition.  **Table 2-2 Minimum performance for NTN PDSCH**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Test num. | Reference channel | Bandwidth (MHz) / Subcarrier spacing (kHz) | Modulation format and code rate | Propagation condition | Correlation matrix and antenna configuration | Reference value | | | Fraction of maximum throughput (%) | SNR (dB) | | 1-1 | R.PDSCH.1-1.1  FDD | 10 / 15 | QPSK,  0.30 | NTN-TDL-C  [+NTN Doppler model] | 2x2, ULA Low | 70 | [TBD] | | 1-2 | R.PDSCH.2-2.1  FDD | 20 / 30 | 16QAM, 0.48 | NTN-TDL-A  [+NTN Doppler model] | 2x2, ULA Low | 70 | [TBD] | |
| R4-2206123 | Qualcomm Incorporated | Proposal 1: The disabled HARQ should be tested with number of re-Tx set to 1 to avoid defining a special test. |

**Issue 3-2-1: How to define the PDSCH requirements for GEO and LEO**

* Proposals
  + Option 1: (Huawei)
    - Define one set of requirements to cover both GEO and LEO.
  + Option 2: (Ericsson)
    - Evaluate both scenarios and to see if there is non-negligible performance difference. If so, then separate performance requirement is needed.
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Qualcomm | The GEO scenarios mimic the behavior of the legacy BS. Therefore, we think we should only define requirements for the LEO scenarios. This will also reduce testing burden. |
| Intel | Question regarding Option 2. What difference between scenarios should be considered during evaluation? Big Doppler shift due to satellite motion vs. no Doppler shift? |
| Apple | We don’t see how single set of requirements can cover both LEO and GEO. The propagation delay id different so different Koffset , number of HARQ processes, etc needs to considered. Unless we define requirements with parameters applicable to both. We can define requirements for LEO and the same should be applicable to GEO. |
| Ericsson | Except for the Doppler shift, the propagation delay is also different for GEO and LEO deployment.    According to the table scratched from TR38.811, GEO has much higher propagation delay than that of LEO.  Given the Doppler shift and the propagation delay are quite different for GEO and LEO, we prefer to define separate performance requirements, especially if UE has different capabilities.  But, if there is only one capability for Satellite UE, we are also fine to only define one set of requirements to cover both GEO and LEO. |
| Huawei | From our understanding, same UE processing can be expected for LEO and GEO. To reduce the test effort, we are also OK to only consider LEO scenarios. |

**Issue 3-2-2: Enhancement on time relationship**

* Proposals
  + Option 1: (Huawei)
    - Select the K\_offset value equal to or a little greater than the satellite-UE one-way delay. The detailed value should be selected after the channel model has been selected.
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Intel | Option 1 seems ok to us |
| Apple | Proposal 1 is reasonable. Related to Issue 3-2-1 should we have different Koffset for GEO and LEO? |
| Ericsson | Fine with option 1. We think we need to consider different k\_offset for GEO and LEO. |
| Huawei | We support Option 1. |

**Issue 3-2-3: Enhancement on HARQ**

* Proposals
  + Option 1: (Huawei)
    - Study a new test method with disabled HARQ feedback, such as using a cable connected between UE and TE to feedback whether correctly decoded PDSCH for the disabled HARQ process or not during the test.
  + Option 2: (Intel)
    - For PDSCH requirements with disabled HARQ processes RAN4 to consider half of HARQ processes disabled and half HARQ processes enabled.
  + Option 3: (Qualcomm, Ericsson)
    - Disable HARQ with number of re-Tx set to 1 to avoid defining a special test as the start point
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Qualcomm | We think that having a cable connection between UE and TE in order to feedback the decoding status put extra implementation/setup burden. Instead, along with Option 3, we could schedule low code rate transmission to validate this functionality. We think that it is not necessary to achieve peak throughput to validate the disabled HARQ feedback feature. |
| Intel | Support Options 2 and 3 |
| Apple | Option 3 is straight forward without introducing new test methods or complicated methodology. |
| Ericsson | Prefer option 3. |
| Huawei | We are also fine with Option 2 and 3. |

**Issue 3-2-4: SCS/CBW set for PDSCH requirements**

* Proposals
  + Option 1: (Huawei, Intel)
    - 15kHz SCS: 10MHz, 30kHz SCS: 20MHz
* Recommended WF
  + To agree with option 1.

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| **Company** | **Comments** |
| Qualcomm | We think that we should start with FDD scenario, i.e., 15kHz SCS/10MHz case as it is a more practical scenario. |
| Intel | Support Option 1 |
| Apple | Use the assumption used in most demod requirements- 15KHz SCS/ 10MHz since its most commonly deployed. |
| Ericsson | Share similar view with Apple. Support 15kHz SCS / 10MHz. |
| Huawei | Option 1. We think FDD 30kHz with 20MHz is also important. |

**Issue 3-2-5: Modulation order for PDSCH requirements**

* Proposals
  + Option 1: (Huawei, Ericsson)
    - Consider QPSK, 16QAM and 64QAM
  + Option 2: (Intel)
    - Consider QPSK and 16QAM
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Qualcomm | We support Option 2. Considering the low SNR scenario in satellite communication, having reliable 64QAM reception could be challenging. |
| Intel | Prefer Option 2. 64QAM can also be added with the applicability rule |
| Apple | We don’t think SNR range for 64QAM would be practical for NTN. We prefer option 2. We would like to understand applicability rule proposed by Intel. |
| Ericsson | According to the link budget, 64QAM can also be considered. We are also fine with option 2 and encourage interested companies to further evaluate the possibility of 64QAM. |
| Huawei | We prefer Option 1. It is feasible for downlink 64QAM from the link budget point of view. |

### Issue 3-3: PDCCH/PBCH requirements

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2205768 | Huawei, HiSilicon | Proposal 1: Do not define new requirements for PBCH and PDCCH to avoid duplicated testing. |
| R4-2205432 | Ericsson | Proposal 1: New demodulation requirement for PBCH needs to be considered for NTN. The detailed assumptions need further discussion.  Proposal 2: New demodulation requirement for PDCCH can be deprioritized. |
| R4- 2206004 | Intel Corporation | Proposal 1: RAN4 to define new requirements only for PDSCH |

**Issue 3-3-1: Whether to define the PBCH requirements**

* Proposals
  + Option 1: (Huawei, Intel)
    - No
  + Option 2: (Ericsson)
    - Yes
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Qualcomm | We support Option 1 |
| Intel | There are no tests for PBCH in Rel-15. The requirements are defined mostly as reference for operators. We don’t see such need for NTN |
| Apple | Support option 1. |
| Ericsson | We are fine to compromise to option 1. |
| Huawei | We support Option 1. |

**Issue 3-3-2: Whether to define the PDCCH requirements**

* Proposals
  + Option 1: (Huawei, Intel, Ericsson)
    - No
* Recommended WF
  + To agree with option 1

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| **Company** | **Comments** |
| Qualcomm | We support the recommended WF |
| Intel | Support Option 1 |
| Apple | Agree with recommended WF. |
| Ericsson | Support the recommended WF. |
| Huawei | We support Option 1. |

### Issue 3-4: CSI reporting requirements

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2205431 | Ericsson | Proposal 1: Not to define any CSI reporting requirements for NTN if it is justified that the CSI reporting delay is large and out of date. |
| R4-2205769 | Huawei, HiSilicon | Proposal 1: Do not consider any CSI reporting requirements for NTN scenario. |
| R4- 2206004 | Intel Corporation | Proposal 1: RAN4 to define new requirements only for PDSCH |
| R4-2206126 | Qualcomm Incorporated | Proposal 1: The requirements for CSI reporting should not defined. |

**Issue 3-4-1: CSI reporting requirements**

* Proposals
  + Option 1: (Ericsson, Huawei, Intel, Qualcomm)
    - Do not define any CSI reporting requirements for NTN
* Recommended WF
  + To agree with option 1.

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| **Company** | **Comments** |
| Qualcomm | We support the recommended WF |
| Intel | Support Option 1 |
| Apple | Agree with recommended WF. |
| Ericsson | Support the recommended WF. |
| Huawei | We support Option 1. |

## Summary for 1st round

*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.*

### Issue 3-1: General assumptions

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|  | **Status summary** |
| **Issue 3-1-1: Channel model** | *Tentative agreements:*  *Select NTN-TDL-A and NTN-TDL-C for NTN UE demodulation requirements*  *Recommendations for 2nd round:*  *No need for the 2nd round discussion* |
| **Issue 3-1-2: Doppler shift model** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *To discuss whether to consider the UE pre-compensation for DL demodulation.*  *Further discuss whether to consider the frequency drift* |
| **Issue 3-1-3: Delay spread model** | *Tentative agreements:*  *N/A*  *Recommendations for 2nd round:*  *Further discuss to sue a single delay spread, e.g., 100ns and 250ns, or a different delay spread. e.g., 10ns/50ns/150ns or 10ns/50ns/250ns.*  *Further discuss whether to consider the sampling frequency offset* |
| **Issue 3-1-4: Antenna configuration** | *Tentative agreements:*  *To consider SAN 2Tx – UE 2Rx*  *Recommendations for 2nd round:*  *To further discuss whether to consider SAN 1Tx – UE 2Rx and SAN 1Tx – UE 4Rx* |

### Issue 3-2: PDSCH requirements

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|  | **Status summary** |
| **Issue 3-2-1: How to define the PDSCH requirements for GEO and LEO** | *Tentative agreements:*  *Define the requirement for LEO*  *Recommendations for 2nd round:*  *Further discuss whether to define separate requirement for GEO* |
| **Issue 3-2-2: Enhancement on time relationship** | *Tentative agreements:*  *Select the K\_offset value equal to or a little greater than the satellite-UE one-way delay. The detailed value should be selected after the channel model has been selected.*  *Recommendations for 2nd round:*  *Further discuss K\_offset values for LEO and GEO if applicable* |
| **Issue 3-2-3: Enhancement on HARQ** | *Tentative agreements:*  *Disable HARQ with number of re-Tx set to 1 to avoid defining a special test as the start point*  *Recommendations for 2nd round:*  *Further discuss if there is a need to verify the peak throughput for disabled HARQ* |
| **Issue 3-2-4: SCS/CBW set for PDSCH requirements** | *Tentative agreements:*  *15kHz SCS/10MHz is selected*  *Recommendations for 2nd round:*  *Further discuss if need to consider 30kHz SCS: 20MHz*  *Moderator’s note” Do we need to align the SCS/CBW set for UL and DL?* |
| **Issue 3-2-5: Modulation order for PDSCH requirements** | *Tentative agreements:*  *Consider QPSK and 16QAM as the start point*  *Recommendations for 2nd round:*  *To further discuss whether to consider 64QAM* |

### Issue 3-3: PDCCH/PBCH assumptions

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| **Issue 3-3-1: Whether to define the PBCH requirements** | *Tentative agreements:*  *Do not define requirements for PBCH*  *Recommendations for 2nd round:*  *No need for the 2nd round discussion* |
| **Issue 3-3-2: Whether to define the PDCCH requirements** | *Tentative agreements:*  *Do not define* *PDCCH requirements*  *Recommendations for 2nd round:*  *No need for the 2nd round discussion* |

### Issue 3-4: CSI reporting assumptions

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| **Issue 3-4-1: CSI reporting requirements** | *Tentative agreements:*  *Do not define CSI reporting requirements*  *Recommendations for 2nd round:*  *No need for the 2nd round discussion* |

### CRs/TPs

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

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

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

## Discussion on 2nd round (if applicable)

### Issue 3-1: General assumptions

**Issue 3-1-2a: Doppler shift model-UE pre-compensation**

* Proposals
  + Option 1: Consider the UE pre-compensation for DL demodulation, i.e., the maximum doppler shift is residual frequency offset with a small value, e.g., 0.1ppm
  + Option 2: Do not consider the UE pre-compensation for DL demodulation, i.e., the maximum doppler shift is total frequency offset (without Doppler compensation at the satellite), e.g., 24ppm
* Recommended WF
  + Companies are encouraged to provide their views on this issue.

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| **Company** | **Comments** |
| Thales | It is difficult to answer since it is unclear to us what is meant exactly by UE pre-compensation for DL demodulation. Based on our understanding, RAN1 agreed to explicitly support UE self-estimated pre-compensation in both time and frequency for UL transmissions. However, the mechanisms mentioned here for DL demodulation remains unclear to us.  Based on our understanding, it is possible to enable DL frequency and time reference tracking at UE side to be assisted by using satellite ephemeris related parameters shared by the network. Such enhancements would be left to the implementation. However, if such enhancement are implemented then it seems reasonable to consider them for DL demodulation. |

**Issue 3-1-2b: Doppler shift model- Frequency drift**

* Proposals
  + Option 1: Consider the frequency drift for DL demodulation
  + Option 2: Do not consider the frequency drift for DL demodulation
* Recommended WF
  + Companies are encouraged to provide their views on this issue.

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| **Company** | **Comments** |
| Thales | The frequency drift can reach important values in LEO-based NTN which are never experienced in TN. It seems reasonable to consider it. Support Option 1. |

**Issue 3-1-3a: Delay spread model-maximum delay spread**

* Proposals
  + Option 1: Single delay spread
    - Option 1a: 100ns
    - Option 1b: 250ns
  + Option 2: Different delay spread
    - Option 2a: 10ns/50ns/150ns
    - Option 2b: 10ns/50ns/250ns.
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Thales | No strong opinion as long as the value considered are representative of realistic satellite LOS/NLOS channel model. |

**Issue 3-1-3b: Delay spread model-Sampling frequency offset**

* Proposals
  + Option 1: Consider sampling frequency offset for DL demodulation
  + Option 2: Not consider sampling frequency offset for DL demodulation
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
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**Issue 3-1-4: Antenna configuration**

* Proposals
  + Option 1: Only consider SAN 2Tx – UE 2Rx
  + Option 2: In addition to SAN 2Tx – UE 2Rx, further consider SAN 1Tx – UE 2Rx and SAN 1Tx – UE 4Rx
* Recommended WF
  + Consider SAN 2Tx-UE 2Rx as the baseline.
  + FFS on whether to consider SAN 1Tx – UE 2Rx and SAN 1Tx – UE 4Rx.

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| **Company** | **Comments** |
| Thales | We propose to consider SAN 1 or 2 TX using either circular polarization or linear polarization.  SAN 1 TX is expected to be the most implemented scheme. |

### Issue 3-2: PDSCH requirements

**Issue 3-2-1: How to define the PDSCH requirements for GEO and LEO**

* Proposals
  + Option 1: Only define requirements for LEO
  + Option 2: Define requirements for GEO and LEO separately
  + Option 3: Define one set requirements which are applicable for LEO and GEO (Moderator’s note: please explain how to define one requirement to apply for LEO and GEO if select this option)
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
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**Issue 3-2-2: Enhancement on time relationship**

* Proposals
  + Option 1: Provide the input for K\_offset values for GEO and LEO

Moderator’s note: It depends on issue 3-2-1.

* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Thales | Support Option 1. |

**Issue 3-2-3: Do you agree to just verify the functionality with disabled HARQ, e.g., schedule a low code rate**

* Proposals
  + Option 1: Yes
  + Option 2: No (please specify the reasons if any)
* Recommended WF
  + Companies are encouraged to provide the views on this issue.

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| **Company** | **Comments** |
| Thales | Option 1 |

**Issue 3-2-4: SCS/CBW set for PDSCH requirements**

* Proposals
  + Option 1: Only consider 15kHz SCS/10MHz
  + Option 2: In addition to 15kHz SCS/10MHz, need to further consider 30kHz SCS: 20MHz

Moderator’s note: Do we need to align the SCS/CBW set for UL and DL?

* Recommended WF
  + Select 15kHz SCS/10MHz, further discuss whether to consider 30kHz SCS/20MHz

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| **Company** | **Comments** |
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**Issue 3-2-5: Modulation order for PDSCH requirements**

* Proposals
  + Option 1: Only consider QPSK and 16QAM
  + Option 2: In addition to QPSK and 16QAM, need to further 64QAM
* Recommended WF
  + Agree with option 1 as the start point

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| **Company** | **Comments** |
| Thales | Option 1 seems reasonable |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on general and NTN UE demodulation requirements | Qualcomm Incorporated | Topic#1 and Topic#3 |
| WF on NTN SAN demodulation requirements | Huawei, HiSilicon | Topic#2 |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| [**R4-2204027**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204027.zip) | Discussion on general issue of NTN demodulation | Ericsson | Noted |  |
| [**R4-2204028**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204028.zip) | Discussion on NTN PUSCH demodulation | Ericsson | Noted |  |
| [**R4-2204029**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204029.zip) | Discussion on NTN PUCCH demodulation | Ericsson | Noted |  |
| [**R4-2204030**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204030.zip) | Discussion on NTN PRACH demodulation | Ericsson | Noted |  |
| [**R4-2205430**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205430.zip) | Discussion on PDSCH requirements for NTN | Ericsson | Noted |  |
| [**R4-2205431**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205431.zip) | Discussion on CSI reporting requirements for NTN | Ericsson | Noted |  |
| [**R4-2205432**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205432.zip) | Discussion on PDCCH and PBCH requirements for NTN | Ericsson | Noted |  |
| [**R4-2205763**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205763.zip) | Discussion on NTN general issues | Huawei,HiSilicon | Noted |  |
| [**R4-2205764**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205764.zip) | Discussion on satellite NTN demod PUSCH | Huawei,HiSilicon | Noted |  |
| [**R4-2205765**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205765.zip) | Discussion on satellite NTN demod PUCCH | Huawei,HiSilicon | Noted |  |
| [**R4-2205766**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205766.zip) | Discussion on satellite NTN demod PRACH | Huawei,HiSilicon | Noted |  |
| [**R4-2205767**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205767.zip) | Discussion on UE NTN demod PDSCH | Huawei,HiSilicon | Noted |  |
| [**R4-2205768**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205768.zip) | Discussion on UE NTN demod PDCCH&PBCH | Huawei,HiSilicon | Noted |  |
| [**R4-2205769**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205769.zip) | Discussion on UE NTN CSI | Huawei,HiSilicon | Noted |  |
| [**R4-2206003**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206003.zip) | Discussion on Satellite Access Node demodulation requirements for NR NTN | Intel Corporation | Noted |  |
| [**R4-2206004**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206004.zip) | Discussion on UE demodulation requirements for NR NTN | Intel Corporation | Noted |  |
| [**R4-2206123**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206123.zip) | Views on NTN UE PDSCH Requirements | Qualcomm CDMA Technologies | Noted |  |
| [**R4-2206126**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206126.zip) | Views on NTN UE CSI Tests | Qualcomm CDMA Technologies | Noted |  |

Notes:

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

## 2nd round

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

Notes:

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

# Annex

Contact information

|  |  |  |  |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)